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TUBERCULOUS DERMATITIS

(Superficial Tuberculous Ulceration of the Skin)

SCHOOL OF MEDICINE
UNIVERSITY OF LEEDS.

THE

DISEASES OF CHILDREN

MEDICAL AND SURGICAL

BY

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FIFTH EDITION

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THE SURGICAL PART OF THIS BOOK I DEDICATE

TO MY FATHER

G. A. WRIGHT

SCHOOL OF MEDICINE
UNIVERSITY OF LEEDS.

PREFACE

TO

THE FIFTH EDITION

In preparing the fifth edition, we have, as in former editions, largely depended on our personal experience of disease in children; but we must acknowledge our indebtedness for much valuable information to the second edition of the 'Traité des Maladies de l'Enfance,' edited by Grancher and Comby, and to the Reports of the Society for the Study of Disease in Children.

The whole of the text has been revised, several chapters have been rewritten, and much new material has been incorporated in the text. Twenty-four new figures and a coloured frontispiece have been added.

We again gladly express our thanks to Mr. A. Wilson for revising the chapter on Anæsthetics and to Dr. E. M. Brockbank for his help in seeing the sheets through the press.

We cordially thank Dr. W. J. Bythell for his 'three-colour' photograph, which forms the frontispiece, and for the trouble he has taken in its reproduction.

H. A.
G. A. W.

Manchester: *September* 1905.

PREFACE

TO

THE FIRST EDITION

THE PRESENT WORK is intended to give to senior students and junior medical practitioners a fairly complete, though necessarily condensed, account of the various morbid conditions peculiar to, or chiefly found during, infancy and childhood. Those diseases which are neither special to children nor modified by their occurrence in early life are either omitted altogether or only briefly considered.

The book is written from a practical point of view, and but little pathological detail will be found in it.

The basis of our work is our experience at the General Hospital for Sick Children, Manchester, an institution at which some 1,200 in-patients and some 10,000 out-patients are annually treated. Our observations have extended over nearly ten years, and during the whole of that time we have been collecting material both at the Children's Hospital and at the Royal Infirmary for this purpose.

The original feature of this book is that it is written conjointly by a physician and a surgeon ; it is hoped that it presents, therefore, a fairly complete account of disease in children. Though we are well aware that the book is not an exhaustive treatise, we think it will be found practical, and it is at least based on experience and is not a mere compilation.

The illustrations are almost entirely taken from photographs of cases that have been under our own care ; where this is not so, their source is acknowledged.

We have to tender our cordial thanks to our friends and colleagues, both at the Children's Hospital and at the Royal Infirmary, for their help. Our thanks are also due to successive generations of house surgeons who have kept the records of our cases.

To our colleague Dr. HUTTON, for allowing us without stint the use of his cases, as well as for much help and advice in correcting our proofs, our especial thanks are due; also to Messrs. SOUTHAM and COLLIER, our colleagues at the Royal Infirmary and the Children's Hospital, for their care and kindness in proof-reading. To Mr. WILSON we owe our chapter on Anæsthetics, which is made especially valuable by his large experience in the administration of these agents both at the Children's Hospital and at the Royal Infirmary. To Drs. HUMPHREYS and MASSIAH, our former colleagues, we are also indebted for the use of their notes of cases.

We must also acknowledge the help rendered to us by Messrs. PAINE and BENGER in connection with the formulæ for medicines and external applications given in this work.

We cannot take leave of our work without further acknowledging our indebtedness to the Board of Governors of the Children's Hospital for their generous treatment of us, and especially for enabling us to publish our annual abstract of cases treated at the Hospital. We also desire to express our appreciation of the value of the work of our sisters and nurses in making observations of cases, and in the preparation of temperature charts.

To Messrs. LONGMAN, our publishers, we are much indebted for their liberality in allowing us to borrow woodcuts from their published works, and for their help in many ways; we desire also to acknowledge the great pains and skill shown by Mr. PEARSON in engraving our photographs.

HENRY ASHBY,
G. A. WRIGHT.

MANCHESTER: *May* 1889.

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SCHOOL OF MEDICINE
UNIVERSITY OF LEEDS.

DISEASES OF CHILDREN

CHAPTER I

THE PHYSIOLOGY OF INFANCY AND CHILDHOOD

The Periods of Early Life.—The life of man is naturally divided into three great epochs—viz. a period of *Growth* and *Development*, of *Maturity*, and of *Decline*.

The first division includes the periods of early life, when those series of operations are in progress by which the ovum or sperm-germ is transformed into the complete organism ; it may be subdivided into *Intra-uterine Life*, *Infancy*, *Childhood*, *Youth*, *and Adolescence*.

Intra-uterine Life.—During this epoch the embryo depends entirely upon its parent for all its wants. The maternal blood supplies it with material for constructive purposes, carries away its waste products, and renders unnecessary the maintenance of an independent temperature. It is clearly a time of great importance to the future being, and it is necessary that this development should take place under healthy conditions, inasmuch as it is physiologically impossible for an unhealthy or weakly mother to supply the wants of the embryo, and any failure in the nutritive powers of the maternal blood is certain to leave its stamp on the future development of the child. An infant may come into the world fairly well developed and plump, from the presence of more or less stored-up fat, in spite of the weakly state of the mother's health, but it is almost certain sooner or later to exhibit tendencies to weakness in the direction of the stock from whence it springs. Not only may the embryo owe a weakly building-up of its tissues to its mother, but it may actually share maternal disease. It may suffer from endocarditis originating in a rheumatic state of its parent, and this lesion affecting, as it usually does, the right side of the heart, may lead to malformations, which are only too likely to cut short its career. From its parents also the sperm-germ may receive the virus of syphilis, from which it may suffer during its embryonic life or after birth. It may inherit a proneness to tuberculosis or epilepsy, or a tendency to gout or rheumatism. During fœtal life many anomalies may arise from arrested development or an overgrowth in certain directions : cleft palate and hare-lip are instances of the former, and supernumerary fingers and nævoid growths of the latter.

Infancy.—The Romans used the word *infans* in its widest sense, and though, as its derivation implies, it was originally applied to those who could

not speak, it came to be employed by them for children of much older years. The terms *infancy*, *première enfance* and *Säuglingsperiode* are most usually applied to the first seven or eight months of life, the time during which the infant is nursed at the breast, and before the eruption of the milk teeth. They are, however, used by some writers to include the whole of the first year. Within the first week or two of life the infant has often to contend with conditions which are peculiar to this period, inasmuch as they depend in one way or another on the act of birth. It may be born asphyxiated in consequence of strangulation by the cord or pressure on the head; various injuries producing hæmatomas may take place; or there may be septic infection in connection with the umbilical cord. The change from placental alimentation to the digestion of food in the infant's stomach is a time of peculiar danger, especially if artificial food is given, and the mortality of infants is much greater during the first week of life than at any other period.

During the first few months of infancy, life is not so purely vegetative as it is during the intra-uterine period, yet the mental faculties are in abeyance and the movements mostly involuntary or reflex.

One consequence of the undeveloped condition of the higher or inhibitory centres is that the reflex centres are less under control than in later years, so that disorderly reflex movements in the form of convulsions are liable to take place on the slightest provocation. Growth at this period is extremely rapid, the weight more than doubling itself during the first six months of life, and a great strain is thus thrown on the alimentary system; the lymphatic and blood-forming organs are also exceedingly active. It is not surprising, therefore, that the diseases which are most common and fatal at this period are those connected with digestion and absorption. The infant requires much rest, and, indeed, divides its time for the most part between feeding and sleeping. It is during this period that 'wasting,' 'marasmus,' or 'atrophy' is so common, a result of chronic catarrh of the intestinal tract and a consequent impairment of the digestive organs.

Childhood.—The eruption of the milk teeth marks an epoch in early life, the term *childhood* being applied to the period commencing with the first dentition and ending with the commencement of the second, at the sixth or seventh year. The terms *seconde enfance* and *Kindesalter* are used in a similar sense. Growth at this period continues to be active, though not proceeding at the same rate as during infancy, but disturbances of the alimentary system are common, and children quickly waste if digestion and absorption are interfered with.

The osseous and muscular systems are developing, so that by the end of the first year the child can crawl or even walk with help. It is at the commencement of this period that rickets, a disease so intimately associated with indigestion, often makes its appearance. The mental faculties are opening out as the brain develops, and the infant begins to recognise its friends and call them by name. During the period of dentition nervous disturbances are common, and the lesions giving rise to infantile paralysis are apt to take place.

Youth.—The terms *youth*, *jeunesse* and *Knabenalter* are generally applied to the period commencing at the second dentition and ending at puberty, or

about the fourteenth year. During this time the milk teeth are replaced by the permanent set, the bones become more solid and the muscles better developed, while the mental faculties are exceedingly acute and the mind readily acquires knowledge. As puberty approaches, the voice becomes deeper and the sexual organs undergo a marked increase of development. During this period, scholastic education is carried on, the memory is exceedingly retentive, perhaps more so than at any other time. Children at this period easily 'outgrow their strength,' the nervous system is readily upset, as is evidenced by the frequency of chorea, and the alimentary canal is apt to suffer from chronic catarrh.

Respiration.—During intra-uterine life the respiration of the fœtus is carried on by means of the placenta. The blood of the fœtus—as far as oxygen is concerned—is supplied in a far more imperfect manner through the maternal blood, than when after birth the oxygen is taken direct from the air to the vesicles of the lungs. Inasmuch as the fœtus has no independent temperature to maintain, and its life is spent in continuous sleep, its tissues require far less oxygen than it does after birth. This condition of things induces a tolerance of oxygen starvation, which frequently stands it in good stead during the act of birth, if the placental circulation is interfered with through pressure on the umbilical cord, and pulmonary respiration not possible. Infants are often born in a condition of asphyxia, especially after severe labours, and have been known to survive without either placental or pulmonary respiration for 10 to 15 minutes, and infants may live for many hours, or even days, with the greater part of their lungs in an unexpanded state. The same tolerance of a venous condition of blood occurs in other newly born animals; thus Brown-Séquard has shown that a newly born mouse will recover after an immersion of 10 minutes in water, a newly born guinea-pig after 12 minutes, while an immersion of 3 to $3\frac{1}{2}$ minutes is fatal to the adult animals.

In the newly born the respirations amount to about 44 per minute; during the early months of life they vary from 35 to 40 per minute; at the end of the first year and commencement of the second they have fallen to about 28; during the third and fourth years they are about 25; by the fifteenth year they have fallen to 20; in the adult they vary from 16 to 20. Infants and children, as might be expected, give off absolutely less carbonic acid than do adults, but relatively more. This may perhaps be accounted for by their greater activity (see page 4).

The absorption of oxygen is also relatively greater in childhood than in adult life; the oxygen in the exhaled carbonic acid does not represent all the inhaled oxygen, the proportion retained being greater in childhood than in adult life.

In the infant and during the first three years of life the type of respiration is the abdominal, the diaphragm being the chief muscle used in tranquil respiration, the abdomen rising and falling, and the ribs moving but little. Later the costo-inferior type is present, respiration takes place by means of the intercostals, and also by the diaphragm, the chest expanding and the abdomen moving slightly. In girls towards puberty the costo-superior type is present, the upper part of the chest moves freely, the lower part and the abdomen hardly at all.

The vital cubic capacity of the lungs is smaller in proportion to their height in children than in adults. This is due in part to the relative smallness of their lungs and to the greater elasticity and flexibility of their chest walls.

According to Schnepf and Wintrich the vital cubic capacity at different ages is shown by the following table:

3 to 4 years	about 450 c.c.	11 to 12 years	about 1,800 c.c.
5 „ 7 „	„ 900 c.c.	13 „ 14 „	„ 2,200 c.c.
8 „ 10 „	„ 1,300 c.c.	In adults (average)	„ 3,300 c.c.

With regard to the amount of carbonic acid given out by children, the following account of an experiment made by the late Dr. Angus Smith, of Manchester, is of interest. We quote his own words: 'Four children, three boys of 6, 7, and 8 years respectively, and one girl of 7, were put into the lead chamber which was made for similar experiments, and in order to observe them more carefully Dr. Ashby sat beside them. They were extremely quiet, and the amount of carbonic acid given out was exactly one-half of that which experiment had given me in previous years for a healthy man of moderate strength. The amount given out by Dr. Ashby was estimated in a separate experiment, and subtracted from that given out by the children, which was equal in amount to 0·361 of a cubic foot per hour for each. The children were then put in by themselves and became very riotous and active, causing the carbonic acid to rise up for each to 0·531 of a cubic foot. They were then put in again and requested to be very quiet. They had a few cards to play with, and talked a great deal, but were bodily fairly still, upon which the carbonic acid fell down nearly to the first amount —viz. 0·4139 of a cubic foot. We found that talking raised the amount of carbonic acid only 0·0529 of a cubic foot, whilst jumping and laughing raised it to 0·1687, or about three times as much.'

The circumference of the chest on an average measures:

Birth	13 inches	6 years	22 inches
6 months	17 „	7 „	22½ „
12 „	19 „	9 „	24 „
2 years	20 „	10 „	24½ „
4 „	21½ „		

Changes in the Circulation after Birth.—The cessation of the placental circulation, the inflation of the lungs with air, and consequently the increased amount of blood passing through the pulmonary artery, lead to a gradual shrinking and obliteration of the various fœtal passages—viz. the vessels of the cord, the ductus venosus, ductus arteriosus, and foramen ovale. These changes commence after the first few respirations have been taken, and within a week or ten days these passages are closed. Not infrequently, however, one or other of them remains open for a much longer period, this being especially true of the foramen ovale. In 62 cases under 2 years of age noted by Parrot, it was only completely obliterated in four; and of 52 cases between 2 and 9 years, in 26 only was it completely closed.

With regard to the ductus arteriosus, Parrot found that of 187 cases of 1 month to 3 years, in 46 it was open, in 18 it was partially closed, and in 119

it was obliterated. The ductus venosus is mostly obliterated within three days; according to Quincke its remaining partially open gives rise to icterus.

Blood.—During the last few years, many observations have been made of the blood of the newly born and also of young infants, with the object of determining the differences as regards the number and character of the corpuscles as compared with adults. The results of various observers are in some cases at variance, and some care is required in drawing conclusions. The results given must not be taken as being universally correct. The nucleated red blood corpuscles, or normoblasts, found during intra-uterine life, are usually seen in small numbers in the blood of the newly born even when born at full time. The red corpuscles are more numerous in the newly born (5,000,000 to 6,000,000 per cub. mill.) than in the adult, and also vary more in size (Hayem). In a few weeks this disparity in numbers disappears, the number of corpuscles falling to 4,000,000-5,000,000. The quantity of Hb is also greater in the newly born, but falls rapidly during the first few days or weeks; it is lower during childhood than during adult life (Leichenstern). The leucocytes are also both relatively and absolutely more numerous (10,000 to 18,000); the greater number are of the small mono-nuclear variety (lymphocytes). The eosinophile cells are also increased (Kanthack). The amount of fibrin-formers appears to be relatively smaller as coagulation occurs less completely. The amount of blood in the body is relatively less than in adults, being one-nineteenth of the body weight, while in the adult it is one-thirteenth (Welcker). In older children in health the blood does not appear to differ materially from the blood of adults.

Pulse.—At the end of fœtal life the number of cardiac contractions per minute is about 132 in boys and 140 in girls; in the newly born infant it has fallen to 130 to 133. According to some observations, the pulse rate falls notably immediately after the ligature of the cord, to regain its normal number an hour or two later. During the week succeeding birth it varies from 120 to 140, crying immediately increasing the number some 10 to 30 beats. By the second year it has fallen to 110, by the fifth to 100, by the eighth to 90, and by the twelfth to 80.

During sleep the pulse rate is diminished, especially in infants, sometimes by as much as 10 or 20 beats. The pulse is more often irregular in infants and children than in adults, and this apart from the influence of disease.

According to Soltmann the inhibitory action of the vagus is less marked in newly born animals than in adults. The circulation of the blood in infants and children is carried on more rapidly than in adults, and consequently the tissues are supplied with a superabundance of arterial blood. The tension in the arteries is comparatively low, on account of the relatively large size of the aorta and arterial system generally.

According to Vierordt a complete circulation takes

Newly born infants .	12 seconds	(134 pulse rate)
At two years . .	15 „	(107 „)
At fourteen years .	18·6 „	(87 „)
In adults . . .	22 „	(72 „)

On account of the proneness of the pulse to be influenced by excitement during infancy, it is of less value in diagnosis at this period than in later years.

Alimentary Canal.—For the first six to eight weeks of life there is very slight secretion of saliva, only sufficient being formed to render the mouth moist. In the third and fourth months the secretion is much more free, so that infants about this period begin to dribble ; the amount of secretion becomes still larger as the period of dentition approaches. By the third or fourth month the saliva contains ptyalin, and readily converts cooked starch into maltose. The stomach of the newly born infant is small, its capacity being one or two fluid ounces, by the end of the fourth week from three to four ounces, at three months about five ounces, and at the end of the first year ten ounces. The muscular layers of the stomach and intestines are at first only slightly developed, hence the tendency to the accumulation of gases in both the stomach and bowels. The gastric juice has at first but imperfect digestive powers, and the stomach is in consequence quickly exhausted ; the peristaltic action of the walls of the stomach is often very vigorous, and may give rise to the regurgitation of the food swallowed. Vomiting is far commoner and more persistent in the infant than it is later in life ; the vomiting centre is more unstable and readily reacts to reflex stimulation from the stomach.

The part which the stomach plays in the digestion of milk during infancy has been much discussed. To what extent is it simply a reservoir in which curdling takes place, digestion being performed in the intestines? Does it perform the double function of reservoir and play an important part in the digestion of proteids? Under normal circumstances there can be little doubt that most of the curd of milk is converted into peptone in the stomach ; a varying amount passes on into the intestines unchanged. Proteid digestion is continued in the intestines in an alkaline medium, and a certain portion appears to escape altogether, and is passed in the fæces. Under abnormal conditions, as when the infant is fed on cow's milk, or is overfed, by far the major part of the curd passes out of the stomach unchanged, to be attacked by the juices of the intestines, but much escapes digestion, and is passed per rectum. Both the juices of the stomach and intestines are easily exhausted by overfeeding, and fermentative changes take place, and decomposition products are formed instead of peptones. Coagulation of milk takes place in the stomach through the agency of a ferment in from 10 to 15 minutes, which is independent of the acid or pepsin. Human milk coagulates in fine flocculi ; cow's milk, especially if undiluted, in heavy dense masses. In young infants taking human milk gastric digestion is complete in an hour and a half or thereabouts, the stomach being empty, but a longer time is required for the stomach to get rid of a meal consisting of cow's milk. Observations have shown that the hydrochloric acid secreted is absorbed by the proteids, and it is only towards the end of digestion, when the stomach has passed on most of its contents, that free acid can be detected. Lactic acid does not appear to be a normal constituent of digestion, but it is common enough as a product of fermentation.[1]

[1] See *Disorders of Digestion in Infancy and Childhood*, by W. Soltau Fenwick, M.D.

For the first few months the diastatic ferments of the pancreatic and intestinal juices are exceedingly feeble, so that starches are not digested, while, on the other hand, the trypsin of these secretions is active from the first. The secretion of bile begins at an early period of fœtal life, probably about the third month ; the bile accumulates in the small intestines and is passed as the meconium during the first few days after birth. It forms dark brown or greenish masses, viscous and tenacious, and of a feebly acid reaction, and consists of mucus holding in suspension fatty matters, epithelial cells, biliary pigments, and cholesterine, but no bile-acids. Three or four days after birth the meconium is succeeded by the golden yellow semi-liquid stools characteristic of the healthy infant. This yellow colour is due to the bili-rubin of the bile ; the green colour sometimes seen in intestinal catarrh depends upon the oxidation of the bili-rubin and formation of bili-verdin. Under normal circumstances newly born infants have two or three stools daily. Their character gradually changes as the infants get older, becoming more and more like the stools of adults.

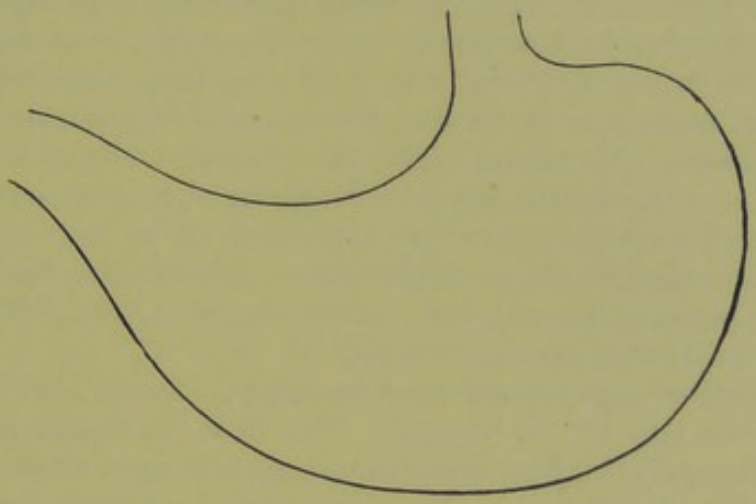

Fig. 1.—Stomach of a Newly Born Infant (natural size).

Urine.—The newly born infant generally passes water within 24 hours of its birth, and continues to do so some 10 or 12 times daily, passing about 1 oz. at a time, or about 10 oz. in 24 hours. The first urine passed is cloudy from the presence of uric acid and epithelial cells, and is of specific gravity 1003–1006 ; later it becomes clear and of a light straw colour. It contains more uric acid and less urea (about ·5 per cent.) than does that of adults.

During the whole of childhood the urine is of a paler colour, has a more decidedly acid reaction, and lower specific gravity (1012–1015) than during adult life (1018–1020) ; smaller quantities are also passed, but on account of the difficulty of collecting the total quantity the amounts have not been accurately determined. The following figures may be taken as approximative :

Between 2–5 yrs.	about	15–25	oz.,	containing	5–14	grammes	of urea	(in 24 hrs.)
,, 5–9 ,,	,,	25–35	,,	,,	14–19	,,	,,	,,
,, 9–14 ,,	,,	35–40	,,	,,	19–22	,,	,,	,,
Adults	,,	50	,,	,,	30	,,	,,	,,

While actually smaller quantities of urine are passed by children than adults, yet relatively the amount is greater ; the observations of Carrière

and Monfit[1] have shown this and also that the amount of solids, total N, and urea per kilogramme of body weight is more during childhood than in adult life. The same observers found the uric acid actually and relatively less in amount.

The amount of urea excreted per kilogramme of body weight is as follows :

15 mths. to 5 yrs. .	·61 gramme	10 yrs. to 15 yrs. .	·49 gramme
5 yrs. „ 10 „ .	·65 „	Adults . . .	·40 „

Temperature.—The temperature of an infant at birth taken in the rectum is about 100° F. (37·75° C., Roger, Sommer). A few minutes after birth it sinks to 97°, or in weakly infants still lower ; in the course of a few hours it again rises and remains at about 98·8° F. This temperature or a fraction of a degree higher—98·8–99° F.—may be taken as the normal rectal temperature during childhood and youth. For young children, if exact observations are required, the rectum is the best place to insert the thermometer, as it is difficult to keep the infant quiet with a thermometer in its axilla. It is important to remember that the rectal temperature exceeds that of the axilla by about ·7° F. For most clinical observations the fold of the groin or the axilla may be taken. What is also of importance is the time at which it is taken. According to the careful researches of Finlayson, the diurnal range of temperature amounts to about 2° F., the maximum being at 5 to 6 P.M. and the minimum in the small hours of the morning ; the range of temperature in adults being somewhat less. According to Reitz, the lowest temperature is between 4 and 5 A.M., increasing to 11 A.M., falling to 2 P.M., then rising to its diurnal maximum at 6 P.M.

The most recent observations upon the temperature of children in health were made by the late Dr. O. Sturges. The most interesting of these were made upon two sturdy children living in the country, aged respectively 1 year and 2 years. The temperatures were taken at various hours from 10 A.M. to midnight, the usual range being 97·4 to 98·6. The highest temperature was after breakfast, when the children were most lively and eager for play.

The heat of the body is maintained with greater difficulty during infancy than in later life, a result due not only to the relatively larger surface, but also to the much greater vascularity of an infant's skin. Infants and children are much more liable to suffer from cold extremities than are adults.

Nervous System.—The closure of the anterior fontanelle takes place towards the end of the second year in strong and vigorous children ; in immature and rickety children it may be delayed till the third year, or it may be later.

The circumference of the head averages at :

Birth . . .	14 inches	2 years . . .	20 inches
6 months . .	16½ „	4 „ . . .	21 „
12 „ . .	18 „	10 „ . . .	21½ „

The cubic capacity of the skull in newly born infants is about one-third that of adults, viz. 500 c.c. ; by the second year it is about 1,000 c.c., while in the adult it is about 1,500 c.c. The brain of a newly born infant forms about 14 per cent. of its body weight, while in the adult it is only 2·37 per

[1] *Presse médicale*, 21 Juillet, 1897.

cent. At birth the brain weighs 280–330 grammes ; at six months 600-680 grammes ; at a year old 750 grammes ; at seven years 1,080 grammes ; increase of weight now proceeds more slowly, reaching by the fourteenth year 1,150 to 1,300 grammes ; the adult brain weighs about 1,400 grammes on an average. The cerebellum after birth develops more quickly than other parts of the brain, the frontal lobes more slowly till six years of age, when they develop rapidly.

If the brain of a newly born infant be examined, it will be noted that its consistence is much less firm than is that of an adult's, and it is much more readily injured. If placed on a plate it spreads itself out or moulds itself into any shape more readily than an adult's brain. The pia mater is exceedingly delicate and very easily dissected off with a pair of forceps. In colour the brain is light grey, often yellowish from the presence of bile pigments ; there is no well-marked difference between the 'grey' and 'white' substance as in the adult brain, and the convolutions are less distinctly marked. The multipolar cells in the grey matter on the surface are ill developed, as also are the pyramidal bundles of nerves which connect them with the basal ganglia and internal capsule, and also the association fibres. According to the investigations of Tredgold, in the embryo of seven months the cells of the frontal lobe are represented by neuroblasts ; these are small round cells devoid of processes and embedded in a ground substance. By two weeks after birth, the nerve cells may be recognised, having a nucleus, an apical process, and traces of other processes. Later they develop into fully formed pyramidal nerve cells. In the motor region the nerve-cell development is somewhat earlier than in the frontal region, in the eighth month fœtus, the pyramidal cells can be recognised, but the processes are imperfect and the Nissl bodies absent. At birth the bundle of nerve fibres forming the pyramidal tracts in the spinal cord are non-medullated, but gradually become so during the first year.

From the above facts it is clear that while the excito-motor centres in the spinal cord and medulla are well developed at birth, the higher centres—the 'think-organs'—on the surface of the brain are imperfect, and so also are the strands or nerve-paths which connect the higher and lower centres. This agrees also with the experiments of Soltmann, who has shown experimentally that the application of some form of irritation, as the induced current, to the surface of the brains of newly born animals does not evoke movements in the face and limbs as it does in adults. The movements of infants—sucking—crying—swallowing—breathing, &c., are reflex, and, as they are uncontrolled by the inhibitory influence of the higher centres, are apt to be disorderly and excessive, as, for instance, in convulsions. The reflex actions displayed by a brainless frog are more violent and vigorous than those displayed when the brain is intact. The readiness with which newly born infants become convulsed is one of the most remarkable features in early life. Hereditary influences play an important part, infants coming of a neurotic stock being much more prone to convulsions from slight exciting causes than others. As the higher centres develop, changes come over the mental character of the infant, and the reflex actions become more and more under control and dominated by the psychical centres. While the movements of newly born infants are almost entirely reflex, certain 'spontaneous' or 'impulsive' movements, such as stretching the limbs, occur.

Sight.—In the first week after birth the infant apparently cannot distinguish objects, but can light from darkness. According to Preyer's examinations, the movements of the eyes are not co-ordinated at first. Königstein, from an examination of 300 newly born infants, states that they were all hypermetropic. The colour of the iris is bluish-grey or green, but one finds also shades of light grey and brown. The same investigator has also noted blood extravasations in the retina, which disappear in a few days. The pupils are very large in the newly born, and sensitive to light; in later childhood they can endure strong light better than can adults. Of the colours, children learn first to distinguish white from black; in the second year they learn to distinguish other colours, first red and yellow, later green and blue.

Hearing.—In the newly born the mucous membrane of the tympanum is swollen so that no cavity is present, consequently they are not very sensitive to sounds, but shrill and strong sounds make impression, the infants waking with cries. In the first months children hear high and sharp sounds better than deep. Older children can hear very weak and high sounds which make no impression on adults.

Taste.—Newly born infants can distinguish sweet, bitter, sour, and salt tastes.

Psychical Phenomena.—In the second month an infant learns to hold up its head and make various movements and to distinguish the voices of its friends. At the 3rd or 4th week it can laugh, and smiles when caressed. In the 3rd to 4th month the infant notices its toys or anything it can hold in its hands, mostly putting them to its mouth. At 7 to 9 months the child can sit up, and 3 or 4 months later makes attempts to walk; when a year old well-developed children can walk a few steps without help. From this time the child begins to say a few syllables, such as *tá-tá*, *dá-dá*, *bē-bē*, without much notion of applying them; then words are learnt, and by the end of the second year most children can string a few words together.[1]

Sleep.—The newly born infant sleeps all day except when it wakes up for food. At a year old the infant sleeps fifteen to sixteen hours; from 2 to 3 years, twelve to thirteen hours; from 4 to 5 years, no sleep in the day, from ten to twelve hours at night; from 12 to 13 years, eight to nine hours. Infants sleep lightly and are easily awakened; at 4 to 5 years of age they are generally heavy sleepers.

Body Weight.—An infant born at full term weighs from 6½ to 7½ lb., 7 lb. being an average weight. For the first two or three days of life there is a loss of 4 oz. to 7 oz., then a regular gain, so that by the 8th or 9th day the initial loss has been made good. According to Gregory, the following figures express the average daily loss and gain during the first six days of life:

1st day	. .	loss of	139	grammes or nearly	5 oz.
2nd „	. .	„	64	„	„ 2¼ „
3rd „	. .	gain of	33	„	about 1 „
4th „	. .	„	50	„	„ 1¾ „
5th „	. .	„	50	„	„ 1¾ „
6th „	. .	„	36	„	„ 1¼ „

[1] For an account of the development of the infant's mind, see *Health in the Nursery*, Longmans & Co.

That these figures are by no means universally correct is clear from the difference in weight noted by different observers ; thus, according to Lewis Smith, in 170 infants born in the New York Infant Asylum (89 male and 81 female), the average weight of the boys was 7 lb. 11 oz. and the girls 7 lb. 4 oz. Fifty of these were wet-nursed, and weighed when one week old, with the following result :

Increase of weight in	32 cases
Loss	13 „
Average gain	4·8 oz.
„ loss	3·3 „
Greatest gain	12 „
„ loss	6 „

Growth during the first year, more especially during the first six months, is extremely rapid, the infant doubling its weight in the first six months and trebling it during the first year. Many observations have been made on the weights of children during the first year ; the following table exhibits the monthly gain, being the average of nine infants observed by W. Pfeiffer, who were nursed at the breast at first, and later this was supplemented with cow's milk :

Age	*Monthly gain*	*Weight at end of the months*	
	oz.	lb.	oz.
1st month . . .	13¼	8	5½
2nd „ . . .	30½	10	4
3rd „ . . .	26½	11	15
4th „ . . .	26	13	9¼
5th „ . . .	21	14	14¼
6th „ . . .	21	16	3½
7th „ . . .	17	17	5
8th „ . . .	21	18	10
9th „ . . .	23	20	1
10th „ . . .	20¼	21	5¼
11th „ . . .	11	22	0
12th „ . . .	7	22	7

Growth after the end of the first year is slower, so that the weight is not again doubled till the end of the sixth year, and doubled again by the end of the fourteenth.

During health it will be often enough to weigh the infant once a week. It is convenient to record the weight on a chart such as the one figured (fig. 2) ; the chart can be fitted into a case and hung up in the nursery.

Much interest and importance is attached to the increase of weight and height during infancy and childhood : weekly weighings, especially during the early months of life, give very valuable information with regard to diet. It must, however, be always borne in mind that increase in weight, especially if it be due to an accumulation of fat, does not always indicate strength, or that the food being taken is suitable. During childhood, under-growth or loss of weight must be looked upon as an indication of danger and as evidence of malnutrition. On the other hand, over-growth without a proportionate increase in weight should always be taken as indicative of weakness.

It is not only of interest, but it is important, to both weigh and measure children at frequent intervals. Periods of under or over growth are periods of danger, as indicating either malnutrition or an overtaxing of the strength. There should also be maintained a close relation of height to weight.

Dentition.—At birth the jaw contains the dental sacs with the already calcified crowns of the temporary teeth. Besides the temporary teeth, there is the calcified crown of one of the permanent set, the first molar, which is situated immediately behind the last temporary molar. (See fig. 3.)

During the interval which elapses between birth and their eruption, the teeth are undergoing further development; the sacs become enlarged, so that

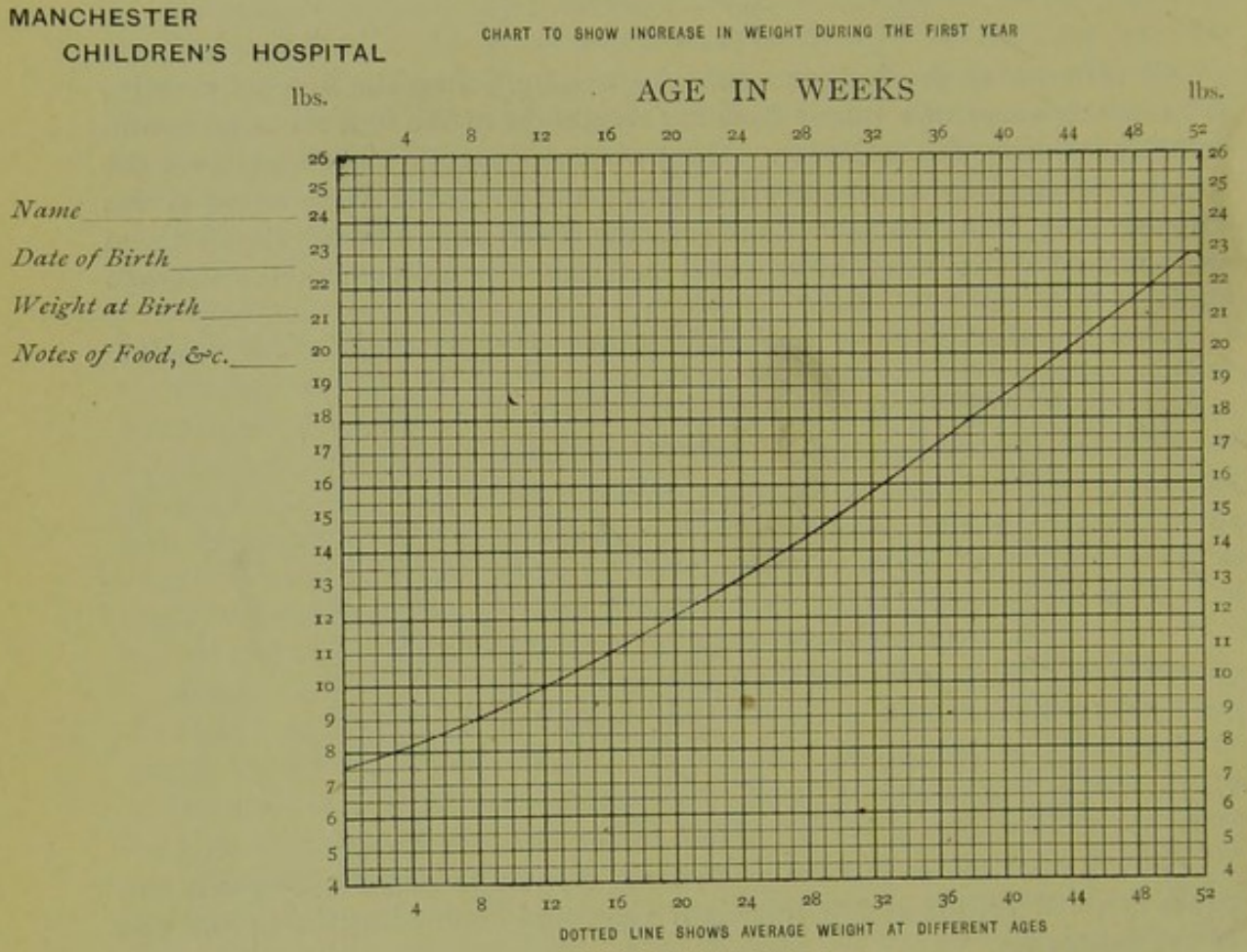

Fig. 2.—Weight Chart, showing normal weights during first year. The infant's weight can be filled in with ink or pencil every week. (Reduced size.)

they are readily felt through the gum as rounded swellings, the edges of the teeth become sharper, and the fangs are developed. As the fangs elongate, the edge of the tooth comes nearer to the surface of the gum, the latter swells and becomes more vascular, the edge of the tooth appears as a line or point beneath the membrane, which finally becomes perforated, and the tooth is cut.

The temporary set appear for the most part in groups in the following order. **First group**—The lower two central incisors appear from the 6th–8th month, followed by a pause of from three to six weeks. **Second group**—The four upper incisors are cut at intervals of a week or two, from the 8th–10th month, followed by an interval of one to three months. **Third group**—The

lower lateral incisors, the upper and lower front molars appear at intervals from the 12th–14th months, followed by a pause of two or three months.

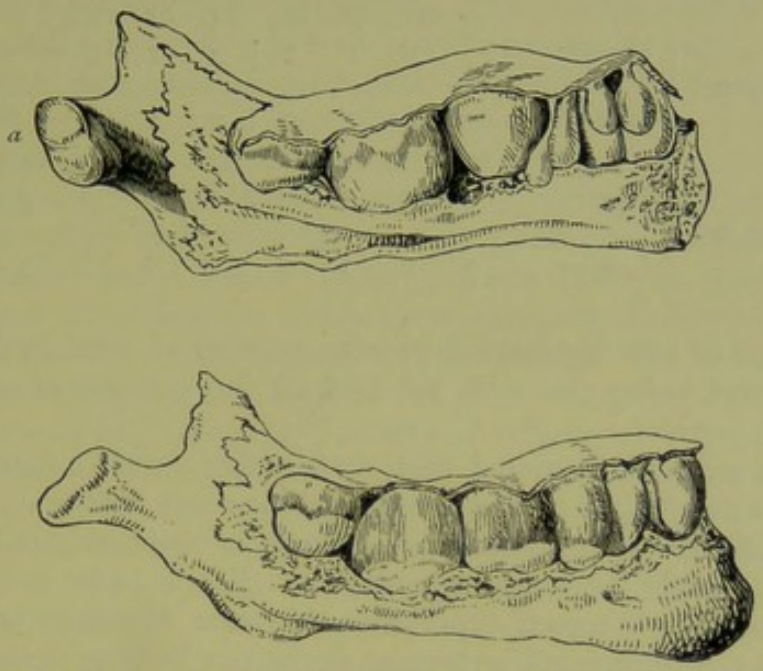

Fig. 3.—Jaw of a Child at Birth, showing the Dental Sacs (Quain's 'Anatomy'). *a*, the left half seen from the inner side; *b*, the right half seen from the outer side; the bone has in part been removed to expose the dental sacs. *b* shows the sacs of the temporary set and the sac of the first permanent molar behind the posterior molar of the milk set. *a* shows the same, and also the sacs of the permanent incisors and canine.

Fourth group—The canines appear, the upper ones usually being first, from the 18th–20th month. **Fifth group**—The posterior molars mostly appear at the age of 2–2½ years.

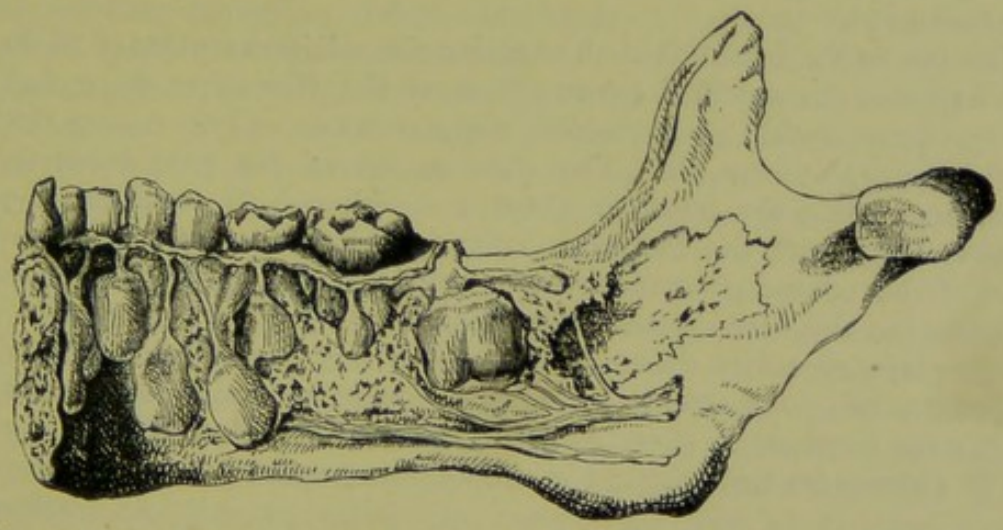

Fig. 4.—Lower Jaw of a Child of about three years, showing the relation of the temporary and permanent teeth. The milk teeth of the right side and incisors of the left are shown, and also the sacs of the permanent set, except the wisdom tooth, which is not yet formed. The large sac near the ramus of the jaw is that of the first permanent molar, and above and behind it is the rudiment of the second molar. (Quain's 'Anatomy.')

The milk set, when complete, remain unchanged for several years, though the permanent set are gradually becoming developed in their sacs, ready to replace the earlier set.

The following formula exhibits the relation between the temporary and permanent set :

		mo.	ca.	in.	in.	ca.	mo.		
Temporary set	Upper	2	1	2	2	1	2	= 10	20
	Lower	2	1	2	2	1	2	= 10	
		mo.	bi.	ca.	in.	in.	ca.	bi.	mo.		
Permanent set	Upper	3	2	1	2	2	1	2	3 = 16	32
	Lower	3	2	1	2	2	1	2	3 = 16	

At six years of age there are a greater number of teeth in the jaws than at any age, there being the milk set and all the permanent set except the wisdom teeth.

It is to be particularly noted that during this period a marked increase takes place in the length of the jaw to provide room for the three molars of the permanent set, which make their appearance posteriorly to the milk set ; the bicuspids replace the temporary molars. (See fig. 4.)

While the above account represents the state of things which obtains under normal conditions, yet important deviations both as to the time of the appearance of the teeth through the gum and the condition of the teeth themselves frequently take place as the result of disease or enfeebled nutrition. It is well known that rickets is the most common cause of delayed dentition, and not only are the teeth cut later than usual, but the defective nutrition which exists in this state frequently interferes with the development of the teeth ; they may in consequence be dwarfed or provided with a thin or partially deficient layer of enamel, so that they quickly become carious after being cut.

The jaw of the infant at birth contains the calcified crowns of all the milk teeth and also the calcified crown of one of the permanent set, namely, the first or 'six-year-old' molar, which commences to calcify during the sixth month of intra-uterine life. The calcification of the permanent incisors commences when the infant is about a month old, the canines at 3 or 4 months of age and the bicuspids later, in the first or second year. The crown of the second permanent molar begins to calcify during the fourth or fifth year, but the wisdom tooth not till about puberty.

It is plain, therefore, that any illness occurring during the first year, such as syphilis, can only affect the calcification of the incisors, canines, and possibly the bicuspids. (See SECOND DENTITION, p. 64.)

The permanent teeth are cut in the following order :

Molar, first	6 years of age
Incisors, central	7 „ „
„ lateral	8 „ „
Bicuspid, anterior	9 „ „
„ posterior	10 „ „
Canines	11–12 „ „
Molars, second	12–13 „ „
„ third	17–25 „ „

Mortality in Infancy and Childhood.—In this country, out of every 1,000 children born, on an average 149 die before the end of their first year of life, and 263 before the age of 5 years. During the next five years, from 5 to 10 years of age, 35 die, and 18 more between the ages of 10 and 15 years. So that out of the original 1,000, 684 will be alive on their fifteenth birthday and 316 will be dead. From these figures it is clear that the mortality is the greatest during the first year, and that it rapidly declines as childhood advances. Indeed, the mortality is the greatest during the first day and succeeding days after birth ; thus Körösi, in analysing the ages of infants at death, found, out of 26,623 infants born in Pesth during the years 1874 and 1875, that for every 1,000 born, 13 died within 24 hours ; 5·7 on the second day ; 34·2 during the first week ; 26·3 during the second week ; and 92 during the first month.

In Glasgow during 1902, 3,168 deaths of infants under a year old took place ; of these 1,088 died during the first month, 327 in the second month, and 230 in the third month ; so that more than one-third of the total number of infants' deaths during the first year occurred during the first month and one-half within three months of birth (Chalmers). This high mortality during the early months represents the death of the immature and weakly infants, who are unequal to the struggle for life which goes on under the adverse conditions of overcrowding and poverty.

The causes in operation which give rise to the high death-rate among infants may be either 'constant' or 'variable.' Among the constant causes are immaturity, bad feeding, carelessness, and ignorance on the part of parents. The variable causes include the effects of an abnormally hot and dry summer and a cold winter, which give rise to epidemics of diarrhœa and respiratory affections.

The mortality of infants differs enormously, according to the amount of care which is taken in their feeding, and the way in which they are looked after, and according to the health of their parents. Roughly speaking, it may be said that among the rural population of Great Britain, and among the well-to-do dwellers of suburban districts, the annual infant mortality amounts to 100 per 1,000, 900 out of every 1,000 children born being alive at the end of the first year. This is the average infantile death-rate of Norway, which is the lowest of any European country, and, indeed, probably the world.

In a large city, such as Manchester or Liverpool, the annual death-rate among infants under a year is 200 per 1,000 births, or, in other words, one-fifth of those born never reach the end of their first year. In the worst and most crowded districts there is little doubt that the mortality is at least 300 per 1,000, one-third of those born never living to become a year old. A still higher death-rate prevails among the unfortunate class of illegitimate children ; the mortality among these amounts at times in some districts of our large cities to 500 per 1,000, not more than half living to be a year old. Indeed, the mortality has in some districts of Salford risen to 710 per 1,000.[1]

In London the rate of infant mortality is about the same as that of the country generally, namely, 150 per 1,000. The mortality is the same in Paris as in London, while in most Continental cities it is higher. In

[1] See Dr. John Tatham's *Health Reports for Salford.*

Munich (1884–1889) it averaged 324 per 1,000 ; in Berlin, 268 per 1,000 ; in Russia, 266 ; and in Austria, 255 (Rahts).

As one would naturally expect, child mortality also differs greatly under different circumstances ; thus we find in the healthy parts of England the annual mortality of children under five years of age is not more than 50 per 1,000 (living at that age), that is, out of every 20 children (under five years of age) only one will die during the year ; whilst in the worst districts 100 or even 110 per 1,000 perish annually.

Child mortality is slowly decreasing in this country. During the ten years 1861–70 the mean annual death-rate of children under five years of age was equal to 68·6 per 1,000. During 1871–80 it fell to 63·5 per 1,000 ; while in 1881–90 it fell to 56·8 per 1,000. This, however, is just twice the mortality given by Ansell's tables, which are based on the experience of child life among the upper classes, namely, 28·2.

In the causes of death in infants, it may be taken for granted that diseases of the digestive system play a most important *rôle* ; but statistics are more or less untrustworthy, as the causes of death which appear on death certificates are often not to be relied upon for purposes of classification. Analysing the causes of death from 2,000 cases of infants under two years of age, who died while under the care of the medical officers of our own Children's Dispensary, we found that of the fatal cases those connected with the digestive system head the list, forming 35 per cent. of the total number. Bronchitis and its allies caused death in 21 per cent. of the cases ; whooping cough in 12 per cent. ; congenital syphilis in 10 per cent. ; and measles in 9 per cent.

Among the less frequent causes of death we find tuberculosis, meningitis, diphtheria, and various malformations. We must not forget to mention that premature birth accounts for some deaths that do not figure in our list, and those unfortunately too common cases which are returned as 'found dead in bed.' During the last fifty years, infant mortality has not decreased as rapidly as the total death-rate. During the last ten years there has been no decrease—see Table.

Table showing Infant Mortality, 1851–1904 (*McCleary*)

Years	Death-rate per 1,000 population	Deaths under one year per 1,000 births
1851–1855	22·6	156
1856–1860	21·8	151
1861–1865	22·5	151
1866–1870	22·4	156
1871–1875	21·9	153
1876–1880	20·8	144
1881–1885	19·4	138
1886–1890	18·8	145
1891–1895	18·7	150
1896–1900	17·6	156
1901	16·9	151
1902	16·3	133
1903	15·4	132
1904	16·2	146

Infant mortality is not calculated by comparing infant deaths with deaths at all ages, or with the number of persons living, inasmuch as in a given population there may be many or few children or few old people, but it is calculated on the infant population, or the number of children living at that age. Thus the number of deaths in infants under a year old is compared with the number of infants living at the time, which is usually calculated as the mean of the births in that and the preceding year. In the same way the mortality of children under five years is calculated by comparing the deaths in the year with the number of children living under five years of age.

CHAPTER II

THE DISEASES INCIDENT TO BIRTH

THERE are certain lesions which occur only once in a lifetime, inasmuch as they owe their origin to the act of birth, or to those important changes which occur in the life conditions of the infant when it exchanges the quiet dependence of intra-uterine life for the greater activity of an independent existence. Though many of these morbid conditions differ from one another in various ways, yet they are so intimately associated in their pathology and etiology that it is more convenient to discuss them together, rather than to relegate them to their respective places in the ordinary classification of disease. The act of birth brings its own special dangers to the infant as well as to the mother, and it is hardly surprising to find that many perish on the threshold of life, and that the mortality during the first few days after birth is greater than that of any other period (see p. 15). It must also be borne in mind that parturition is not only responsible for many infant deaths, but for damage to the nervous centres by pressure or hæmorrhage, which may be irreparable, and if the infant lives it is paralysed for life or a hopeless imbecile. These diseases which are connected with parturition are also of much interest and importance, in that many of them are eminently preventible, and are often the result of the ignorance of the friends or neighbours, who, in the absence of a medical practitioner or trained nurse, preside in the lying-in room, or may possibly be the result of 'meddlesome midwifery.' However this may be, many a life is lost and various morbid conditions arise from want of assistance during the later stages of labour, want of care and cleanliness, or exposure to infection during the first few days which succeed birth. A delayed or abnormal labour is responsible for some of the troubles which occur at the time of birth, as for instance asphyxia. Instrumental or manual interference may in some instances give rise to injury to the fœtus; in others traumatism may be due to some abnormal delay during the passage of the infant through the pelvis. Infection by various organisms may result in ophthalmia, tetanus, or sepsis of the umbilical wound. There is no doubt also that infants may be infected by septic organisms through the mouth in kissing, or the teat of the bottle if artificially fed.

Asphyxia Neonatorum.—It is hardly to be expected that the transition from placental to pulmonary respiration should be accomplished without some risk of the cessation of the one before the commencement of the other. Fortunately for the infant, as we have already remarked, its nervous centres and tissues generally are far more tolerant of a venous condition of blood

than they are in after-life, for during intra-uterine life the aeration of the blood is far less perfectly performed by the placenta than it is afterwards by the lungs, and, moreover, there is a mixture of the placental blood with the venous blood of the inferior vena cava before it is distributed to the body. (*a*) The infant may die from this cause before birth, or it may be born asphyxiated; (*b*) asphyxia may supervene after birth through failure of the pulmonary respiration.

(*a*) Asphyxia before birth is caused by the death or faintness of the mother, detachment of or interference with the placental circulation, or compression of the cord. Asphyxia of the fœtus may be suspected if the fœtal heart becomes faint, the pulsation of the cord ceases or is weak, or if meconium is passed. In infants born asphyxiated the symptoms vary according to the degree of asphyxia present; when slight, the lips are of a bluish tint, the skin dusky, the conjunctivæ injected, the limbs are motionless, but the muscular tonus is present, the heart's action is slow and mostly visible, the movements of respiration are separated by long intervals, or no attempts are made unless some strong reflex irritation is applied. In the deeper stages of asphyxia the face and lips are pallid, the extremities blue, the muscles of the limbs and neck have lost their tonus, no attempts are made at respiratory movements, or only a few inspiratory efforts accompanied by indrawing of the ribs and epigastrium, but without any effect in expanding the lungs.

(*b*) Asphyxia after birth is in rare cases the result of a hæmorrhage into the fourth ventricle or medulla, and thus the respiratory centres are paralysed (Horrocks). In others, mucus or liquor amnii has been sucked into the air passages during the act of birth, or a hæmorrhage has taken place into the lungs through pressure (Spencer). Among the rare causes, asphyxia may be due to an imperfect development of the diaphragm, double pleuritic effusion, syphilitic infiltration of the lungs, and pressure on the trachea from enlarged glands. The commonest cause, however, is weakness or immaturity of the infant; its ribs are wanting in rigidity and its inspiratory forces feeble, so that it fails to draw in air with sufficient power to inflate the lungs; as a consequence the lungs remain to the greater part of their extent in the fœtal or unexpanded state, a condition to which the term 'atelectasis' is applied. Those infants who have some complete physical obstruction to the entrance of air into the lungs necessarily only survive their birth a few minutes; either no attempt at respiration is made or inspiratory efforts are accompanied by recession of the chest walls, without any air entering the chest. Premature or weakly infants may survive for many hours or even days with a large portion of their lungs in an unexpanded state. They are extremely feeble, their cry is weak and whimpering, their lips and limbs are dusky blue, and their temperature below normal. Their respiratory movements are confined to slight contractions of the diaphragm, sometimes accompanied by indrawing of the walls of the chest; they have hardly strength to suck, and are in a drowsy or semi-comatose condition. They frequently suffer from local twitchings, less often general convulsions. If they live over forty-eight hours they become jaundiced and the limbs œdematous. An examination of the bodies of such infants reveals the usual signs of death from asphyxia: the blood is dark and fluid; the right heart and veins distended;

the sinuses and membranes of the brain congested and a meningeal hæmorrhage may be present. The lungs will be found in a condition of atelectasis or pulmonary apoplexy. In a case which we recently examined in which the infant died six hours after birth, both lungs sank in water, were solid everywhere except at the anterior edges, where there were clusters of air-containing lobules of a light red colour, scattered over the surfaces of the upper lobe. The cut sections displayed purple solid lung without a trace of expanded lobules, a condition due probably to a pulmonary apoplexy occurring during birth. In another case, where the infant lived three days, the lungs and heart together just floated in water, but the lungs everywhere had a solid feel, crepitating very slightly ; the surfaces of both lungs were covered with distended lobules, while the central parts were solid. As a rule, the upper lobes are more often expanded than the bases, and the anterior and inferior edges and surfaces more than the central parts. Care must be taken not to confound atelectasis of the lung with pneumonic consolidation ; the latter condition is rare in the newly born.

Treatment.—1. Remove any mucus or fluid from the fauces and air-passages by means of the finger or by suction with a soft india-rubber catheter. Inverting the body may be useful.

2. Attempt to excite respiration by some form of irritation applied to the skin. Fanning the face or directing a current of air by means of a pair of bellows is often of use. This may also be effectually done by placing the infant in warm water (100° F.), and then dashing cold water over it by means of a sponge or the hand, or by slapping it with the wetted corner of a towel, or, if the faradic current is at hand, a feeble current may be applied to the diaphragm and other inspiratory muscles.

3. If these methods fail, no time should be lost in directly inflating the lungs by a soft catheter passed into the larynx or by Richardson's bellows, or by practising artificial respiration by Sylvester's or Schultz's method, which is to be continued as long as the cardiac sounds can be heard.

Active treatment will less often be required in those cases of asphyxia supervening after birth from non-expansion of the lungs. Gentle measures may be undertaken to excite more active respiratory effects, and to combat the somnolence by means of hot and cold water, or by the application from time to time of stimulating liniments to the chest. Such infants, however, but feebly respond to our efforts, and over-treatment in this direction may easily do more harm than good ; our efforts will mainly have to be directed to placing the infant under the most favourable conditions for gaining strength and gradually bringing about expansion of the lungs (see p. 59).

Apoplexia Neonatorum.—Cerebral hæmorrhage occurring in early life is hardly ever the result of a ruptured artery, but is almost invariably caused by a venous congestion, and takes place from the capillary vessels of the pia mater or choroid plexuses. The arteries of the young are not liable to suffer from atheroma, but retain their elasticity, and, moreover, are not likely to have to submit to any unusual strain from an hypertrophied heart. On the other hand, the pia mater in early infancy is exceedingly delicate and its capillaries fragile ; this can be readily demonstrated by noticing how easily it is stripped from the brain by means of dissecting forceps, and how loose is its connection with the soft brain substance beneath it. Further, we have already alluded

to the fact that the cerebral sinuses and veins become distended with blood in asphyxia from various causes—a rupture of the capillary vessels of the pia mater takes place, and blood is effused into the sub-arachnoid space. This effusion, in consequence of the loose connection of the pia with the brain, may extend over a large surface, or burst into the sub-dural space. The blood clot may compress or lacerate the brain substance, and if the infant lives for a few days this may be followed by softening. The hæmorrhage may take place during birth, from compression of the umbilical cord, producing asphyxia, and is consequently especially common in breech presentations ; or it may result from pressure on the head by the uterus or the blades of the forceps (Spencer). We must bear in mind that the pia mater is not only very delicate and its capillaries easily ruptured if they are over-distended,

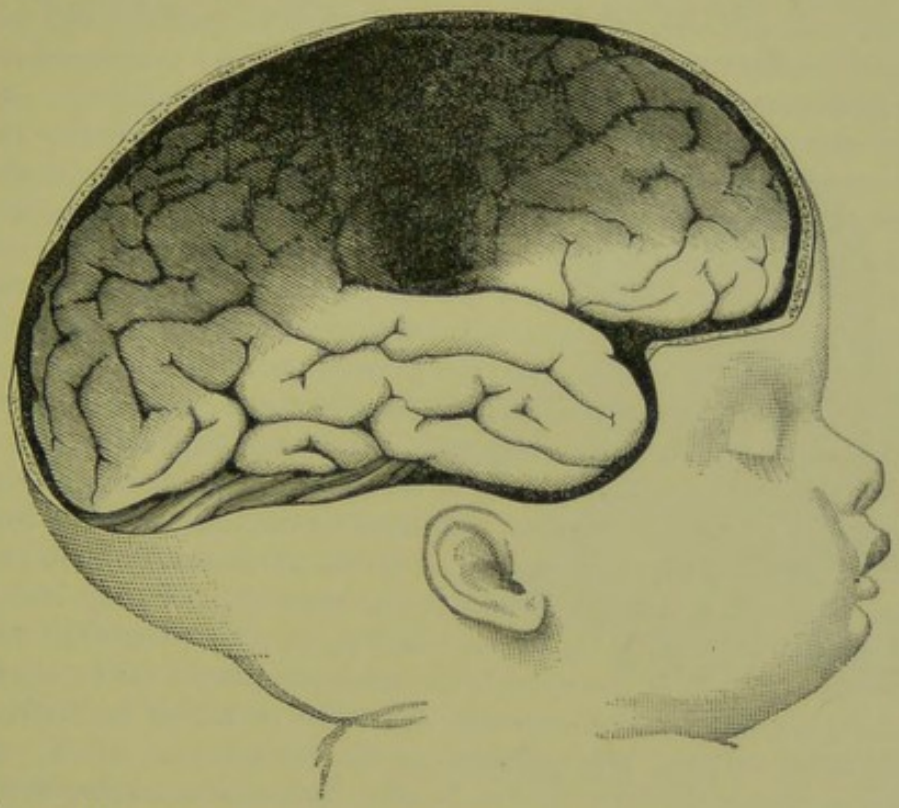

Fig. 5.—Meningeal Hæmorrhage in an Infant ; death on the twenty-second day. (*After McNutt.*)

but also that a stasis is very apt to occur in the superficial veins on account of their peculiar connections. Gowers has laid stress on the fact that here ascending arteries pass into ascending veins, and, moreover, these surface veins empty themselves into the superior longitudinal sinus in a forward direction and consequently against the blood current. Thus the Sylvian vein commences in the fissure of that name and courses upwards to empty itself into the superior longitudinal sinus, receiving the small veins from the motor area *en route*. Near its commencement the Sylvian vein has connections with the superior petrosal sinus (Trolard) and also with the basilar vein.

Spencer [1] comes to the conclusion, as the result of an examination of the

[1] *Obstetrical Transactions*, vol. xxxiii.

bodies of 130 infants born dead or dying soon after birth, that pressure on the skull by the forceps or the uterine walls plays an important part in producing meningeal hæmorrhage. He believes that when the bones of the skull are abnormally soft and the sutures lax, the lower edge of the parietal bone may press on the Sylvian vein or its connections, when the head is subjected to severe pressure during labour, and thus a hæmorrhage in the Rolandic area may be produced (fig. 5.) He also thinks that clamping of the internal jugular by the forceps or pressure on the infant's neck by the parturient canal may give rise to congestion and meningeal hæmorrhage. It would appear from the observations of Spencer that, while these cerebral hæmorrhages are most common in severe and instrumental labours, they are not unknown in labours that are short and easy. The infant may live some days after the hæmorrhage has taken place, as in a case recorded by McNutt ; the labour, which was a breech presentation, was easy ; the breathing became irregular on the day of birth ; later it suffered from convulsions, difficulty of swallowing, left hemiplegia, and emaciation. It died on the twenty-second day. At the *post-mortem* the right hemisphere was covered by a clot (see fig. 5), which was firm and gelatinous, and of a dark colour ; the convolutions beneath it were in part destroyed, especially so in the ascending frontal and parietal regions. The clot also invaded the brain substance, actually forming part of the roof of the ventricle, whilst the site of the corpus striatum and optic thalamus was occupied by a reddish-brown clot mixed with softened brain tissue. This case is remarkable as showing how long an infant may survive an extensive cerebral hæmorrhage and the further damage by the secondary inflammatory softening which evidently took place.

These are instances of fatal cases, but there is good reason to believe that such cases frequently survive, and bear for the rest of their lives traces of the damage done to their brains at birth. It is not difficult to imagine the damage which a surface hæmorrhage may do. It may lead to compression of the convolutions, or meningitis, or softening, or it may more likely lead to atrophy, or interfere with the development of the convolutions. Such a case, verified by *post-mortem*, has been recorded by McNutt. The infant was born with the feet presenting, the labour was tedious, and there was delay in disengagement of the head. Convulsions supervened, lasting for some days ; the child never walked or spoke ; there was spastic paralysis of both sides, except the face ; it died at two and a half years. Atrophy of the convolutions about the fissure of Rolando was found at the *post-mortem*. Similar cases are tolerably common ; there is a history of a difficult labour ; the infant is blue, and perhaps is thought by the midwife to be dead ; it may be convulsed, but recovers. There is probably no marked paralysis at first, but after a few months it is noticed that an arm or a leg, or both legs, are weak ; then contractions take place, the legs becoming adducted, with the toes pointing, the forearms supinated, and the elbows more or less fixed (see CEREBRAL DIPLEGIA). The intelligence is often affected, and the child is late in talking.

Hæmorrhages into other Viscera.—Spencer found in his *post-mortem* examination of stillborn children hæmorrhages into the lungs, liver, kidneys, intestines, testes &c In the lungs the most frequent site was the base, the appearance being that of ordinary pulmonary apoplexy, the hæmorrhagic

portions being solid and of a black red colour on section. If the infant lives pneumonia may arise. Hæmorrhage taking place into the kidney may cause death during the first few days of life by suppression of the urine (Spencer). Hæmorrhage into the bowels may cause obstruction.

Cephalhæmatoma.—During birth a hæmorrhage may take place from the vessels of the periosteum of the skull, and a collection of blood form between that membrane and the bone ; more rarely a hæmorrhage occurs between the occipito-frontalis aponeurosis and the periosteum, or between the skull and the dura mater. The name 'cephalhæmatoma externum' is applied to the first two, thus :

Cephalhæmatoma externum . .	1. Sub-aponeurotic.
	2. Sub-periosteal.
„ internum . .	3. Sub-cranial.
Meningeal hæmorrhage. . . .	4. Sub-arachnoid.

In the common form the tumour is sub-periosteal. The swelling, occupying a position immediately over a parietal bone, generally the right, is usually discovered for the first time a day or two after birth, when the swollen and distorted head of the infant should begin to assume a more natural shape. According to the statistics of Hennig and Hofmokl, a cephalhæmatoma occurs about once in every two hundred births ; in one hundred and twenty-seven cases noted by Hennig, it was situated fifty-seven times over the right parietal bone, thirty-seven times over the left, twenty-one times over both, seven times over the occipital, three times over the frontal, and twice over the temporal bone. It forms a more or less tense elastic tumour, neither hot nor tender, and it does not extend beyond the limits of the bone over which it is situated, inasmuch as the periosteum is firmly attached to the sutures. The scalp is not discoloured. The tumour varies in size from a walnut to a small orange, increases in bulk for a few days after birth, and then begins slowly to diminish. After it has existed for a week or two, a ridge of bone may generally be felt at its circumference, where new bone has been thrown out by the periosteum (see fig. 7 *c'*). When the tumour is examined for the first time in this stage, it is apt to give the impression that there is a circular defect in the parietal bone, through which a fluid tumour is protruding. At times, especially in chronic cases, thin plates of bone form here and there in the periosteum forming the roof of the tumour and give rise to a feeling of crepitation when it is handled. In the course of a few weeks or a month the tumour shrinks and disappears, leaving for perhaps many months a more or less complete bony ridge, which marked the circumference of the tumour. The etiology of these blood-swellings is not very

Fig. 6.—Double Cephalhæmatoma in an Infant twenty days old (from a photograph). Labour difficult, forceps applied, right facial paralysis.

clear, but, like other hæmorrhages which take place during birth, they owe their production in part to asphyxia, in which there is increased tension in the cranial veins, and a condition of blood which readily allows of extravasation. From the fact that the tumour mostly occurs at the site of the caput succedaneum, being over the right parietal bone in nearly three-fourths of the cases, it would appear that pressure upon the head played an important part in its causation ; but, on the other hand, cases are reported in which a blood-swelling appeared over a parietal bone in a case of breech presentation (Runge, McNutt). Small extravasations, the size of a pea or a shilling, may frequently be seen beneath the periosteum in making *post-mortems* on newly born infants. If the caput succedaneum be incised, the tissues immediately beneath the scalp will be found infiltrated with a jelly-like effusion with numerous minute hæmorrhages scattered through it, and on examining the parietal bone numerous small hæmorrhages may be seen beneath the periosteum, some linear in shape, corresponding with the lines or foramina in the bone situated near the inter-parietal suture or posterior fontanelle. According to Féré the edges of the foramina play an important

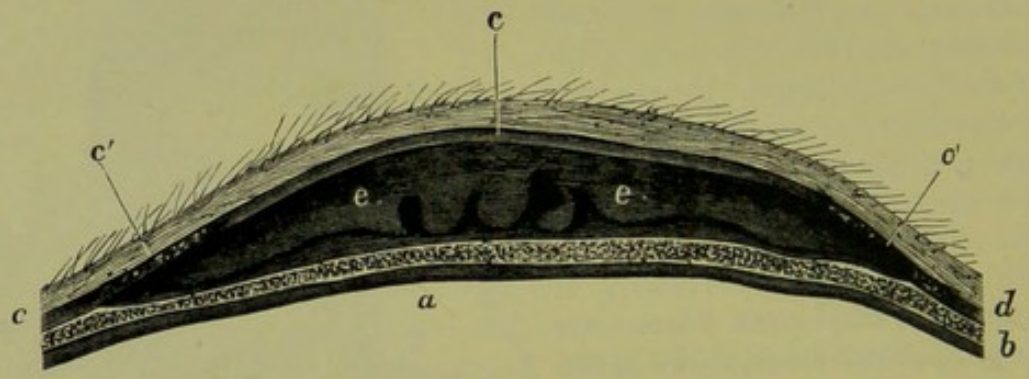

Fig. 7.—Section of a Cephalhæmatoma (semi-diagrammatic), Hennig. *a*, Dura mater ; *b*, parietal bone ; *c*, periosteum ; *c'*, ossification of ditto ; *d*, scalp ; *e*, blood clot.

part in wounding the vessels during labour, and producing a hæmorrhage, as they are the means of transmitting small veins from the scalp to the cerebral sinuses. It is important to bear in mind that not infrequently an effusion of blood external to the skull communicates with an effusion of blood between the bone and dura mater through one of these openings, and, further, a meningeal hæmorrhage may also take place.

The diagnosis is not generally a matter of difficulty. A blood-tumour beneath the periosteum is distinguished from a caput succedaneum, inasmuch as the latter does not fluctuate, disappears in a day or two, and extends beyond the limits of a parietal bone. It is distinguished from a meningocele in that the latter corresponds to a suture or fontanelle, pulsates, and increases in size when the infant cries. Very rarely a blood-swelling takes place between the scalp and the periosteum. In such cases the scalp is discoloured, no bony ring would be formed, and the swelling might extend beyond the sutures. The prognosis as far as a cephalhæmatoma is concerned is favourable, but inasmuch as it is possible that it is complicated by meningeal or extra-dural hæmorrhage the prognosis must be guarded, and any brain symptoms are necessarily of evil omen.

Treatment.—The treatment of these blood-swellings has been much discussed. On the one hand, it has been urged that if the cephalhæmatoma is subperiosteal, it should be aspirated without delay while the blood is fluid and before coagulation has taken place, as in this way the long delay during which absorption and deposition of bone are taking place is avoided. On the other hand, it has been pointed out that it is never possible to tell if the blood-swelling does not communicate with a blood extravasation within the skull, thus rendering surgical interference risky, and moreover that although absorption of the effused material may be tardy, it is both safe and sure, and a good result may be confidently looked forward to. The latter course is certainly to be recommended ; surgical interference in a newly born infant always has its risks : there is always the possibility of introducing septic organisms into the blood-swelling by aspiration, and at the most all that is to be gained by such a proceeding is the saving of a few weeks of time. We believe that all cephalhæmatomata are most safely let alone, care being taken to protect them from injury ; small ones may be shaved and painted with collodion, or during sleep some spirit lotion may be kept applied. In the rare event of their suppurating the treatment would be that of an ordinary abscess—viz. evacuation of the pus and drainage.

Hæmatoma of the Sterno-mastoid.—If an attempt be made by an unskilful midwife to disengage the after-coming head by pulling on the legs or body of the infant, there is a strong probability that injury will be done to the neck or other part, especially as the muscles of the semi-asphyxiated infant are flabby and toneless, and the blood readily oozes out of the vessels. Such an injury does at times take place, giving rise to a blood-tumour within the sheath of one of the sterno-mastoids in consequence of the tearing through of some of the fibres of the muscle or injury to some of its vessels. The swelling appears to be actually composed at first of blood and of the retracted torn muscle, later no doubt of plastic material resulting from the injury, and in some cases where a permanent thickening remains it is due to cicatrised tissue round the torn and retracted muscle. Thus we have seen the clavicular part of the muscle torn away from its attachment, and a swelling at the junction of the two bellies. It is not often that an opportunity occurs of verifying this condition *post mortem*, inasmuch as no serious consequences arise from the accident, but the investigations of Tordeus, Spencer, and others make it clear that these swellings are due to local injuries at birth. In one of our own cases in which the infant died of diarrhœa when six months old, a cicatrisation of the muscle at the spot where the injury had taken place was found. In another case we had also the opportunity of a *post-mortem*. At least three-fourths of these cases are breech presentations ; in the remaining fourth, which occur in head presentations, the injury is no doubt caused by dragging on the head in order to disengage the shoulders and body. The swelling in the neck may be noticed by the mother a few days after birth, or it may escape observation for some weeks, or even longer. On examination a tumour about the size of a pigeon's egg may be felt in the upper part of the right sterno-mastoid ; it is generally irregular, or perhaps elongated, in shape, and if not seen for some time after birth, when cicatrisation has taken place, it is hard and cartilaginous to the touch. The left muscle is less often injured than the right ; sometimes the whole length of the muscle is affected, though

the lesion is generally in the upper part. The tumour disappears in the course of a few months, but for a long time a cicatrix may be felt. There is no treatment required. These cases mostly occur among the poorer classes, who are attended in their confinements by neighbours or unskilled midwives. Injury to the sterno-mastoid during birth derives its importance from the fact that such injury is likely to be the cause of wry-neck in after-life (see TORTICOLLIS).

Occipital Hæmatoma.—Injury to other muscles may occur during birth, and we have seen in one case a 'tumour' in connection with the muscles at the back of the neck arising from injury during birth. It was a head presentation, and there was also a sterno-mastoid 'tumour.' The child was seen at five weeks old. Labour had been prolonged, head delivered by forceps with much difficulty, and subsequently severe traction was needed to extract the body. Two symmetrical swellings were felt in the muscles at the back of the neck, evidently due to hæmatoma. There was left facial paralysis and paralysis of the left arm. The child was heard of two years later, and it was said to have completely recovered.

Obstetrical Paralysis, Facial.—The commonest form of paralysis seen after birth is a facial paralysis due to an injury of one of the facial nerves through pressure exerted by one of the blades of the forceps during delivery (see fig. 6). In rare cases facial paralysis is present when no forceps have been used, and in these cases it seems likely, as suggested by Ballantyne, that the pressure on the nerve has been caused by the promontory of the sacrum or ischial spine during labour. When facial paralysis is present, the deformity of the face is marked when the infant cries, while the eye of the paralysed side remains open during sleep. The paralysis usually passes off in a few weeks, but we have seen traces remain for four or five months in a case in which no forceps were employed; in a few cases reported the paralysis has been permanent.

Congenital facial diplegia due to a nuclear lesion has been described (Rainy and Fowler). The orbicularis muscles are not affected.

Injury to Brachial Plexus.—The less common form of paralysis occurring during birth is that described by Duchenne as 'obstetrical paralysis,' due to an injury of one or more cords of the brachial plexus. The head is born, the shoulders engage the pelvis, and traction is exerted to disengage them; or traction is made on the head or arm. It appears in some cases where no instrumental or other interference has taken place.

The cord derived from the fifth cervical is the one most usually injured, or the injury affects the cord formed by the fifth and sixth; but the damage is not always confined to these cords. In a typical case the muscles paralysed are:

{ Infraspinatus.
{ Teres minor.
Deltoid.
{ Biceps.
{ Coraco-brachialis.
{ Brachialis anticus.
{ Supinator longus.
{ „ brevis.

The trapezius, serratus magnus, and the extensors of the fingers are not uncommonly affected. The arm hangs uselessly by the side and cannot be raised, the humerus is rotated inward and adducted, the elbow is extended and the wrist pronated and often flexed (see figs. 8 and 9). In slighter cases the paralysis is less marked. In two cases reported, one by Seeligmuller, the other by Thorburn, the paralysis was much more extensive than usual, and included retraction of the eyeball and contraction of the pupil of the same side. The sympathetic was no doubt involved.

The brachial plexus injury in some cases is double, and it may be accompanied by a sterno-mastoid laceration.

The prognosis necessarily depends upon the nature and extent of the injury, and while probably all cases improve more or less, complete

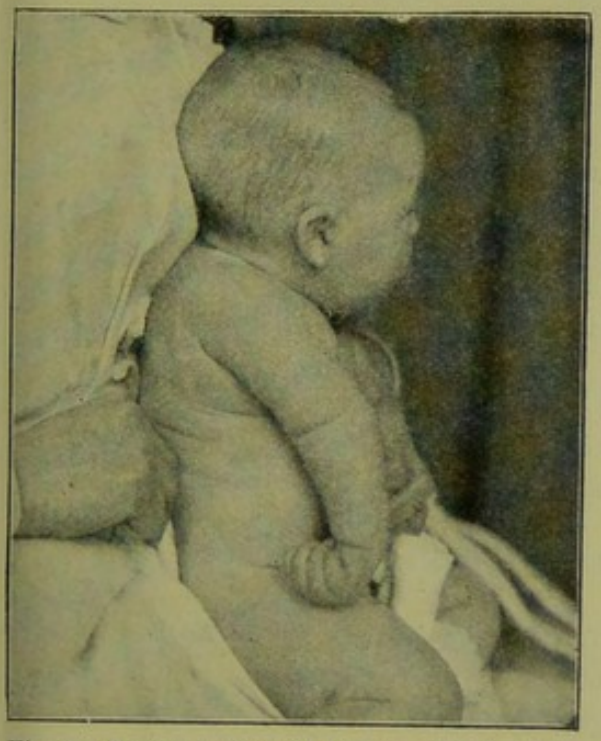

Fig. 8.—Injury to Brachial Plexus at birth. The arm is adducted by the pectoralis major, the elbow extended, the wrist flexed and pronated. The injury involved the cord formed by the fifth and sixth cervical nerves (Mr. W. P. Montgomery's case).

Fig. 9.—Injury to Brachial Plexus during birth. Infant seven weeks old.

recovery cannot in any case be confidently predicted. As time goes on the muscles affected waste from degeneration of the nerves below the injury. Recovery of the flexors of the elbow is generally more marked than the deltoid or supinators. The child may have to learn to write with his left hand if the right is affected. We have seen one case in which fair recovery took place in the muscles of the arm, while the upper part of the trapezius and serratus magnus remained partially paralysed. In other cases the arm remains paralysed, and cannot be raised at the shoulder or the elbow flexed so that the hand can be raised to the mouth.

The diagnosis can hardly present any great difficulty in infants under six months old; in older children it is possible to mistake a birth injury to the brachial plexus for an anterior polio-myelitis of the upper arm type (Erb) The history would materially aid in the diagnosis.

In the treatment of these cases it must be borne in mind that one or more of the cords of the brachial plexus has been injured, with an accompanying local hæmorrhage ; and therefore, the more at rest the arm can be kept for the first few weeks the better. It seems doubtful if any shampooing or galvanising of the muscles can at first do much good. The treatment must be rather that of a fractured bone—rest at first, and afterwards more or less active movement to exercise the muscles and prevent stiffness. The arm should be carefully wrapped up in cotton-wool, flexed and supported by being fixed to the side, care being taken to prevent undue disturbance during the daily bath, and not to allow it to hang down and drag on its connections with the trunk. It must be borne in mind that the circulation of blood will be sluggish, and easily obstructed by tight bandaging. At the end of three weeks, when there is reason to believe that absorption of the effused blood has taken place, movements of the arm may be begun, in order to give the muscles some exercise and to call forth the voluntary efforts of the child. Galvanism and shampooing the muscles, with stimulant applications to the skin, must be persevered with as long as any improvement takes place. If the progress of the case is unsatisfactory after two or three months, it is probably wiser to attempt to deal with the injured nerves on the lines of the operation employed for rupture of the brachial plexus in later life. The cords of the plexus should be exposed in the posterior triangle of the neck, and freed from fibrous adhesions. If it is then found that an actual rupture has taken place, the ends of the injured cords should be refreshed and united by sutures. This is not always possible ; and in cases where the nerve roots are torn away close to the intervertebral foramina or actually detached from the spinal cord, there is little or no prospect of improvement by operation. In favourable cases highly satisfactory results have been obtained.

Icterus Neonatorum.—Infants often suffer from a more or less pronounced jaundice which comes on a day or two after birth. It has been estimated by Continental writers that this occurs in from 60 to 80 per cent. of the total births ; but these observations have been mostly made in lying-in hospitals, where it appears to occur much oftener than in private practice, though there is little doubt that on account of the slightness of the yellow coloration of the skin, and the frequent absence of discoloration of the sclerotic, it may easily be overlooked. Jaundice may arise from or be symptomatic of various pathological conditions, the principal during the first week of life being the following : 1. The common form in which no disease is apparent—icterus neonatorum. 2. Jaundice accompanying a condition of septicæmia or pyæmia ; in acute fatty degeneration of the newly born ; in Winckel's disease. 3. Jaundice due to congenital stricture, or obliteration of the common or hepatic duct, or to syphilitic perihepatitis. The common form to which the name of 'icterus neonatorum' is generally applied differs from the other forms in not being accompanied by any serious symptoms, and in passing off in a few days or a week. In these cases the yellow coloration of the skin makes its appearance on the second day, less often the third, rarely either before the second or after the third, and lasts, according to its intensity, from two or three days to a week. The yellowness is first noted on the face, around the mouth and chest, then on the abdomen, later on the

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limbs ; it may be easily overlooked, unless pressure is made by the finger on the skin. In mild cases the sclerotics remain unaffected, and the urine does not stain the linen ; this is the more noteworthy, as in the jaundice of adults the sclerotics are affected before the skin is tinged ; and pigment is very early present in the urine ; probably the vascularity and transparency of the infant's skin account for the difference. When the jaundice in the infant is more intense, the sclerotics become tinged ; the urine stains the diapers, and bile pigment may be detected. The stools are unchanged and contain the usual quantity of bile. In cases which die when suffering from this form of jaundice, the internal organs are found stained yellow, especially in the cartilages, the brain, and in a lesser degree the abdominal viscera. The majority of infants who are jaundiced appear in perfect health; it has, however, been asserted by Hofmeier that infants with icterus do not flourish as well as other infants, that their loss of weight during the first week is greater than that of healthy infants, and that a higher percentage of urea and uric acid appears in the urine. The cause of this form of jaundice is uncertain ; it is much more frequent in lying-in hospitals than in private practice, and in premature weakly infants with partially expanded lungs than in full-time and healthy infants. There have been many hypotheses concerning its cause, but none of them are entirely satisfactory. One of the most plausible explanations has been suggested by Quincke ; he attributes the jaundice to the ductus venosus remaining patent, thus allowing some of the portal blood (which contains bile pigments) to pass into the general circulation, instead of all of it being submitted to the action of the liver. Virchow and others believe it to be a hæmatogenous jaundice, the bile pigment originating in a destruction of blood corpuscles which it is supposed takes place shortly after birth.

While this form of jaundice is *per se* a symptom of little importance, and in the vast majority of cases the infants do well, it is well to remember that occasionally cases occur which are jaundiced shortly after birth, and which die about the ninth or tenth day without any definite disease being discoverable. These cases sometimes occur in the same family, as in the following remarkable instances : the father and mother were both healthy and in comfortable circumstances, there was no history of syphilis, the first and second children were never jaundiced, and are at present alive and well ; the third, fourth, fifth, and sixth children became jaundiced on the second or third day, and died on the ninth or eleventh day. In all, the skin and conjunctivæ were jaundiced, the urine contained bile pigment, the stools were normal. The fifth child was seen with Mr. G. H. Pinder, their medical attendant, when five days old ; it seemed a perfectly healthy infant, except that it was jaundiced. The infant became weaker and drowsy, and died comatose on the ninth day. A partial *post-mortem* only was obtained ; the abdominal viscera were bile-stained ; the ductus venosus was only partially closed ; there was nothing abnormal about the bile-ducts. What is the nature of these and similar cases it is at present impossible to say. We have seen several other similar cases, where infants have become jaundiced shortly after birth and died in a few days without any apparent explanation. The diagnosis between icterus neonatorum and the jaundice which accompanies septicæmia does not present much difficulty, for in the latter case

there would be some suppuration or phlebitis of the umbilical cord or ecchymosis and various hæmorrhages. In acute fatty degeneration and Winckel's disease there are usually cyanosis, purpuric spots, and hæmorrhages. In jaundice from obstruction of the ducts, the jaundice is intense and bile is absent from the stools. Nothing much can be said about the treatment of infantile jaundice, which consists rather in attending carefully to the general health of the infant than in the administration of any special drug. Small doses of hyd. c. cret. may be given for its laxative effect, and to relieve any tendency to mechanical congestion of the liver.

Hæmorrhagic Diathesis. Hæmophilia Neonatorum.—It not infrequently happens that within a few days of birth the infant exhibits a tendency to bleed. There may be hæmorrhages from the nose, stomach, bowels, or kidneys, and petechiæ and ecchymosis may make their appearance on the skin. Oozing of blood, which is perhaps difficult to arrest, may take place from the navel on the separation of the cord. This tendency to bleed is no doubt to be looked upon as rather a symptom than a disease or the result of disease. It cannot be said that our knowledge is very exact regarding the conditions which give rise to the hæmorrhagic diathesis in infants, but in a large majority of cases at least the infant is either syphilitic or suffers from septicæmia or from both conditions. The poisons generated by the syphilitic or septic infection appear to cause such changes in the blood as give rise to bleeding on the slightest injury. In some of the cases in which there was no evidence of syphilis during life, the evidence has been forthcoming at the *post-mortem*, and, moreover, syphilis is not disproved by no lesions being discovered in an infant a few days old.

In seven cases recorded by Fischl[1] in which hæmorrhages took place shortly after birth from the mucous membranes or into the skin, there was evidence of syphilis ; there being characteristic rashes on the skin, enlargement of the spleen, and interstitial hepatitis. In one of the author's cases, however, the only evidence of syphilis was the enlargement of the spleen and an interstitial hepatitis. A careful microscopical examination of the minute blood-vessels was made in these cases, with the result that they were found normal, so that the bleeding could not be attributed to arteritis.

In three cases of hæmophilia in infants recently investigated by H. Neumann[2] pyogenic organisms were found, and the author inclines to the belief that the entrance of the septic organisms into the system either before or during the act of birth had much to do with the hæmorrhagic state. In the first case the infant, which was illegitimate, suffered from jaundice, petechiæ on the skin, melæna, and hæmatemesis ; it died on the fifteenth day. The autopsy showed there had been capillary bleeding from the mucous membrane of the alimentary canal, enlargement of the spleen, and interstitial hepatitis (syphilitic). A bacteriological examination of the blood showed the presence of the *Bacillus pyocyaneus* β. In a second case, undoubtedly syphilitic (snuffles and rash), which suffered from bleeding from the nose and mouth, and which died when seven weeks old, a bacteriological examination showed the presence of pus cocci, namely, *Staphylococcus pyogenes aureus* and *albus* and also *Streptococcus pyogenes*. In a third case, in which the

[1] *Archiv für Kinderheilk.* Band viii.
[2] *Ibid.* Bande xii. xiii.

mother suffered from syphilitic ulceration of the labia, the infant suffered from jaundice and various hæmorrhages, and died on the ninth day. Both bacilli and cocci (*Bacillus pyocyan.* β and *Staphyloc. pyog. aureus*) were found in the blood. It is not easy to say in the present state of our knowledge whether the bacilli and cocci found were accidentally present, or whether they were directly or indirectly the cause of the blood change which gave rise to the blood extravasations. The bacilli may enter the fœtal tissues before birth through the placental circulation or be inoculated at the time of birth or afterwards through the navel.

Acute Fatty Degeneration of the Newly Born.—Buhl, in 1861, described the symptoms and morbid anatomy of a rare disease, occurring in newly born infants, to which he gave the name of acute fatty degeneration. His observations have since been confirmed by Hecker, Furstenburg, Roloff, and Runge, though it cannot be said that this condition is sufficiently well known for it to take its place as a well-defined and definite disease. The infants suffering from it are generally born in a condition of asphyxia without obvious cause, and some die asphyxiated. If they survive, they usually suffer from more or less cyanosis, with hæmorrhage from the bowels, stomach, or from the navel on the separation of the cord. There is often jaundice, and blood extravasations take place beneath the skin, conjunctiva or mucous membrane of the mouth; there may be general œdema; death usually takes place within two weeks. At the *post-mortem* minute hæmorrhages are found in the various internal organs, which are sometimes infiltrated with blood; the tissues are bile-stained. On microscopical examination of the tissues of the heart, liver, kidneys, &c., they are found to be in a condition of fatty degeneration. The nature of the disease is quite unknown. It is interesting to note that a similar condition has been observed in newly born pigs and other domesticated animals.

Winckel's Disease.—A disease somewhat similar to the last has been described as occurring in an epidemic form by Winckel, and is characterised by cyanosis, jaundice, and hæmoglobinuria. This epidemic occurred in the Foundling Hospital at Dresden in 1879, when twenty-three infants were affected in the course of a month. The symptoms noted were first of all a bluish tinge on the skin of the face, body, and limbs, with a more or less icteric tint; in some cases there were vomiting and diarrhœa. The urine was of a light brown colour, with a sediment consisting of epithelium and casts; the blood contained an excess of white corpuscles and many granular bodies. The symptoms usually began on the fourth day after birth, death occurring in one case in nine hours, though the average duration of the disease was about two days. The sections showed a yellow staining of the skin and internal organs. The spleen was large and hard and dark red; the kidneys were usually dark brown in colour, the microscopic examination showing their tubules to be filled with granular pigment. There were punctiform hæmorrhages on the surface of the various internal organs, and fatty degeneration of the liver and heart.

Melæna Neonatorum. Gastro-intestinal Hæmorrhage.—The vomiting of blood, or its passage per anum, is not an uncommon occurrence in the newly born. The most common cause, especially of hæmatemesis, is the swallowing of blood oozing from a cracked nipple, which the infant sucks,

or from some wound in the infant's mouth or nose. Large quantities of blood may be swallowed in this way, and vomited in a more or less altered condition, or passed as blackish masses with the fæces. A hæmorrhage may have taken place into the bowel during labour and the blood passed in the stools. A much more serious condition exists when the source of the bleeding is a small ulcer or ulcers in the stomach or duodenum, which may open a large vessel and cause fatal hæmorrhage, as in a case recorded by Goodhart and another by Sawtell. Neumann has recorded a somewhat similar case in an infant born of healthy parents, which died on the third day from birth, after vomiting blood. At the *post-mortem* an ulcer was found in the duodenum. In the majority of cases the bleeding appears to be capillary, due to a tendency to hæmophilia, which has been described (p. 30). The hæmorrhage in most instances comes on in the first twenty-four hours; if the amount of blood lost is large, the infant quickly becomes pallid, the skin cold, the fontanelles depressed, and convulsions probably follow. Death usually takes place within twenty-four hours of the commencement of the symptoms; if the infant survives this period and no fresh attack comes on, there is reason to believe there is no lesion of the stomach or duodenum, and there is good hope that the infant may survive. The treatment would naturally depend upon the diagnosis as to the cause. Small doses of ergotine (quarter grain to half grain), in syrup, by the mouth or subcutaneously, would be the most likely to be of service. In any case of passage of blood per rectum in an infant, the possibility of an invagination of the intestine must be borne in mind.

Hæmorrhage from the Genital Organs.—It sometimes happens that there is a small oozing of blood from the vagina during the first few days succeeding birth, sufficient to stain the napkins. The blood may often be seen oozing from the vagina, while no lesion of any kind can be detected. The discharge lasts for a few days only, generally from two to five, the health of the infant does not suffer, and recovery seems always to take place. Cullingworth has collected thirty-two such cases, two of which came under his own observation. He agrees with Cameron in believing that the bleeding is due to a congestion of the pelvic veins, the result of the cessation of the circulation in the umbilical arteries when the cord is tied. As already stated, there is sometimes a coincident discharge of blood from the rectum, due apparently to the same cause (see above). It must not be forgotten that cases of precocious menstruation may occur, commencing shortly after birth, and continuing monthly afterwards.

Diseases of the Navel. Separation of the Cord.—Under ordinary circumstances the umbilical cord shrivels up and drops off at a period after birth varying from the first to the fifth day, thin small cords drying up and separating earlier than large soft ones (Bouchut); the cicatrix is not usually dry and firm until the tenth or twelfth day.

Umbilical Polypus.—Occasionally, after the cord has separated, a small red prominent projection is left with a moist surface; this 'polypus' is the result in most cases of incomplete withering of the cord, at other times the outgrowth is rather of the nature of a simple granulation polypus from irritation, the so-called 'fungus of the navel.' The projection, when small, is often hidden by the overhanging skin of the part, and may remain for

weeks or months, giving rise to slight discharge from the scar and perhaps excoriation of the skin around. In another class of cases, such as one sent to us by Dr. Serra, of Eccles, the proximal part of the cord instead of shrivelling up remained as a red vascular projection some three inches long. On examining this child some five or six weeks after birth, there was a red fleshy prominence then about 1½ inch long projecting from the navel; it was about as thick as a cedar-pencil, and its surface appeared to be a mucous membrane except at one spot where a patch of delicate cuticle was found. The apex of the protrusion was perforated by an orifice which readily admitted an ordinary probe, and the instrument could be passed downwards in the middle line and swept round on each side for some three inches; it could only be passed upwards for about half an inch. A thin watery mucus in small quantities was discharged, but no fæces or urine. Subsequently fæcal matter escaped from the orifice. The protruded mass was ligatured and removed with a good result. This condition is due no doubt to persistence of the vitelline duct in the proximal part of the cord and its conversion into intestine; it communicates with the ileum by means of Meckel's diverticulum. After the distal part of the cord has become detached the end cicatrises, and a prolapse takes place of the whole thickness of the tube; hence in the section in fig. 10 two layers of mucous membrane with an intervening muscular and fibro-cellular layer are seen. Such cases are not rare; we have met with several, in which the 'protrusion' was not so large as in the above case, but from which there was a thin biliary discharge. A section after excision showed traces of muscular fibres and columnar epithelial cells. We have seen a similar case in a child six years old, but the parents declined any interference.

Fig. 10.—Section of Ileo-Umbilical Diverticulum. *a*, central canal continuous with Meckel's diverticulum lined with villi; *b*, remains of villi of the everted portion of mucous membrane; *c*, tubular glands; *d*, remains of muscular coats; *e*, section of blood-vessels (× 4). The muscularis mucosæ layers are also seen.

Another form of umbilical fistula is that due to persistence of the urachus. In such cases, sometimes called **navel urachus fistulæ**, urine escapes externally at the umbilicus. Sir T. Smith, Mr. Bryant, Mr. T. Paget and others have described instances of this deformity, and we have seen several such cases. It may sometimes be cured by ligature. An imperfect obliteration of the urachus may also give rise to the formation of a cyst in the middle line of the abdomen below the umbilicus.

The *treatment* of these affections is often very simple: for the larger ones a ligature should be applied tightly round the base, and the mass cut short off; the smaller ones may be snipped off with scissors or rubbed down with nitrate of silver, or dusted over for a few days with powdered nitrate of lead, which we have found an effectual remedy. Where a patent urachus gives rise to cyst formation it may be necessary to lay open and pack the cavity or even to dissect out the cyst wall, and if there is leakage from the bladder

along the fistulous track it is necessary to divide and close the passage at the apex of the bladder. It must be remembered that there is considerable variation physiologically in the process of separation of the cord ; in weakly children it falls off later and the raw surface is slower in healing. Where the cord stump is projecting it is liable to be irritated by friction and its healing is slow : this is the condition described as **excoriation**. When a sort of 'mucous surface' remains and goes on discharging, the so-called **Blennorrhagia** exists, while the presence of a thick consistent film on the surface of the sore has been described as **croupous** or **diphtheritic exudation** ; in some instances it is probable that a true diphtheritic membrane is formed. Where there is any spreading ulceration after separation of the cord, infective influences should be looked for ; the mischief may spread superficially or it may tend inwards and involve the peritoneum. A mere superficial excoriation of the skin analogous to intertrigo elsewhere is often seen in older children as a result of dirt and neglect. It is readily cured by the application of boric powder.

Simple ulceration is never fatal unless it extends deeply ; it should be treated by some simple antiseptic powder or ointment, such as boric acid or iodoform.

Umbilical Infections.—Under this term we may include omphalitis, gangrene, erysipelas neonatorum, thrombo-phlebitis, and arteritis, all being due to an infection by streptococci through the umbilical wound. Fortunately such conditions are rare in this country, though in times not long past they were common enough in the 'lying-in' hospitals on the Continent. The prognosis in all such affections is very serious, as newly-born infants, especially if premature, bear sepsis very badly, and the treatment is rather preventive than aught else. The greatest care should of course be taken in the matter of cleanliness, and aseptic treatment of the cord is essential. In erysipelas of the newly born, as Ballantyne points out, the first signs of redness are often to be seen near the symphysis pubis and not round the umbilicus, as the infection often travels along the hypogastric arteries. The redness may spread to the scrotum, gluteal regions, and thighs. The skin is red and shiny, perhaps brawny or œdematous ; there is usually high fever, quick collapse, drowsiness and death. There may be nothing abnormal to be seen about the umbilical wound, though it is clear the infection has entered at this spot. In other cases the navel itself is surrounded by a zone of redness, and later this may spread over the abdomen. Local abscesses or widespread suppuration may form in the subcutaneous tissues. The cord may become gangrenous, or phlebitis may take place, with intense jaundice, and possibly peritonitis or pneumonia.

The umbilical wound is not the only avenue of infection ; the conjunctival mucous membrane or the mouth may become infected, and secondarily the lungs and alimentary canal. There is often a co-existing diarrhœa, wasting, and later death from exhaustion. In milder cases boils form in the subcutaneous tissues, and perhaps after a doubtful struggle recovery takes place.

Dermatitis Neonatorum. Ritter's Disease.—Possibly different diseases are included under these terms. There is, however, a form of dermatitis seen not infrequently in the newly born in which the prominent symptoms are an erythema followed by free desquamation. There is usually

rapid wasting, and death from inanition. The disease has undoubtedly been confused with congenital syphilis, in consequence of the rash and the desquamation and wasting. Probably it is a form of septic infection, and has nothing to do with syphilis. We are inclined to think that some of the cases described as infantile syphilis in the third generation have in reality been cases of Ritter's disease. The erythema appears at times to spread from the 'napkin area,' involving most of the skin, and is often well marked on the face and around the mouth; and as there is perhaps some nasal discharge, the infant's appearance may closely simulate that of syphilis. We have seen infants suffering from dermatitis when syphilis could certainly be excluded.

Umbilical Hæmorrhage is to be looked upon as a symptom rather than a disease in itself; it is met with in the shape of bleeding from the umbilical vessels themselves, and as a general oozing from the raw navel surface.

Bleeding from the vessels may occur from slipping or imperfect tying of the ligature round the cord; as, for instance, when a thin ligature cuts into the vessels. Bleeding, of course, by no means necessarily follows slipping of the ligature, or even failure to tie the cord at all. The aspirating action of breathing prevents any hæmorrhage in most instances, and this is supplemented by the contraction of the vessels after birth.

Asphyxia may, however, produce some escape of blood as the vascular pressure rises in slight degrees of suffocation; in other instances deficient muscular contraction appears to be the cause, hence bleeding is most common in premature children who have been asphyxiated or whose lungs have not expanded. If it arises from imperfect muscular contraction it may occur some hours after birth (Hoffmann). As the vessels begin to contract at the cord, and the obliteration extends towards the hypogastrium, there is more risk of bleeding if the cord is cut very short. So, too, drying up of the cord tends to obliterate the vessels, while gangrene and swelling tend to prevent their closure. Bleeding may also occur later from rough handling of the navel and separation of the scab. All danger from this form of hæmorrhage may be prevented by tying the cord firmly with a broad ligature not too near the abdominal wall; should bleeding occur, pressure or the application of astringent powders, a fresh ligature or acupressure will arrest it.

Idiopathic, or spontaneous bleeding so called, is a very rare occurrence, and its etiology is obscure. Grandidier collected twenty-two cases from various sources. The bleeding usually occurs about the fifth day, just after or more rarely before the cord comes away, the blood trickles from the surface of the umbilicus, and not from any distinct vessel; the oozing may be continuous or intermittent. The subjects of the affection are generally healthy full-time children: there is often, however, slight icterus; in other cases there is some intestinal disturbance, vomiting, colic, &c., with deep icterus, cyanosis, and drowsiness before the bleeding occurs; in any case these symptoms appear soon afterwards. Bleeding not seldom comes on from the stomach or intestines, or there may be general purpura, and sometimes there is œdema of the hands and feet together with the umbilical hæmorrhage.

The great difficulty or impossibility of stopping the flow is characteristic of the condition. Most of the cases die before the second week; the

mortality is put down as 83 per cent. The infant usually dies comatose, less often in convulsions.

Umbilical hæmorrhage is a symptom of several diseases; probably in some cases, as we have already pointed out, it is due to hæmophilia or syphilis. Privation, drink, and other depressing causes acting upon the mother are also assigned as reasons for it. Septicæmia and 'fatty degeneration of the newly born' are causes that have been established by *post-mortem* evidence. The blood in these children does not clot readily. It is said to be a commoner disease in America than elsewhere.

Pressure by various means, such as pads, filling the navel with plaster of Paris, underpinning, &c., may be tried as means of treatment with some hope of success; caustics and astringents, such as perchloride of iron, do not appear to be of much use; the actual cautery has succeeded. The local application and internal administration of solution of adrenalin chloride (♏ij–v of 1 in 1,000 solution) would be well worth trying in such a case. Idiopathic bleeding is very rarely met with. Fürth has, however, collected records of some cases;[1] it is sometimes epidemic. Weiss had 31 cases out of 742 children in one year at Prague.[2]

For other morbid conditions of the umbilicus, see 'Deformities of the Umbilicus.' A more detailed account of diseases of the umbilicus will be found in former editions of this book; they have been omitted here on consideration of their rarity, and for reasons of space.

Tetanus Nascentium.—This disease is almost unknown in this country at the present day, although in past times, when less attention was paid to general hygiene in lying-in hospitals, it was common, and sometimes was the largest factor in infant mortality; it was also frequent at one time among the negro population in America. The disease is identical with the wound tetanus of adults, and is caused by inoculation of the navel with the tetanus bacillus. This bacillus, as shown by Nicolaier, is constantly present in the superficial layers of the earth, and it gains entrance to the infant's body by dirty dressings applied to the navel. The bacillus multiplies in the neighbourhood of the navel, and a strychnine-like poison is absorbed, which gives rise to the muscular spasms. The bacilli may be detected in the pus of the navel wound, and if the pus be injected into mice they die with tetanic symptoms. (Rosenbach, Peiper.) Tetanus ('nine-day fits') usually appears in the first two weeks of life, most commonly from the third to the tenth day, the limits, according to West, being from the fifteenth hour to the fifteenth day. The symptoms are usually acute, the earliest being inability to suck from spasm of the facial and jaw muscles (trismus); general contractions, however, soon occur, the spasms are continuous, but increase in violence at intervals; in most cases there is no complete relaxation. The child often utters a peculiar whining cry, and there is well-marked risus sardonicus; the maximum rigidity is generally reached in twelve hours, and the child dies in a fit or becomes comatose.

The spasms are increased by any exposure to cold and by noise; emaciation is very rapid, and there is often jaundice. Death usually occurs in one

[1] *Arch. f. Kinderh.* Band v. p. 305.

[2] For further details, *vide* a paper by Dr. Francis Minot in the *American Journ. of Med. Sci.* Oct. 1852.

or two days : in rare cases the disease is chronic. Hartigan says the chronic form begins with dysentery and coldness and pallor of the skin ; hence it has been called 'white lockjaw.' It is attended by wasting and twitchings, and was described by Marion Sims as 'Trismoid.' Unlike the acute form, which always occurs within the first month of life, the chronic variety may appear at any time within six months, and may be a sequel of the acute. The disease is readily recognised by the spasms and general rigidity.

The *preventive treatment* consists in the most rigid cleanliness in dressing the navel and the removal of insanitary conditions. Opium, chloral, bromide of potassium, cannabis indica, belladonna, and other drugs have been occasionally successful ; warm baths sometimes relieve the spasms, and spinal icebags are worth a trial ; anæsthetics, such as ether and chloroform, are useful to relieve pain and allow the child to be fed, but none of these remedies have given any constant good result. Further details of the disease and references will be found in the works of Bouchut, Meigs and Pepper, Peiper,[1] Baginsky.[2]

Sclerema Neonatorum.—This rare disease is practically unknown outside foundling asylums and lying-in institutions, and is by no means common under any circumstances. The chief characteristics of the disease consist in an induration of the skin and subcutaneous tissues, and marked wasting, with an abnormally low temperature. The infants at birth may present no abnormality, and in some cases at least are plump and healthy-looking ; within a few days of their birth they begin to waste, the temperature becomes abnormally low, 83° to 86° F. in the rectum, and the integuments become hard and rigid ; the change usually begins in the lower extremities and spreads upwards, and involves the trunk, upper extremities, and face. In typical instances the skin is of a dirty yellow colour, its surface is hard and does not pit, and it cannot be raised from the subcutaneous tissues. The surface of the body has a cold feel almost like stone. In some described cases the rigidity of skin has been so great that the infant could be lifted by the head and heels like a rigid body. On account of the rigidity of the skin of the face, sucking is performed with difficulty, and the infant has to be fed with a spoon. The prognosis is bad, as such infants almost invariably die in a few days. In a typical case investigated by Dr. W. P. Northrup, of New York, the microscopical examination of the skin showed nothing abnormal. In a case of Dr. J. W. Ballantyne's there was an increase in the number and size of the connective-tissue bundles and an atrophy of the adipose tissue. Langer attributes the rigidity of the integuments to solidification of the fatty tissues, in consequence of the abnormally low temperature. In one case, however, reported by Dr. A. G. Barrs, which he believes to have been of this nature, the infant, which was a month old when seen by him, made a good recovery. In this case the skin over the buttocks and thighs was hard and rigid, and could not be raised from the deeper tissues. But it appears to have been red and shiny, and without the cold feel so typical of the ordinary cases of sclerema. We have seen a similar case in a girl two weeks old, in which the tissues of the back of the trunk, arms, and legs were much indurated, red, and shiny. They were too hard to pit with the finger. We

[1] *Deutsches Archiv für klinische Medicin*, Bd. xlvii. H. 1 u. 2.
[2] *Berliner klinische Wochenschrift*, No. 7, 1891.

think that this case, as also Dr. Barrs's, were not identical in nature with those described as sclerema. Cases such as the above of a local induration of the subcutaneous tissues are not very uncommon in the out-patient room. They occur in apparently healthy infants, and mostly appear to affect the skin of the back, buttocks and backs of the thighs. The skin when palpated feels hard and brawny and is fixed to the indurated subcutaneous tissues. The indurated part is sharply differentiated at its edge from the healthy skin. Such cases gradually get well in the course of some months.

Œdema Neonatorum.—Weakly, especially premature, infants are apt to be œdematous at birth, or become so soon after. An œdematous condition of the skin and subcutaneous tissues differs from sclerema in that the former readily pits beneath the finger, and the skin is more or less smooth and shiny. It is obvious that œdema may be present in many different conditions, and it does not in itself constitute a disease. We have seen one case of congenital nephritis in which there was general œdema during the first week.

Gonorrhœal Ophthalmia.—Though hardly within the scope of this work, mention ought perhaps to be made of the danger to the infant of infection by gonorrhœal discharges from its mother at birth or shortly after. The most common affection is that of the eyes, in which a virulent purulent ophthalmia is produced. The inflammation rapidly spreads to the eyelids, and involves the cornea, speedily causing opacity, and, if allowed to run its course unchecked, ending in perforation of the cornea, with escape of the contents of the globe and complete shrinking of the eyeball. Many cases of total blindness in children are due to this cause. In any case where there is a suspicion of vaginal discharge from the mother, an antiseptic douche should be carefully used before the birth of the child, and immediately after it is born the child's eyes should be examined and carefully washed out with a solution of perchloride of mercury (1–4,000), followed by a douche of boric acid lotion. At the least sign of any inflammation the eyes should be washed with a solution of sulphate of zinc (2 grains–$\bar{3}$j), and unless the mischief is at once checked a solution of nitrate of silver (10 grains–$\bar{3}$j) should be employed once a day, washing out again with a solution of salt directly after to prevent too powerful action of the silver. The eyes should be bathed every hour day and night with a lotion of boric acid, and the silver repeated if necessary. It is only by such means that the eyes can be saved in severe cases. The utmost care must of course be taken to use all applications thoroughly and get rid of every particle of discharge, as well as to avoid subsequent reinfection. For infantile gonorrhœal rheumatism *vide* chapter on 'Diseases of the Joints.'

CHAPTER III

THE HYGIENE AND DIET OF INFANTS AND CHILDREN

Newly-Born Infants.—One of the first cares of the nurse after the navel has been attended to, should be to direct her attention to the infant's eyes, carefully wiping away, by means of a soft rag, any mucus or vaginal discharge which may adhere, and thoroughly cleansing the eyelids with warm water. This is a matter of much importance and should never be neglected, for if conjunctivitis or a purulent ophthalmia be set up, much trouble may ensue and some time elapse before a healthy state is again attained, and the risk of corneal opacities and consequent loss of sight is by no means small. The temperature of the room in which mother and infant are should be maintained, at least in winter, at 65°, and means be taken to ventilate it thoroughly without producing draughts.

In giving the infant its first bath—necessary on account of the slimy whitish secretion with which the infant is covered—care should be taken that it is done before a good fire, and that the water of the bath is not too hot ; the temperature should not exceed 100° F., for the infant's skin is tender and easily damaged by prolonged contact with warm water. The surface of the infant is well cleansed with flannel and soap while on the nurse's lap ; it is then bathed, all soap being removed in the bath. This cleansing operation is repeated daily, the genital organs and buttocks requiring especial care, on account of their becoming fouled by contact with soiled diapers ; intertrigo and erythematous eruptions are likely to arise if the greatest cleanliness is not practised. Some infants' skins are far more tender than others and liable to eczema, and require constant care to avoid irritation. Care should be taken in the selection of a soap which is free from excess of alkali, such as the best class of pure Castile soaps, all excess being removed in the bath. The skin should be carefully dried with a soft towel, and some fine dusting powder applied to the folds of the groin and buttocks. This may consist of finely powdered maize or oatmeal mixed with 2 per cent. of salicylic acid, 5 per cent. of boric acid or thymol, to prevent any tendency to decomposition. Pure boric acid, as in the 'Sanitary rose powder,' answers very well, and as it is soluble in water is easily removed by washing. The diapers should be of a soft and absorbent material ; at least a dozen should be provided for use during the twenty-four hours. They are usually made of 'swansdown' or 'Turkey towelling,' but by far the best material is 'Gamgee,' or 'Robinson' tissue, a piece being cut in a triangular shape, and the edges run. These are more absorbent than the ordinary napkin, and can be burnt when soiled. They can be obtained ready-made under the name of 'knapkinettes.' [1]

[1] Southall, Barclay & Co.

During the first week a flannel binder is necessary to keep the dressings in position, but afterwards binders are best avoided ; at least, nothing tight should be applied round the abdomen which would cause discomfort to the child by compressing the abdominal viscera. A knitted Shetland-wool belt is much preferable to the ordinary strip of flannel which is stitched or pinned. The cord may be dressed with a pad of wood-wool wadding or Gamgee tissue.

It is hardly needful to say that a cot should be provided for the infant with a firm mattress protected by a waterproof covering, and under no circumstances whatever should the infant be allowed to sleep in bed with its parents or nurse ; fatal accidents through suffocation of the infant beneath the bedclothes are constantly occurring in consequence of the mother falling asleep with her infant in bed with her.

Clothing.—All the clothing should be loose, and as far as possible consist of flannel or knitted woollen material, so arranged that the infant can be readily dressed and undressed. The common tendency is to load the chest and body with too great an amount of clothes and to leave the arms and legs too much exposed. For the latter, long loosely fitting woollen drawers coming to the waist should be used, carefully protected by the diapers from being wetted.[1]

Infant Feeding at the Breast.—The natural food of an infant is the milk from the breast of its mother, no kind of food being thought of for the first eight or nine months of its life. The mother's health may of course sooner or later interfere with the performance of this duty to her infant, but it is of great importance that a trial should be made if for only a few weeks for to undertake the artificial feeding of an infant from the first is to expose it to serious risk.

The infant should be put to the breast a few hours after birth, when the mother has somewhat recovered from the pains and fatigue of labour, and has had some sleep. It is of much importance that both mother and infant should get as much rest at night as possible, and if the infant frequently wakes crying, every means should be taken to hush it off to sleep again, and for this a little sweetened water or barley water may be used. It is not unlikely that for the first day or two, especially in primiparæ, the supply of milk will be scanty and the infant will hardly get its full supply ; but this is a matter of little importance, and it is well not to overload the stomach at first, but to give it an opportunity of gradually accustoming itself to its new function.

On the other hand, some recent writers (McLane, Holt) have shown that thirst and starvation give rise to a febrile condition to which the term of **Inanition Fever** has been given. In some cases at least where the infant has sucked at a dry breast and has had no artificial food or fluid, or an insufficient quantity, the temperature rises to 102–104° on the third day, less often on the second. The infant is restless, its lips and skin are parched. All the symptoms are quickly relieved by its taking freely of breast milk, or, failing this, water or artificial food. A temperature of 106° has been observed.

From the very first it is of importance to accustom both infant and

[1] See *Health in the Nursery* (Longman & Co.).

mother to regular times for feeding. After the first two days every two hours during the daytime will be quite often enough for an infant of average weight and strength. A longer interval may be taken in the night, so as to give the mother as long a sleep as possible; nine or ten feedings in the twenty-four hours will be sufficient. A strong newly-born infant empties the breast in about fifteen minutes, and, during this time, takes from 1 to 1½ oz. of milk, the total amount taken during the twenty-four hours during the first week being 10 to 12 oz. The infant's stomach, at this period, being only capable of holding about 1½ oz. (see fig. 1) without marked distension, too rapid filling with fluid is very likely to give rise to vomiting. It is therefore of importance for the mother to feed the infant slowly, extending the time to fifteen or twenty minutes.

The infant's stomach rapidly enlarges, and the secretion of milk increases as time goes on; so that, after the first month, eight nursings in the twenty-four hours—that is, every two and a half hours during the day, and a longer interval at night—will be enough. From the end of the third month till the end of lactation, every three hours will be often enough, some 3 to 6 oz. being taken at a time, and some 20 to 40 oz. in the twenty-four hours. Six to seven nursings in the twenty-four hours will be sufficient.

Too frequent nursing is bad for the infant, inasmuch as an overworked stomach cannot properly perform its functions, and dyspepsia is only too likely to occur; the mother's breasts require an interval of rest, for, if too frequently drawn, the milk is apt to be unequal in composition, too watery after a long, and too rich and concentrated after a short interval.

During the whole time the infant is being nursed the health of the mother is necessarily a question of the greatest importance, as it is impossible for a weakly mother, or one in ill-health, to give good milk. The food which she takes and the life which she leads are all-important. Anything causing indigestion in the mother will be extremely likely to affect the breast milk and disturb the infant's digestive organs.

Various drugs, such as morphia and Epsom salts, when taken by the mother, are excreted in the milk, and may of course affect the infant. Any violent emotion, such as a great sorrow, or any prolonged anxiety suffered by the mother, is very likely to alter the quality of the milk, and the infant consequently suffers. Indeed, under these circumstances, the milk may cease to be secreted, and the infant have to be artificially fed. The mother's diet should consist largely of milk, porridge, soups, potatoes, fish, and light puddings, while beef, mutton, and stewed fruit should be taken in moderation. She should avoid all highly seasoned foods, and those difficult to digest, such as pastry, raw fruit, and uncooked vegetables. Alcoholic liquors are unnecessary, and tea and coffee should be taken in moderation. Exercise in the open air is of the greatest importance, but it must be graduated according to the strength of the mother.

Exercise appears to tend to diminish the amount of proteids in the milk, and decreasing the amount of butcher's meat taken will tend in the same direction. Increasing the proteid element in the food, assuming that the extra proteid food is digested, renders the milk richer, especially as regards the fat.

The milk of the first few days (colostrum) differs from normal milk in

that it is of a yellowish colour, is unusually rich in proteids, and has a laxative effect upon the infant's bowels. It also contains less sugar than normal milk. Microscopically a number of granular corpuscles are seen, which are apparently epithelial cells undergoing fatty degeneration. In a few days the excess of proteid disappears, but it may be a week or more before the milk is normal. The changes which occur in the quality of the milk during the lactation period depend very largely of course on the health of the mother. During the later months of lactation the milk tends to become poorer and more watery, with a diminution of the proteids and fat. It must be borne in mind how completely the secretion of the milk is under the influence of the nervous system, and how, also, it varies from time to time from various causes ; and more or less caution must be observed in drawing conclusions as to the effect of any one cause on the quality of the milk.

The occurrence of menstruation in a nursing mother or wet nurse is apt in some way or other to alter the secretion of the milk, and the infant, in consequence, may suffer from colic, flatulence, or diarrhœa. In many cases the infant does not appear to suffer at all, while in exceptional cases the intestinal disturbance and loss of flesh are so great that the question of weaning may have to be entertained. It may happen that the infant is affected a good deal at one period and not at the next or succeeding ones. The chemical changes which occur during menstruation have been investigated by several observers, but no constant change has been found. In some cases the careful observations of Rotch have shown that the milk during this period is poorer in fat and richer in proteids, but it is tolerably certain that this is not universally the case. Monti found that menstruation exercised no constant change or influence on the specific gravity or the fatty elements, though in some cases observed by him there was an increase in the quantity of fat during the period.

Wet Nurses.—It not infrequently happens that, if an infant's life is to be saved, a wet nurse must be procured. It may happen that a weakly infant is deprived of its mother's milk, and a foster-mother must be obtained if its life is to be preserved. In some cases, perhaps, an attempt has been made to feed a young infant on some artificial food, various foods being tried, one after another, till severe convulsions or continuous diarrhœa warn the attendants that a return to the infant's natural food is the only possible resource left. Much has been written about the advantage and disadvantage of a wet nurse. We may say at once that, in our opinion, there is not the least doubt that no artificial food yet devised can compare with or form a substitute for the milk of a healthy woman. To attempt to bring up a weakly infant from the first on artificial food is to expose it to far more serious risks than if it is provided with a healthy wet nurse. The younger the infant is, the more likely is it to take the breast milk of a wet nurse and to thrive on it, or, in other words, the value of a wet nurse is greatest during the first few weeks of an infant's life. To put an infant of three or four months of age that has been artificially fed to the breast of a wet nurse is likely to end in failure. Unfortunately, in this country wet nurses are difficult to obtain, and when obtained are not always easy to manage in the household. At the same time, we are inclined to think that the character of wet nurses as a class has often been painted in too black colours ; certainly

we have known many who have done their duty to their foster infants in a most worthy and exemplary manner. A difficulty often is presented with regard to the nurse's own child; it is put out to nurse, and is deprived not only of its mother's milk, but also of its mother's care, and is only too likely to go the way that so many 'out-to-nurse' babies have gone before. In large cities wet nurses are usually obtained at the workhouses, where many women go to be confined, and are often glad to escape from the discipline of the workhouse, and to obtain a situation in a private family at good wages.

A wet nurse should not be above thirty-five or below twenty-one years of age; very young wet nurses are especially to be avoided, on account of their inexperience and the difficulty in managing them. It is better for the nurse's infant to be a month or so older than the infant to be nursed. Great disparity of age is an objection, as a nurse who has been confined six months before is not likely to make a good nurse for a newly born infant, at least not for the whole time that the infant has to be nursed; but such a nurse may be employed temporarily in the absence of a more suitable one. A disparity of two or three months is no objection, provided the nurse is suitable in other ways. A medical examination of the nurse should always be made—at least, the medical attendant should satisfy himself that both the nurse and her infant are free from disease. There is one advantage in the nurse's infant being two or three months old, and that is that time would have been afforded for any syphilitic rash to make its appearance on the infant, and the infant if strong and vigorous is reliable evidence of the good quality of the milk. If possible, an analysis should be made upon several occasions, especially with regard to the amount of fat present in the milk. But, in spite of all precautions, we must be prepared at times to find that the milk of a wet nurse who in every way appears suitable does not agree with the infant, and the only resource is to try another. Great pains must be taken in the dieting of the nurse, errors being most frequent in the direction of overfeeding with too little exercise. Meat once a day is enough, beer and porter are best avoided, and exercise in the open air must be insisted on.

No infant suffering from hereditary syphilis should be wet-nursed, on account of the risk of its infecting its foster mother.

Weaning.—The length of time during which the infant takes its sole nourishment from its mother's breast depends upon a variety of circumstances. When the mother remains strong and healthy and has a sufficient supply, the time may be extended to eight or nine months, or even more. Among the working classes the time is often extended much longer than this. Infants who are over-nursed are apt to be fat, but are not necessarily strong—indeed, they often appear rickety in a minor degree. In a case recently come under our notice, the mother nursed her infant entirely at the breast for seventeen months. The child weighed twenty pounds, it showed signs of rickets, the epiphyses being moderately enlarged and the ribs beaded. An examination of the mother's milk, which was plentiful, showed it was poor—the amount of fat (average of three samples) 1·7 per cent.; the specific gravity was 1031.

Whenever weaning takes place it is wise to do it gradually, in the first place substituting the bottle for the breast once or twice in the twenty-four

hours, and carefully watching the result before attempting more than this. Gradually artificial feeding may be made to take the place of the breast entirely. It is well to avoid the hottest weather for this change on account of the risks of diarrhœa at this time.

At any time during the period of lactation it may be necessary, on account of the mother's health, to supplement nursing with other food, or to give up nursing altogether. The question of whether to give up nursing or not is often a difficult one to decide. If the mother is suffering from any organic disease, there cannot be any doubt as to giving up nursing both for her own sake and that of the infant. It may happen that the breast milk entirely goes, and either a wet nurse must be obtained or artificial food be substituted ; in other cases the decision is much more difficult ; the infant does not appear to thrive, and the fault may be in the quality of the mother's milk.

Much useful information may be gained by weighing the infant every week ; a regular gain of 5 to 6 oz. a week during the first three or four and 3 to 4 oz. from the third to the sixth month will indicate that the infant is thriving in spite of some minor troubles it may be subject to. It must be remembered, however, that the infant may be fat without a corresponding development in the other tissues.

Valuable information may be obtained by an examination of the breast milk ; unfortunately, no mere inspection or microscopical examination is of any use : an analysis must be made by a competent chemist by ordinary methods, or approximate results may be attained by the estimation of fat by means of the acid butyrometer (see APPENDIX). Care should be exercised to see that the milk taken for analysis is the middle portion : that is, the infant should be put to the breast for five minutes or more, and then 1½–1 oz. drawn from the same breast by means of a breast pump. This will give a fair sample of the milk. The two most important considerations, as Rotch points out, are the amount of fat and the amount of proteids present. A low proportion of fat and a high proportion of proteids indicate a bad milk.

The following analyses represent examples of human milk of different qualities (Rotch) :

	Normal	Poor	Over-rich	Bad
Fat	4	1·50	5·10	0·80
Proteids	1–2	2·40	3·50	4·50
Lactose	7	4·00	7·50	5·00
Ash	0·2	0·09	0·25	0·09
Total solids	12–13	7·99	16·35	10·39
Water	88–87	92·01	83·65	89·61
	100–100	100·00	100·00	100·00

However desirable an analysis of breast milk may be, it is often not possible, and the decision as to whether the mother should give up nursing must be arrived at on other evidence. If the infant on being put to the breast is temporarily quieted, and then after a few minutes begins to become

impatient and cries, it is probable that it fails to draw sufficient milk. An infant taking too little breast milk may suffer from colic, and pass frequent liquid green stools. It fails to gain in weight from week to week. Under these circumstances, and assuming that the mother is fit to continue nursing, the best plan is to supplement breast feeding by giving a small quantity of diluted boiled cow's milk and water after each or some of the breast feeds. The mother gives the infant the breast, say, every three hours during the day and every six hours at night ; then after the infant has emptied the breast and is not satisfied, it may be given half an ounce or an ounce of diluted milk with a tea-spoon. This method, at least for a start, is better than giving the infant two or three complete meals a day of artificial food. As time goes on it will be easy to judge whether to wean completely or not. To take an infant from the breast because it is not getting enough, and substitute artificial food, often means the commencement of a steady downward career.

Care should be taken of the health of the mother, by prescribing fresh air and a generous diet. A change to the seaside is often of value.

Artificial Feeding

The most convenient substitute for human milk is the milk of the cow. The milk of some other animals, such as the goat, ass, mare, has been used with more or less advantage, but cow's milk is likely to remain the all but universal substitute. Goat's milk has one or two practical advantages ; in the first place, the goat appears rarely to suffer from tuberculosis, an immunity which it owes to its outdoor life, while the cow is known to be very frequently affected with this disease ; and, in the second place, for a family in the country having their own grass plot, it may be often very convenient to purchase a milch goat and fodder it at home. A milch goat is of course much cheaper than a cow, and can be kept at practically no expense. The chemical differences between the milk of the cow and that of the goat are not great, and there is no advantage except that already mentioned in substituting goat's milk for cow's milk.

The milk of the ass much more nearly resembles human milk than either the milk of the cow or goat. Unfortunately ass's milk is difficult to obtain in this country, and is also costly ; but it is often of service for weakly infants, when diluted cow's milk fails (see APPENDIX).

Cow's Milk.—The milk of the cow has been studied more closely than the milk of any other animal, on account of its great importance to the community as an article of commerce. As a food its importance is derived from the fact that it supplies in due proportion proteids, carbo-hydrates, hydrocarbons, salts and water, while it contains no waste products, and, moreover, it is digested with comparative ease. It requires when fresh and pure no preparation to render it fit for consumption.

The richness of milk is influenced in various ways—the materials with which the cows are fed, the length of time during which they have been in milk, and also by the breed. The milk supplied at our doors, it is needless to say, varies with the honesty of the purveyor and the cleanliness observed in its collection and transit

A superstitious belief in the superior virtues of the milk of 'one cow' is still common among the public, and it is often looked upon as a most important matter to secure this. As a matter of fact, a good average milk is more likely to be obtained from mixing the milk of a *number* of cows than in taking it from *one*, for it is well known that the first portion of milk obtained from the udder is poor in fat, while the last portions are rich, the amount of fat varying from 2 to 8 per cent. If the first part of the milk taken is reserved for an infant, it is tolerably certain to get a poor milk. Whenever a cow is specially reserved to supply milk for an infant, care should be taken to see that it is sound and healthy. It should be tested with tuberculin by a competent veterinary surgeon.

What is of far more importance than the question of 'one cow' is the health of the cows, how they are fed, and the care taken to prevent the contamination of the milk with organic matters. In the vicinity of our large towns it is no uncommon thing to see cows out at pasture in fields watered by brooks contaminated with sewage, of which they freely drink; moreover, they are extremely likely to lie down in the sewage water, and their udders, and consequently the milker's hands, become befouled with sewage. In the winter time the cows are frequently fed largely on turnips and brewer's grains, instead of hay, maize, or other dry fodder; possibly also their sheds are infrequently cleaned out and only sparingly supplied with straw, so that the animals lie in fæces, and their udders may be seen caked with dried excrement. It is no uncommon thing to find a greenish-looking sediment in milk from second-rate dairies, due to contamination of fæcal matters.[1] The storage of milk is an exceedingly important matter; it is readily contaminated when kept in cellars or kitchens pervaded with sewer gas or the emanations of decomposing animal substances. The temperature at which it is kept is also important, as it far more quickly turns sour and decomposes when kept in a warm place than in a cool place. This is recognised by many milk purveyors, who take measures to cool the milk directly it is received from the cow by means of iced water. The day's supply of milk for the household or for the children should never be kept in the nursery or kitchen, but should be covered and kept in cool, well-ventilated cellars, or out of doors in the shade. According to Soxhlet fresh milk turns sour and curdles at the following temperatures and times:

At 32° C. (90° F.) in 19 hours — At 17½° C. (63·5° F.) in 63 hours[2]
At 25° C. (77° F.) in 20 hours — At 10° C. (40° F.) in 208 hours
At 0° C. (32° F.) in 3 weeks.

Freeman has shown by experiment the effect of temperature on the growth of bacteria in milk. Samples of the same milk were kept at different temperatures for twenty-four hours, and the number of bacteria estimated in a fixed amount of each specimen. The one kept at 45° F. had 445; that at 50° F. 1,362; that at 55° F. 67,170; while that at 68° F. had the enormous number of 134,340.

We give here three different analyses of cow's milk: (I) a good average

[1] The bacillus coli communis is constantly found in ordinary milk, in consequence of fæcal contaminations. See *Brit. Med. Journal*, August 31, 1895, p. 544.

[2] Temperature of ordinary kitchen.

specimen according to Leeds ; (II) a pure milk according to Langlois ; (III) an average specimen as supplied by the milkmen of Paris (Langlois) :

	I	II	III
Specific gravity	1029·7	1031·7	1033
Vol. of cream	—	10	7·7
Fat	3·75	4	3·34
Lactose	4·42	5	4·92
Proteids	3·76	3·4	3·4
Ash	·68	·6	·57
Total solids	12·61	13·0	12·23

The **Fat** of milk consists principally of margarine and oleine ; it is present in milk as minute globules, which on standing rise to the surface in the form of cream. A microscopical examination of a drop of milk displays these minute globules of fat, and also colostric corpuscles and fatty epithelial cells if the animal has recently calved. According to some the fatty globules are surrounded by an albuminous envelope ; others believe milk to be really an emulsion, in which the fatty particles are held in suspension by the albumen and caseinogen in the milk. The fat can be extracted by shaking with ether, after the addition of a drop or two of a solution of caustic potash. If milk be long heated at 100° C. or at a higher temperature, the emulsion is in part interfered with, and globules of butter oil will rise to the top if the milk is warmed ; a microscopical examination of such milk shows the fatty globules to have in part run together.

The **Lactose** or **Milk Sugar** is the member of the carbo-hydrate group present in milk, and is destined to be converted into glucose, and in this state enters the blood of the portal vein. It is readily converted into lactic acid in the stomach and intestines. It is uncertain if lactic acid is present in normal digestion in the stomach, but in some forms of dyspepsia excessive quantities are formed, so that some infants who are suffering from chronic dyspepsia have a strong 'sour milk' odour. Possibly this rancid smell may be due in part to butyric acid. Lactic acid may be decomposed into alcohol and carbonic acid, and also into butyric acid and carbonic acid. The latter two processes probably only take place in abnormal digestion.

The **Proteids** of milk are two in number—caseinogen and lactalbumen (Halliburton). In cow's milk the former is present in much larger quantities than the latter, the reverse holding good in woman's and ass's milk. Caseinogen is precipitated by acetic acid or by saturating with a neutral salt such as sulphate of magnesia ; lactalbumen is coagulated on boiling. Lactalbumen closely resembles serum albumen, but it coagulates at a somewhat higher temperature, 77° C. (Halliburton). It only slowly coagulates at this temperature, and even at a higher temperature some time is required to coagulate it fully. If rennet be added to cow's milk the caseinogen is decomposed into casein or curd of milk, which is precipitated in dense flakes, and a second proteid, the '**whey proteid**,' which remains in solution. The

presence of lime salts is necessary for this change to take place (Hammarsten). 'Whey proteid' is not precipitated by heat.

The curd of cow's milk forms a dense heavy lumpy precipitate in the stomach, differing very markedly from the soft flocculent precipitate from woman's milk. It is attacked with difficulty by the gastric juice, and a large proportion of it passes into the intestines practically unchanged.

The **Salts** of milk consist of potash, lime, and soda in combination with phosphoric acid and chlorine.

The **Ferments** of milk have during the last few years been the subject of numerous investigations. These researches have shown that milk, like all other secretions, contains small amounts of enzymes or soluble ferments. They appear to consist of the following :

(I) A hydrolising group, including amylase which converts starch into sugar, and a lipase which splits up milk fats into butyric acid and glycerine. The latter is more active in the human than in cow's milk.

(II) An oxydising group, which in the presence of a solution of peroxide of hydrogen turns tincture of guaiacum a blue colour.

(III) A group including ferments, which convert glycogen into sugar, coagulate hydrocele fluid, and others which have a proteolytic action on albuminous matters. Like all ferments, they are destroyed by a heat of 60° C.

Woman's Milk.—The following figures, according to Leeds, represent the principal differences between cow's and woman's milk :

	Sound dairy milk	Average woman's milk
Reaction	acid	alkaline
Specific gravity	1029	1031
Fat	3·75	4·13
Lactose	4·42	7
Proteids	3·76	2
Ash	·68	·2
Bacteria	numerous	absent

We have taken the analyses of Professor Leeds of woman's milk as being the average of a large number of specimens, but the variations in different samples is very considerable. The analyses given by different authorities also differ considerably, as the following table will show :

Woman's Milk

—	Solids	Proteids	Fat	Lactose	Salts
Pfeiffer	11·778	1·944	3·107	6·303	·192
Hoffmann	12·340	1·030	4·070	7·030	·210
Leeds	13·268	1·995	4·131	6·936	·201
Luff	11·490	2·350	2·410	6·390	·340
Adriance	12	1–2	3–4	6–7	·20
Colostrum					
Pfeiffer	15·7	9·756	2·954	2·942	·408

The principal points to be noted are the following: (1) the excess of proteids in cow's milk, and the excess of curd (caseinogen) over lactalbumen as compared with woman's milk. According to Hirt, the amount of curd in cow's milk is 3 per cent. (lactalbumen ·75 per cent.), in woman's milk it is only ·63 per cent. (lactalbumen 1·5 per cent.), so that the amount of curd is nearly five times as great in the former as in the latter. (2) Smaller quantity of lactose in cow's milk. (3) The fat is about the same. (4) The ash is greater in cow's milk. (5) By the time the cow's milk reaches the consumer it is slightly acid and contains numerous bacteria, while woman's milk is supplied direct to the infant, and is alkaline and sterile.

In substituting cow's milk for human milk, we necessarily endeavour to imitate the latter as much as possible. The great difficulty to be overcome is the large quantity and solidity of the curd, which is thrown down in cow's milk when the latter comes in contact with the curdling ferment of the infant's stomach. Woman's milk curdles in soft flakes, which hardly offer any resistance when pressed between the finger and thumb, while the curd of cow's milk, especially if the curdling has been rapid, consists of firm cheesy lumps. The digestive juices of the infant's stomach and intestines are unable to dissolve these lumps, and, if not vomited, they partially decompose under the influence of the bacteria they contain, gases and ptomaines are formed, and much discomfort and perhaps diarrhœa or convulsions take place before the decomposing curd is passed in the stools. Any one who has had an opportunity of carefully watching the effects of cow's milk when taken by an infant a few days old, and noted the effect if the milk of a wet nurse is substituted for cow's milk, will see at once the difference in the quality of the stools, and the immediate cessation of the discomfort and indigestion which the infant is certain to have suffered when taking the cow's milk. The difficulty with regard to the curd can partly be got over by diluting and peptonising or adding malt extract, but no method has been discovered by which cow's milk can be rendered as digestible and nutritive as woman's milk. The curd thrown down from sterilised milk, or milk which has been desiccated, appears to digest more readily and with less discomfort than the curd of fresh cow's milk.

Modified Milk.—The readiest way to prepare an infant's food from cow's milk is to dilute with water and add sugar. It is plain, however, that while the resulting mixture if sufficiently diluted may be suited to the infant's digestion as far as the proteids are concerned, it will certainly be deficient in fat, and will not be a good copy of human milk. On the other

—	Proteids	Fat	Sugar
Human milk	1–2	3–4	6–7
Cow's milk	3·75	3·75	4
Cow's milk 2 parts, Water 1 part	2·5	2·5	2·7
Cow's milk 1 part, Water 1 part	1·87	1·87	2
Cow's milk 1 part, Water 2 parts	1·25	1·25	1·3

hand, if only a small proportion of water is added, the mixture will contain a too high proportion of the proteids. This is seen in the table (p. 49).

What must be aimed at is a mixture containing the various constituents in the proportion of an average example of human milk.

It must, however, be remembered that it is clearly an advantage to the physician not only to provide the infant with a good imitation of human milk, but also to be able to vary the proportion of the constituents to suit the idiosyncrasies of the patient as well as the abnormal conditions of digestion produced by disease. In order to provide these advantages, Walker-Gordon milk laboratories have been established in various cities of the States and in London, and other cities will doubtless follow. The pioneer work in this direction has been done by Dr. T. M. Rotch of Boston, U.S.A., and the first milk laboratory was established there under his direction. There must necessarily be a farm in connection with the laboratory, where healthy milch cows are kept under the most rigid sanitary conditions, strict care being taken to prevent the entrance of bacteria into the milk, and to insure a milk of good quality. Then by means of a cream of known strength, diluted with separated milk and a solution of milk sugar, any prescription sent to the laboratory can be made up and supplied to the patient.[1] It is certain, however, that milk laboratories will for the present at least be out of the reach of the majority of practitioners, and the expense will stand in the way in many cases. The food of the infant will for long to come have to be prepared at home. Many attempts have been made by physicians, Biedert, Meigs, Frankland, to prepare mixtures of cream and milk sugar, which should be good copies of human milk. The difficulty has always been to obtain a cream of definite and constant strength. The cream of the shops varies much in strength, and moreover is often by no means fresh, and frequently contains boric acid or other preservative.

The plan we have followed for some years has been to prepare the infant's food from 'top milk,' diluting this with a solution of milk sugar. It must be borne in mind that milk that has already stood at rest for some hours and then been shaken up does not cream well a second time, so that it is important to obtain the household milk from a farm or dairy near at hand, and supplied to the household without delay. Milk that has travelled many miles by train and stood in cans for hours before delivery does not cream so well as fresh milk. We must remember, too, that the afternoon's milking is usually richer in cream than the morning's milking.

Stand 30 oz. of fresh milk of average quality (3·75–4 per cent. fat) in a glass bottle, such as one of those supplied with Hawksley's steriliser (see fig. 11) for four or five hours in a cool place, such, for instance, as in running water. A plug of clean cotton wool is placed in the neck of the bottle to keep out dust. At the end of this time a certain amount of cream will have risen to the upper part. We may roughly reckon the upper third, i.e. 10 oz., contains 10 per cent. fat, or the upper half, i.e. 15 oz., contains 7 per cent. fat. Syphon off the lower two-thirds or 20 oz., or the lower half 15 oz., according to the strength of the food required ; replace by 20 oz. of solution of sugar of milk (1 oz. of milk sugar in 2 oz. of water), or by 15 oz. (1 oz. of milk sugar in

[1] For details and full directions see *Nutrition of the Infant*, by Ralph Vincent, M.D.; also APPENDIX.

15 oz.). The bottle is then placed in the steriliser, and the mixture kept at 155° F. for half an hour. It is then cooled as quickly as possible in running water or in ice. When the infant has to be fed, as much as is required for the feed is placed in the feeding-bottle and warmed up to 100° F. If the weaker mixture is made, it will contain about 3–3·5 fat, 1–1·3 proteid, and 6 milk sugar; the stronger mixture will contain more proteid, viz. 3–3·5 fat, 1·75 proteid, and 6 milk sugar.

The best way to start the syphon is to fill it with water, nip the rubber tube so as to close it, carefully placing the short leg of the syphon in the bottle so that it touches the bottom, and release the end of the rubber tube.

Another method is to allow 30 oz. of fresh milk to stand in a clean glass jug for four or five hours in a cool place, keeping it covered to prevent dust falling into it, and removing the top 10 oz. by means of a Chapin's dipper (which holds 1 oz.) or small ladle. Dilute this 10-per-cent. cream with two to five parts of sugar water (1-20) according to circumstances, and Pasteurise at 155° F. for half an hour. One twelfth part of lime water can be added to each bottle.

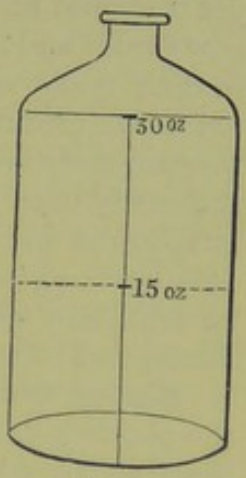

Fig. 11.

Newly-born infants and infants of a few months old seem to have much difficulty in digesting the curd of cow's milk; they pass curdy or pasty stools, suffer from colic, and fail to gain in weight from week to week. In such cases a weak food must be given for awhile; the 10-per-cent. cream may be diluted, taking one part to three or four of sugar water, and gradually increasing the strength when the digestive organs are working better.

Healthy infants, with average powers of digestion, should be able to take, when two or three weeks old, one part of 10-per-cent. cream, diluted with two parts of sugar water, and at three or four months of age 7-per-cent. cream, diluted with an equal quantity of sugar water. Many infants fail to digest a food of this strength, and their food has to be kept well diluted for many weeks or months.

Whey.—Whey is an extremely useful food for a newly-born or weakly infant. It is also often of great service as a substitute for richer foods during a period of indigestion. It may be often usefully employed as a diluent for cow's milk. It is best prepared by warming 30 oz. of milk in a glass bottle (see fig. 11) or saucepan to a temperature of 104° F., adding a teaspoonful or two of Benger's essence of rennet; allowing to stand for a few minutes till coagulation has taken place, then stirring and agitating the contents of the bottle, so as to break up the curd and liberate some of the fat, then straining through muslin or a fine sieve; 30 oz. of milk will yield about 23 oz. of whey. Whey so prepared contains about—fat 1·5 to 2 per cent., proteids ·8 to ·9, lactose 4·75, salts ·6 (F. Baden Benger). The whey should be sterilised, and it will probably require straining again, as a slight separation of proteid takes place, but this coagulation of proteid is no disadvantage, except that it is apt to clog the teat. In some cases of weak digestion it may be wise to dilute the whey with barley water. On the other hand, if it is found that whey agrees with an infant and it is thriving, milk may be added to the whey after sterilisation, and some milk sugar also added. A weak humanised milk may be made by mixing 10 oz. of milk with 20 oz. of whey,

and adding ½ oz. of milk sugar. To make a stronger humanised milk use 7-per-cent. cream instead of ordinary milk for the above mixture.

Diluted Milk.—Undoubtedly the readiest way to prepare an infant's food is to dilute milk with water and lime water, and add sugar. That food so prepared is inferior to the food in which cream forms the basis is evident, yet it cannot be denied that very many children are brought up on diluted cow's milk and appear to thrive on it. Many such children pass much curd in their stools without being the worse for it. The poorer classes cannot get fresh cream, or indeed any cream at all, and have from necessity to prepare their infants' food from milk. As we should naturally suppose, it is the newly-born infants who are most intolerant of cow's milk, and great care is required in adapting the strength of the milk to the infant's condition. It is best to give a newly-born infant whey for the first few days if it has to be artificially fed, and then well-diluted milk, at first one part to four of sugar water, and increase the strength if its digestion appears good.

Barley Water, Oatmeal Water, &c.—For many years past it has been the practice to use certain thin gelatinous fluids, such as barley water, oatmeal water, arrowroot water, or fluids containing maltose and dextrin, to dilute milk with for infant feeding. All these fluids, except perhaps the last named, contain small quantities of starch. Now it is certain that the powers of young infants for converting starch into sugar are feeble, and if these fluids are used care should be taken in their preparation to avoid any quantity of starch being present. The saliva of infants three or four months old has undoubted powers of starch transformation, and apparently the pancreatic and intestinal juices have also, so that by the time this age is reached we have nothing to fear from thin starchy fluids. It has been claimed for these gelatinous fluids that when used to dilute milk they play a useful part in preventing the curd from running together into lumps during the time that coagulation is taking place. It is certainly difficult to demonstrate this in a test tube, but it is probable that any colloidal or gelatinous fluid interferes with the rapid diffusion of the curdling ferment through the fluid, and consequently the curdling takes place slowly, and there is in consequence less tendency to the formation of lumps of curd. Neither starch nor maltose is present in the natural food of infants, yet experience teaches that the addition of a thin malted food or barley or oatmeal water has a considerable nutritive value, and we entertain no doubt on this point. For infants below six months of age, we dilute milk more or less in order to reduce the amount of curd present ; in doing so we render the food poorer in hydrocarbons than mother's milk. This diluted milk is rendered more nutritive by the addition of malted starch, and this is, in some instances at least, more readily assimilated than milk diluted with water only.

Peptonised Milk.—The predigestion of the curd, or rather the caseinogen of cow's milk, is undoubtedly a useful resort in the artificial feeding of infants. It can be easily demonstrated that milk partially peptonised less readily curdles on the addition of rennet or acid, and that the curd thrown down is softer than that thrown down from fresh cow's milk. Clinical experience also testifies to its value, especially in infants with irritable stomachs or gastric catarrh. It does not, however, always agree with infants ; speaking generally, it is of more use in gastric than in intestinal

disturbances. It is not wise to continue its use for many months together ; the infant should gradually become used to milk which has not been predigested. If it is the sole food for many months, especially after the sixth or seventh month of life, scurvy is very apt to arise. The best way to prepare this form of food is to utilise the cream mixture already referred to, and also the sterilising apparatus. A reliable peptonising powder containing pancreatine and soda may be added to the mixture when nicely warm (110° F.), and the temperature raised during the next ten minutes or quarter of an hour to 160° F., or it may be carried to the boiling point. Peptonising for ten minutes or a quarter of an hour does not much alter the flavour of the milk, but this time is not long enough to do more than digest a part of the curd. If the process is continued for half an hour to an hour, the curd is much more completely digested, but a bitter taste is developed. In quite young infants this bitter milk appears to agree very well under some conditions, but many infants will not take it. Peptonised milk food may be made from one of the well-known foods prepared by Benger & Co. or other reliable firms.

Sterilisation.—Where milk can be obtained absolutely fresh and uncontaminated from undoubtedly healthy cows, and is consumed at once, sterilising processes are unnecessary, but only those who keep their own cows or are resident near a Walker-Gordon laboratory can have the advantage of using raw milk. Cow's milk, as used by householders in towns, is usually many hours old before it is received, and it may be kept, or at least some portions of it, for twenty-four hours longer before the infant takes it. During this time the bacteria which it has received by means of various contaminations multiply enormously, especially in hot weather. Milk which is acid and 'just on the turn' is, it is needless to say, quite unfit for infants' food. Many of the bacteria found in stale milk are probably harmless, or at any rate not actively mischievous ; others which may be present, especially the 'peptonising bacteria,' are unquestionably deleterious, inasmuch as they form during their growth various animal poisons of the ptomaine type, which give rise when taken to acute diarrhœa or gastro-enteritis.

Various pathogenic bacteria may be present in milk, either derived from a diseased cow, or from sewage or other contamination entering the milk. Tubercle bacilli may be derived from cows suffering from tuberculosis of the udder, and there can be no doubt that diphtheria, scarlet fever, typhoid fever, and foot-and-mouth disease may be spread through contaminated milk. Fortunately all these bacteria are destroyed at the temperature of boiling water ; indeed, there is good evidence that they cannot withstand a temperature of 75° C. if continued for half an hour. Of the saprophytic bacteria there are many varieties. There are the lactic acid group, and with these are the butyric acid producers. Others, which are much more important, are those which do not act on the lactose, but if present in sufficient numbers peptonise the proteids, forming peptones and albumoses. Milk containing the latter, if it is at all stale, given to mice or guinea pigs, produces diarrhœa, while pure cultures quickly produce diarrhœa and death.

Sterilising for household purposes rests on a somewhat different footing from sterilising in large establishments where the milk has to keep for many months. The milk sterilised in the household has only to be kept for twenty-

four hours or thereabouts, and therefore so high or continuous a temperature is not required. The success of the sterilising process largely depends upon getting the milk fresh and clean, and consequently containing few bacteria and no spores. It is impossible in a household to sterilise stale milk. Stale milk is certain to contain many spores, and the spores of some of the saprophytic bacteria such as those which attack casein require a temperature of 100-105° C. or more to destroy them. If the milk can be procured fresh and clean and is intended to be consumed within a day or two, a temperature of 70° or 75° C. is quite high enough to expose the milk to. This temperature does not affect the taste or coagulate the lactalbumen. If milk has to be kept a longer time or is not very fresh, it is better to expose it to a temperature of 100° C. for half an hour. Milk which is long heated at 100° C. or a higher temperature suffers certain changes, the chief of which is connected with the coagulation of the albumen, the partial destruction of the fat emulsion, and precipitation of the calcium salts. Moreover, the milk-ferments or oxydases, which appear to play an important part in digestion and nutrition, are destroyed by a heat of 75° C. In such milks some of the fat floats in the form of large globules of butter on the top of the milk when it is warmed. A brown colour is developed on account of the partial destruction of the lactose. The proteids of boiled or long heated milk are not precipitated by reunion, and in consequence are less readily digested in the stomach. This has been claimed as an advantage, but it cannot be looked upon with favour, at least in the case of infants when in health.

Ought we to sterilise milk for infants and children? The answer unquestionably is, it ought not to be necessary. If suitable and perfectly practicable precautions are taken to ensure healthy cows and cleanly methods, cooling and bottling the milk at the farms and distributing the bottles packed in ice, sterilisation is unnecessary.

Sterilisation or Pasteurisation to be really effective ought to be done at once after milking and before the bacteria have had time to produce toxins which are not destroyed by heat.

Sterilised milk in consequence of the changes produced is less suitable for infant feeding than clean fresh milk. Good sterilised milk is safer and better than dirty, stale, unsterilised milk.

Various forms of apparatus have been devised for sterilisation in the household, the best known being on the Soxhlet type. This form can be used for heating to 100° C. or to the lower temperature of 75° C. (167° F.). Hawksley (see APPENDIX) has also devised a steriliser with a thermometer, which is convenient and reliable. Aymard's steriliser is also convenient for the purpose. Freeman's is much used in America.

Condensed Milk.—Condensed milk has long been a favourite substitute for mother's milk among the lower classes, and its use is by no means confined to the lower orders, though it has had but few defenders among medical men. The fact that some brands contain a large proportion of added cane sugar has condemned it in the eyes of most medical writers, and many serious allegations have been made against it. It has been accused of producing eczema, diarrhœa, constipation, rickets, scurvy, and it has been alleged that while children who have been brought up on it are fat and plump they readily succumb when attacked with acute disease. On the

other hand, it is sterile when taken from a freshly opened tin, and does not readily undergo fermentative changes in the stomach. It will often be retained when so-called fresh milk is vomited or gives rise to flatulence and colic. We believe it may be substituted for fresh milk with advantage as a temporary resort, care being taken to select a reliable brand which contains a full percentage of fat. The best varieties are those which have been preserved without the addition of cane sugar, and to which cream has been added. We should not advise condensed or any form of preserved milk for months together on account of the risk of scurvy. Care should be taken when a tin is opened to make sure that the milk is in good condition, as occasionally a tin containing partially decomposed milk may be met with.

In using condensed milk accurate directions must be given as to the strength to be employed and also as to the manner of measuring it. A graduated measure should be employed and the milk poured into it. For an infant of three months old it may be diluted 1 in 8 by weight, or what is nearly equivalent to this, 1 in 10 by measure. It should rarely be used stronger than this, but it may be necessary to dilute to 1 in 15 or 20 for very young infants, and in special cases.

Diluted to 1 in 8 by weight, we shall have the following composition (Leeds) :

	Sweetened condensed milk	Diluted 1 in 8 by weight
Fat	12·10	1·51
Lactose	16·62	2·06
Cane sugar	22·26	2·78
Proteids	16·07	2·01
Ash	2·61	·32
Total solids	69·66	8·68

It is important to use a good brand of condensed milk, inasmuch as the cheaper forms are deficient in fat. The 'Milkmaid' brand contains nearly 12 per cent. of fat, while some other brands have less than 2 per cent.

Some good brands of condensed milk may be obtained without added sugar. The following is an analysis of the 'Viking' brand ; it will be seen that it corresponds with a good milk which has been concentrated by driving off two-thirds of the water. A measured ounce of this milk weighs 480 grs., that is one-tenth more than an ounce of water. It can be diluted for use 1 in 4 or 6 by measure.

	Unsweetened condensed milk	Diluted 1 in 6 by weight
Fat	9·9	1·65
Lactose	13·3	2·2
Proteids	8·9	1·5
Ash	1·9	·16
Solids	34·0	5·51

It will be seen by examining the second columns that each of these foods is deficient in fat, while the latter is deficient in carbo-hydrates, but this can

be remedied by adding sugar. It is well to bear in mind that in all concentrated or desiccated milks the calcic phosphates are thrown down in a more or less insoluble form, and in preparing the food in the ordinary way are only in part redissolved.

Dried Milk Foods.—The difficulties attendant on the preparation and storage of sterilised milk for sale have brought into the market various preparations of desiccated milk. These will keep good in any climate, and occupy only a small bulk as compared with liquid preparations. A form of dried milk known as 'galak' prepared by the Just-Hatmaker process is useful in some cases of indigestion in infants.

The chief value of these dried milk foods consists in their being useful substitutes for fresh milk, when the latter cannot be obtained, or when the infant suffers from frequent vomiting, colic, or diarrhœa. They do not readily ferment in the stomach, and consequently less gas is formed, as compared with some forms of fresh milk. At the same time it is certain that they cannot be perfect foods inasmuch as they are deficient in fat and also in lime salts. The added water does not redissolve the whole of the calcium salts in the food. If continued for many weeks or months, especially if the infant is over six months, both scurvy and rickets are very apt to ensue. Some of the worst cases of scurvy which we have seen have been in infants fed solely on desiccated milk foods.

Amount of Food to be given.—The amount of food to be given to an infant must necessarily depend not only on its age, but also on its digestive powers and its development. It is evident that it is quite as important to regulate carefully the times of taking food and the amount to be taken as it is to decide upon the nature of the food. It must of course be borne in mind that the amounts given below are for an infant of average weight and digestive powers. Neither age nor weight should be taken blindly as a guide to the amount of food an infant should take. For the first two or three weeks (weight 6 to 8 lb.), give 1 to 2 oz. of food every two hours and a half in the daytime ; 8 bottles being given, and 12 to 15 oz. of food being taken in the twenty-four hours.

During the second month (weight 8 to 11 lb.), 3 to 4 oz. of food every two hours and a half ; 8 bottles being given, and 20 to 30 oz. being taken in the twenty-four hours.

During the third and fourth months (weight 11 to 14 lb.), 4 to 5 oz. of food every three hours ; 7 bottles being given, and 30 to 35 oz. being taken in the twenty-four hours.

During the fifth and sixth months (weight 14 to 16 lb.), 6 to 7 oz. of food may be given every three hours ; 6 bottles being given, and 35 to 40 oz. being taken in the twenty-four hours.

Feeding Bottles.—The simplest feeding bottles are the best. It is wise to avoid all those provided with india-rubber tubes, corks, and those that have indented letters on their surfaces. The rubber tubes soon crack and become rough inside, corks absorb some of the food and quickly become foul, while any indentations on the inner surface of the bottle make it difficult to scour clean with a brush. The best class of bottles are those with rather wide mouths (see fig. 12), or such as are supplied with Soxhlet's or Escherich's milk sterilisers, and are perfectly plain and fitted with large teats that can be

turned inside out for the purpose of cleansing. The small teats supplied with the fancy bottles cannot be readily cleaned. The bottles after being used should be thoroughly cleaned with a brush kept for the purpose, and inverted so that they may drain and no dust may be allowed to get into them. The great point in cleansing bottles is to attend to them at once after being used. Wash them thoroughly in soda water and set them to drain. The teat must be thoroughly washed, and a tooth brush used after the teat has been turned inside out. Both bottle and teat may be *boiled*, but boiling is apt to cause the rubber to perish quickly.

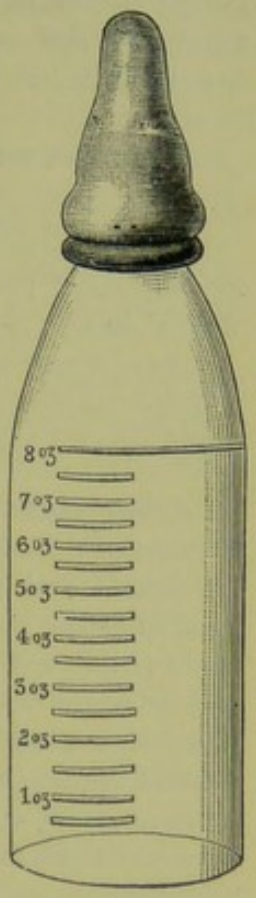

Fig. 12.

Diet from Six to Twelve Months.—While some mothers are strong enough, and are sufficiently good nurses, to suckle their children to the end of the first year, there are many others who begin to flag about the 6th or 7th month, and in such cases it is desirable to supplement the breast by means of some milk food. There is no lack of artificial or patent foods from which to choose. If the infant is entirely dependent upon artificial food, it should take from 1½ to 2 pints of good cow's milk every twenty-four hours, between 6 months and 1 year, diluted with one-fourth or one-third of barley water or sugar water. Some form of starchy food may be added with advantage, for now the digestive powers of the infant are sufficiently advanced to form dextrine and maltose out of starch, thus forming a valuable and easily assimilated carbo-hydrate. Care must be taken that all starchy matters are thoroughly boiled, so that the starch granules become gelatinised, as raw starch is less easily digested.

Barley jelly, whole-meal flour, maize, oatmeal, all answer very well if thoroughly cooked and made sufficiently thin to pass through the teats of ordinary feeding bottles.

If the digestion of starch is not proceeding well or if curd is being passed in the stools, malt extract or 'Bynin' may be added to the food after it has been boiled, and allowed to become just cool enough to taste; it is then set aside for a few minutes before giving it. Five meals in the twenty-four hours will, as a rule, be sufficient, some 6 to 8 oz. being taken at each meal. The *first* meal may be taken between 7 and 8 A.M.; the *second* between 10 and 11 A.M.; the *third*, 1 to 2 P.M.; the fourth, from 4 to 5 P.M.; and the *fifth*, the last thing at night. There is no harm in giving the infant a well-toasted crust to nibble, but thick foods should not be allowed, and beef tea and eggs are certainly unnecessary and best avoided.

During the 7th, 8th, and 9th months, 3½ oz. to 3 oz. will be an average gain, and by the end of the 9th month 20 lb. weight may be reached. During the last three months 2 oz. to 1½ oz. per week; and the weight is usually over 22 lb. by the end of the first year.

It must not, however, be forgotten that infants may put on fat which naturally adds to their weight without their being necessarily strong and

healthy. Care must be taken to weigh them at the same time of day, so that there may be no mistake.

At twelve months, if the child be strong and healthy, the bottle may be gradually left off, and food of a more solid character may be substituted, but milk is still to be the staple food.

Diet from Twelve Months to Eighteen Months of Age.

First meal, 7.30 A.M. Fine bread sops with milk, or oatmeal or hominy porridge made with milk.
Second meal, 11 A.M. A drink of milk.
Third meal, 1.30 P.M. Bread crumbs and gravy or a lightly boiled egg and bread and butter. Sago or rice pudding.
Fourth meal, 5.30 P.M. Bread and milk.
Fifth meal. Milk to drink.

After eighteen months of age, when healthy children have cut their first set of double teeth, small quantities of fish, fowl, or meat may be allowed. Of fish, boiled whiting, sole, or cod, carefully freed from all the bones, is readily taken by most children. Boiled fowl is better than butcher's meat in early childhood. Of the latter, underdone mutton chops, torn into shreds and mixed with bread crumbs or well-mashed potatoes, are the best and most digestible kind of butcher's meat. Rice, sago, and tapioca puddings, stewed apples, and preserves of various fruits, may be allowed. Children unfortunately are often strangely fastidious in their tastes, and will frequently take a dislike to many forms of the most digestible foods. It is always well to introduce as much variety as possible into their diet.

For **older children** hominy porridge with treacle for breakfast, to be followed by small quantities of bacon or egg, with cocoa or weak tea, are as a rule well digested and are beneficial, provided that the porridge or bread and milk forms the *pièce de résistance* of the repast. Soups made in various ways from meat and vegetables form an exceedingly wholesome and digestible meal. Pastry, as a rule, is bad ; boiled rice with raisins and stewed fruit of various kinds is much to be preferred.

When the child is old enough to sit up to table at dinner and take meat cut from a joint, the greatest care should be taken to see that the meat is carefully cut up into small pieces before it is put into the mouth, and is thoroughly masticated before swallowing. So important is this, that if there is any doubt as to the cutting up by the nurse, it will be well to insist that all the meat should first be put through a mincing machine ; the gravy can be afterwards added to it. Masses of half-masticated meat will not be digested if bolted in the usual way, and will be passed almost unchanged in the fæces ; and if the food is thus bolted, it is less satisfying, and leads to more being consumed than is required by the system. A stand must always be made against the common practice of giving children biscuits or gingerbread at almost all hours of the day. The stomach requires rest like every other organ in the body, and is certain to become deranged if sweet things are being taken at all times.

The Care of Immature and Weakly Infants.—Infants born before the full time of forty weeks require special care in nursing and feeding, and

this is true also of delicate infants born at full time. Infants born before the thirtieth week and weighing under 2½ lb. only exceptionally live more than a few hours. There are, however, instances on record of infants weighing under 2 lb. at birth being successfully reared. In one case under the care of Dr. A. Mumford which he brought under our notice the infant weighed 1 lb. 14 oz. at birth, it survived, and has since done well. Villeman and Charpentier and others have recorded somewhat similar cases. Those born at the thirtieth or thirty-first week and weighing 2¾ to 3 lb. have a better chance of being reared, though the mortality among such is very high. Those born at the thirty-sixth week and weighing 4 to 4½ lb., or at the thirty-eighth week weighing 4½ to 5½ lb., have a good chance of surviving, but require exceptional care.

For the most part premature infants have but little subcutaneous fat, and feeble powers of maintaining their temperature ; they quickly lose heat and readily succumb if exposed to cold. They are usually of a dull-red colour from the asphyxiated condition of blood, their skin hangs in loose folds, their movements are sluggish, and the cry is feeble in consequence of the partial expansion of their lungs. The muscles are limp and toneless, the respiratory and sucking movements wanting vigour as compared with an infant born at term. No washing operations must be attempted, but the infant as soon as it is separated from the placenta must be completely enveloped in warm dry absorbent cotton wool. Separate pieces may be made to envelop the limbs, and another piece in contact with the buttocks to absorb the urine and fæces. It is wrapped in blankets or woollen wraps, placed in a padded basket or box, and kept warm with hot-water bottles. The cotton-wool diaper can be removed when soiled, and the rest of the cotton-wool wrapper may be renewed daily if the condition of the infant admits of the necessary handling and exposure. The apartment must be kept at a temperature of 70° F. at least ; much higher than this will render it very uncomfortable for the mother and attendants. It is well to have a cylinder of oxygen in the apartment to use for the infant in case of necessity.

The feeding of premature infants is likely to be a matter of some difficulty ; the infant may be too feeble to suck, and very likely no milk may make its appearance in the mother's breasts. The breast milk in these cases is likely to be more rich in proteids than ordinary colostric milk, and consequently may disagree, giving rise to sickness and diarrhœa. It will probably be the best plan to draw off the mother's milk at intervals, dilute with warm water, and give it to the infant with a pipette with an india-rubber ball attached. Failing the mother's breast, sterilised whey may be given (p. 51), or, in case of a weakly infant, the whey must be diluted with an equal quantity of water. Two to four drachms may be given hourly. If there is much vomiting, or if the infant is not taking its food well, the food should be introduced direct into its stomach by means of a rubber catheter. (See GAVAGE, Appendix.)

Later, 10 per cent. cream—obtained by letting 30 oz. of fresh milk stand for four hours, and taking the upper 10 oz., may be diluted with sugar water and Pasteurised. The food should be well diluted at first, and the strength and amount increased if all goes well. Thus 3 oz. of 10-per-cent. cream may be taken and made up to 15 oz. with sugar water ; later, 4 oz. made up

to 2 oz., with sugar water. Then 4 or 5 oz. may be taken and made up to 20 oz., with sugar water, these amounts being given in twenty-four hours.

The introduction of **Incubators** or **Brooders** has undoubtedly been the means of saving the lives of premature infants, especially in maternity hospitals, where the infant can be placed at once after birth in the apparatus. An incubator usually consists of a small chamber, which can be kept at a temperature of 90° F. if need be, and is well ventilated. Various forms have been designed for the purpose; the one most used in this country is Hearson's,[1] the Couveuse Lion[2] being largely used on the Continent. It is needless to say that the management of a baby-incubator requires the attendance of intelligent and experienced nurses.

[1] 235 Regent Street, London, W.
[2] 26 Boulevard Poissonnière, Paris.

CHAPTER IV

DISEASES OF THE DIGESTIVE SYSTEM

Examination of the Mouth.—An inspection of the cavity of the mouth and fauces in infants and children is of great importance, and mistakes in diagnosis are exceedingly likely to be made if this is neglected. In newly-born infants the mucous membrane of the mouth is comparatively dry, and continues so for the first two or three months of life ; the secretion of saliva becomes gradually freer as the glands develop, and the infant begins to dribble, for it is some time before it learns to swallow its saliva and to keep its mouth shut. The lining of the infant's mouth is at first of a dull red colour, and flocculi of milk are often to be seen adhering to it, as the movements of the tongue and lips are imperfect, and there is but little secretion of fluid to cleanse the mucous membrane. All through infancy and early childhood the mucous membrane is exceedingly apt to become the seat of various lesions. The membrane is necessarily delicate, the epithelium is easily injured, and affords a favourable ground for the cultivation of cryptogamic growths and various micro-organisms ; hence the frequency with which we find parasitic stomatitis and various superficial ulcerations and aphthous patches.

Inspection of the mouth of the newly born may reveal various abnormalities, some of minor importance, such as the small millet-seed nodules situated in the middle of the roof of the mouth, a shortened frænum linguæ, or the presence of small clear swellings (ranula) beneath the tongue. Among the important abnormalities may be mentioned cleft palate, and an abnormally high arched roof.

All through early life there is a tendency to hypertrophy of the lymphatic tissues in the naso-pharynx and fauces. It must be borne in mind that the passage through the naso-pharynx in infants is exceedingly narrow, and the presence of adenoid overgrowths or enlarged pharyngeal tonsil (which may perhaps be congenital) seriously interferes with the infant's respiration, and in some instances seems to excite 'choking fits,' or spasm of the glottis.

Dentition.—The influence of dentition upon the health of the infant depends very much upon the child's constitution. A strong and vigorous infant which has been brought up at the breast will cut its teeth one after another without trouble, and but for the appearance of the teeth through the gums the friends will not be aware that dentition is in progress. On the other hand, if the infant is rickety, weakly, or the inheritor of neurasthenic tendencies, the period of dentition may be a period of danger, as the irritation caused by the pressure of the tooth is liable to give rise to various forms of

discomfort and trouble. The first dentition begins during the middle of the first year, and ends with the appearance of the posterior molars in the middle of the third year. Sometimes, without any known cause, the first teeth make their appearance before this; indeed, it is not infrequent for infants to be born with a tooth already cut: such teeth, however, are imperfectly developed, and consist merely of a thin shell of enamel. Some by no means strong children cut their teeth early. In rickets dentition is delayed; in those cases in which rickets makes its appearance prior to the sixth month, dentition may not commence during the first year, the infant being toothless at a year old. In other cases the infant only becomes rickety towards the end of the first year, when the incisors are perhaps through the gum, and then there follows a long delay.

By the fifth or sixth month saliva is formed in large quantities, so that there is frequently dribbling from the mouth, and the infant is constantly putting its finger to its mouth, as if there were some sort of irritation going on there. A month or so later the gums may become tender, the mucous membrane congested, aphthæ appear on the tongue, inside the lips, or on the hard palate, and the infant is feverish and cross to a degree. Perhaps now the edge of a tooth, usually one of the lower middle incisors, will be felt through the gum. Some days or even weeks will perhaps elapse before the edge of the tooth is actually cut. It is a singular but by no means unusual circumstance for a tooth to advance so as almost to stretch the mucous membrane of the mouth, and then become stationary for some time.

Now while it is the almost daily experience of the practitioner that the process of cutting the first teeth gives rise to discomfort, he knows also that mothers and nurses are ever ready to attribute every childish illness to the teeth. Many infantile ailments are mysterious in their origin, especially attacks of feverishness, and in children under two years old there is always a tooth nearly cut, or has just been cut, or is about to be cut, to supply the explanation. It is this popular tendency to attribute every childish ailment to the teeth which explains the large sale of 'teething powders.' The danger is that important errors in diet, a patch of pneumonia, or meningitis may be overlooked if the teeth are allowed to explain everything. While it is unwise to shut our eyes to the disturbance and discomfort produced by a stretched and swollen gum, care is needed to avoid using the explanation of 'tooth cutting' to cover ignorance or merely to satisfy the clamour of an anxious mother for a definite opinion as regards her child's illness. It is a good rule always to seek for an explanation elsewhere than in the teeth, if there is no local lesion in the gum, such as swelling, tenderness, or some evidence of inflammation.

Feverishness.—When the gum is swollen and tender prior to the cutting of a tooth, the infant is apt to be irritable, having fits of crying without any apparent cause, which nothing will pacify; at first gently rubbing the gum will give ease, but at a later stage this only aggravates the trouble from the acutely painful state of the gum. The fever is intermittent, the child being hot and feverish for the most part at night and unable to sleep, while towards morning it cools down and dozes for a few hours; the temperature may reach 102° or 103°, rarely more. Such attacks may often pass away without the tooth being cut, or may continue for some time after the edge of the

tooth has appeared, and before the rest of the tooth has made its way through.

Stomatitis.—The mucous membrane of the mouth, more especially that part of the gum where the tooth is about to appear, the tongue, hard palate, and inside of the cheeks, may be the seat of small superficial ulcers or small spots denuded of epithelium, their surface being of a grey or yellowish colour, and their edges surrounded by a zone of erythematous redness. These spots are evidently sore, and may be the cause of the infant refusing the breast, and crying whenever liquids containing salines, such as beef tea, are taken.

Enlarged Glands.—Occasionally it happens in children predisposed to glandular enlargement that the irritation caused by these aphthous patches gives rise to a swelling of the glands, either the submaxillary when the lower jaw is affected, or the parotid or upper cervical lymphatic glands, which receive the lymph from the upper jaw. These swellings may quickly subside, or end in acute or chronic suppuration. In the latter case successive teeth being cut keep up the source of irritation.

Eczema and Lichen.—It frequently happens that infants who suffer, or are liable to suffer, from eczema are much worse while a tooth is pressing through the gum. The eczema very frequently gets well in the intervals, the face and body being free, until a tooth comes near the surface, and there is a return of the eczema, the face and forehead flush up and papules appear which begin to ooze and crust. Lichen in the form of strophulus or urticaria is also common.

Convulsions.—It may be taken for granted that no healthy infants suffer from convulsions; those who do are either rickety or the children of neurotic parents, and inherit a tendency to nerve disturbance. Spasmodic affections of various groups of muscles occasionally take place.

Treatment.—Much controversy has arisen from time to time with regard to the use of the gum lancet, and the propriety of employing it in assisting dentition; while many practitioners are in the frequent habit of using it. Others look upon lancing the gums as useless, if not mischievous. If the mucous membrane over the tooth is red, swollen, and tender, and the edge of the tooth can be felt, much pain and discomfort will be spared the infant by cutting down upon the tooth, presuming, of course, the infant is not a 'bleeder,' nor comes of a family in which there is a history of hæmophilia. The relief afforded is due in all probability to the local loss of blood, as well as to the relief of tension in the gum. That it has been done often unnecessarily, and that many troubles are attributed to dentition that have no connection with it, is no argument against the use of the lancet in proper cases. The evidence is too strong to be lightly explained away, that fits of crying, feverishness, or even convulsions may be quickly relieved by freely lancing a swollen and tender gum. It, perhaps, need not be said that it is useless to lance the gum unless there is evidence that the cutting edge of the tooth is near the surface, or disappointment will certainly follow. In one case coming under our notice, in which an upper incisor was lanced in a rickety child, the tooth was not cut till exactly a year after the operation. The feverishness and tenderness in the mouth and sleeplessness may be generally relieved by mercurial purges, bromides, or simple salines. (F. 1 and 2).

As much as five grains of bromide may be given if the infant is very restless, or two or three grains of chloral hydrate, or a mixture containing two and a half grains of each in a teaspoonful of syrup. Painting a tender and swollen gum with a saturated solution of bromide of sodium in glycerine and water will often relieve pain. If the gums remain spongy, or there is aphthous stomatitis, borax with tinct. myrrh may be used (F. 3).

The temporary teeth differ in size and hardness in different children; in weakly rickety children they are not only late in appearing, but when they do appear are dwarfed and consist of mere shells, quickly becoming black and carious, or loose and falling out of their sockets. In other children the enamel appears deficient, and caries occurs early. Great care should always be exercised in the preservation of the first set of teeth. A soft tooth brush should be used every night, and the mouth thoroughly cleansed with warm water, in order to dislodge the fragments of food which have collected between the teeth. If the teeth show signs of caries, it is a good plan to use the tooth brush after every meal, adding a few drops of an alkaline mixture to the water (sp. ammon. aromat. ℥j, sp. vini rect. ℥iij). Whenever it is possible, carious temporary molars should be properly filled.

The **second dentition** is not accompanied by the same troubles as the first, or at any rate to the same degree. The first molars and incisors usually make their appearance unobserved, and rarely occasion any inconvenience. The second molars may give more trouble. It sometimes happens that the gums get into an unhealthy state, being spongy and bleed readily, while the teeth become loose and give pain during mastication. It is during this period that ulcerative stomatitis may be present. Gumboils may be another source of trouble. If it is of importance to attend to the cleansing of the mouth during early childhood, it is of still greater importance to do so when the permanent teeth are appearing, and no effort should be spared to prevent their premature decay.

The structure of the permanent teeth is no doubt influenced by the state of the health during infancy. We have already referred to the fact (p. 14), that illness taking place during the first year of life may affect the permanent set of incisors and canines, while the bicuspids and first molars probably and last two molars certainly escape. Mr. Hutchinson long ago pointed out that congenital syphilis often gives rise to a peculiar formation of the incisors of the permanent set. The 'test teeth' for syphilis are the upper central incisors; the effect of this disease occurring during infancy is to arrest their development, causing dwarfing and also a central notch at the cutting edge, or perhaps a 'screw-driver' form of tooth; the other incisors may share in this want of development, but only in a secondary degree. Mr. Hutchinson has also pointed out that stomatitis occurring during infancy gives rise to a pitting or erosion of the enamel. The 'test tooth' for infantile stomatitis being the first molar, the incisors also may be affected, and they may be grooved by a 'transverse furrow crossing all the teeth at the same level.' In some cases the pitting of the upper surface of the molar produces well-marked rugosities (*érosion en mamelon*). Other deficiencies of the enamel of more or less extent have been described by French authors. Mr. Hutchinson believes that the stomatitis giving rise to this condition is often mercurial in its origin, mercury having been given in

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the form of 'teething powders' or in other ways. Mr. Moon used to speak of a 'mercurio-syphilitic' tooth in which there was a want of enamel over a semilunar space near the cutting edge, and in consequence a breaking down of the enamel over this area. M. Magitot attributes erosion of the teeth to the effects of infantile convulsions, but it is probable the convulsions are coincident only.

It is by no means always easy to explain why some children have good teeth with perfect enamel, while in others the enamel is deficient and the teeth quickly become carious. There cannot be any doubt, however, that a strong and vigorous infancy and early childhood with a good digestion and careful feeding must favourably influence the development of the teeth; while infants who suffer from dyspepsia and are badly fed will suffer later on from bad teeth. No doubt apparent exceptions may occur.

Diseases of the Mouth

Catarrhal Stomatitis.—Catarrhal inflammation of the mouth may be primary, but it is more often secondary, accompanying dentition, dyspepsia, pneumonia, and other diseases. Stomatitis is especially apt to make its appearance during the first year of life, though it is common during the whole of childhood. Infants who are thus suffering, having begun to take the breast, suddenly let it go and cry, and are apt to stuff their fingers in their mouths; they are feverish and irritable, the saliva is increased in quantity, and the mouth feels hot if the finger be inserted; the salivary glands, especially the sublingual, are swollen and tender. On examination of the oral cavity, patches of intense redness are to be seen on the mucous membrane inside the cheek, on the gums, or hard palate, the tongue is generally bright red and clean, or the surface is covered with a thick creamy fur, the edges and tip being clean and red. Very frequently at the seat of these erythematous patches, an exudation of yellowish or greyish secretion takes place, or there is a breach of surface where the epithelium is abraded, and small shallow ulcers are formed. These yellowish patches or ulcers are surrounded by a zone of redness. Such patches are usually termed **Aphthæ**, and when present the term 'aphthous stomatitis' is often applied. Older children are subject to these attacks, and it is often seen to affect a whole household at the same time, the adults by no means always escaping. It is uncertain if it is contagious, but is certainly epidemic; it is sometimes associated with tonsillitis. There may be feverishness, the temperature rising to 103°, accompanied by the appearance of vesicles on the mucous membrane of the lips, tongue, and soft palate; the vesicles soon disappear, being followed by patches of yellow exudation, or a shallow ulcer may remain. The spots remain sore for several days. The term **Herpetic Stomatitis** is sometimes applied to this form. Similar attacks have been described as occurring both in infants and children from drinking the unboiled milk of cows suffering from 'foot and mouth' disease; and in any case where these affections occur in a widespread epidemic it is well to make careful inquiry into this as a possible cause. There are probably several distinct diseases resulting from specific micro-organisms included under the term 'aphthous stomatitis.' Fraenkel has found pus cocci, such as *Staph. pyog. citreus* and *albus*, as well as 'gas-forming bacilli' in stomatitis. During attacks of

tonsillitis, scarlet fever, measles, &c., aphthæ often make their appearance on the tongue and inside the lips, while the corners of the mouth become excoriated.

Sometimes patches of greyish-white or yellowish membrane form on the edges or sides of the tongue ; this form has been called **Membranous Stomatitis.** It has nothing to do with diphtheria, but streptococci and diplococci have been found in the fibrinous exudation.

In infants aphthous patches, two in number, situated on the hard palate, one on each side of the median raphé, near the junction of the hard and soft palate, are often seen ; these are round superficial ulcers $\frac{1}{4}$–$\frac{1}{3}$ in. in diameter, their base being of a yellowish colour and surrounded by erythema. They have been described as Bednar's aphthæ, or plaques ptérygoïdiennes by Parrot. They are produced by the pressure of the back of the tongue against the hard palate in sucking. They have nothing to do with syphilis.

The treatment must depend upon the cause, whether the stomatitis depends upon dentition, gastro-intestinal catarrh, or other pathological condition. In most cases a mild purge will be useful to expel any indigestible food present in the alimentary canal, to be followed by some small doses of rhubarb and soda. It is doubtful if chlorate of potash is of any use in this form.

Locally the spots may be touched with a solution of permanganate of potash (5 grs. to the oz.) or boric acid (15 grs. to the oz.). If the spots are slow in healing, they may be touched with lapis divinis. This latter consists of equal parts of sulphate of copper, alum, and saltpetre fused together. The diet should consist of milk and barley water made more dilute than usual, and for older children milk and sops. Beef tea and saline fluids are generally objected to on account of causing smarting in the mouth. (F. 5, F. 6).

Parasitic Stomatitis. Thrush.—This form of stomatitis differs essentially from the forms already described, as it is due to the presence and growth in the epithelium of the mouth of a species of cryptogam. It is especially common in newly-born infants and in those of a few months old, who are suffering from some form of wasting disease, and in whom the mucous membrane of the mouth is in an unhealthy condition. But it is also found in infants during the last half of the first year, less commonly during the second and later years. It appears as small white distinctly raised points or scattered patches on the soft palate, mucous membrane of the cheek, lips, and tongue. While its chief seat is the mouth, it has been found in the larynx, œsophagus, stomach, cæcum, and in one or two instances in the lungs. If touched with a small paint brush, the patch is found to adhere firmly to the mucous membrane and cannot be detached as can milk flocculi, for which it may readily be mistaken ; if forcibly detached there is left a red surface denuded of epithelium. The mucous membrane of the mouth is often red and unhealthy around the patches, in other cases it is quite normal. In mild cases these white patches are small and few in number ; in severe cases they become confluent and large, and the surface of the tongue and cheeks is covered with them. Infants so affected are mostly weak and ill, and often suffer from diarrhœa or gastric catarrh with wasting. It occurs in older children in the last days of tuberculosis, tuberculous meningitis, typhoid, and pneumonia.

If a piece of the white patch be detached and examined microscopically, it will be found to consist of epithelial cells, bacteria, yeast fungi, and the thread-like filaments of various mould fungi. The identity of the fungus which gives rise to the disease is a matter of uncertainty, the difficulty of identifying it being largely due to the presence of various organisms in the white patches. It has been wrongly identified as the *Oïdium lactis*, the mould fungus which is present in sour milk ; the cultivations of Grawitz led him to believe it to be identical with the yeast fungus or wine ferment (*Saccharomyces mycoderma*). Rees, who further investigated it, believes it to be a yeast fungus, though not identical with the above ; he gave it the name of *Saccharomyces albicans*. The micro-organism of thrush is most probably, as Fraenkel states, a link between the yeast fungi (*Saccharomycetes*) and the mould or thread fungi (*Hypomycetes*). It can be cultivated in syrup, gelatine, or potatoes and bread paste ; under certain conditions of nutrition it appears to resemble the yeast fungi, as on the surface of the gelatine ; while at the bottom of the test-tube cultures it appears more like the thread-like forms of the mould fungi. It is aërobic, and does not liquefy gelatine.

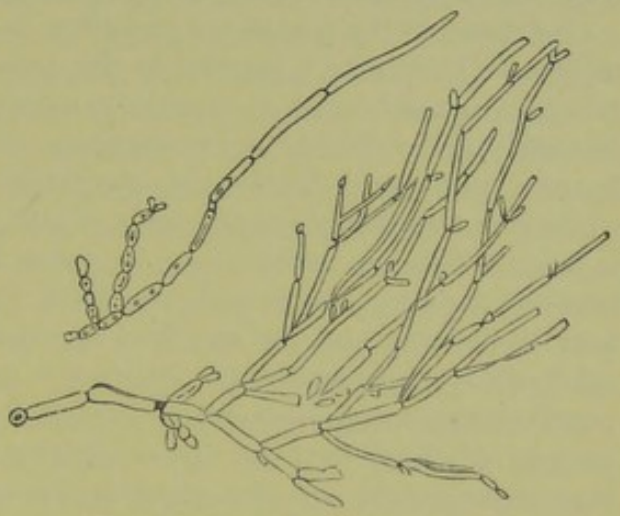

Fig. 13.—Fungus of thrush (×300). (*After Crookshank.*)

The fungus usually appears in the form of filaments made up of cells joined together 3-4 μ broad and 50-60 μ long ; these branch in various directions ; oval cells bud out from the joint between the elongated cells ; spores are present in these roundish cells. (See fig. 13.)

Treatment.—It is of much importance that great care should be taken to cleanse the mouth after the infant has taken the bottle, especially in a weakly infant of low vitality, weak alkaline solutions, just tinged with Condy's fluid, being useful for this purpose. This can be done with a large paint brush or soft wet rag, and on the first symptoms of thrush the borax lotion (F. 3) or similar solution should be used. As a stronger application to the parasitic patches a solution of sulphate of copper (2 grs. to the oz.) or carbolic acid (2 grs. to the oz.) is very effectual when applied with a paint brush. The success of the treatment depends not only on the destruction of the fungus but also on an improvement in the child's general health. (F. 5, F. 6.)

Hæmorrhagic Stomatitis occurs in infantile scurvy.

Ulcerative Stomatitis.—This form only occurs in children who have cut teeth, and is most common after the molars have been cut. It occurs in children both with healthy and also with carious teeth. The children who suffer from it in the severe form are unhealthy, and are either recovering from some infectious disease, or have been badly fed, or have been exposed to unhealthy surroundings ; it is also common in tuberculous children. The early symptoms are feverishness, salivation, and smarting when food or drink is taken. When the attack is developed, an examination of the mouth will show that

the gums are much swollen and tender, and a purulent secretion is present along their free edges. The breath is foul, and some bleeding takes place from the swollen gums. The ulceration may extend to the mucous membrane of the cheek, especially that part contiguous to the lower molars. Here a deep ulcer with a yellow base may often be seen, and the fissure between the cheek and gums may also be involved. The side of the tongue is affected in some cases. Bernheim has recently described two micro-organisms, a bacillus and spirochæte, which he believes to be specific. Ulcerative stomatitis appears at times to be epidemic and contagious.

Necrosis of the jaw is apt to follow in some of the more severe cases of ulcerative stomatitis; instead of the process ceasing, as it usually does, the mischief spreads and a chronic osteomyelitis of the jaw is set up, much intensely fœtid discharge comes away, the child's health suffers, the cheeks become puffy and flabby, the ulceration of the gums spreads, and after a while it is found that a large piece of jaw, carrying perhaps two or three teeth, is loose; if this is taken away, in some instances the process stops; often, however, any new bone that may have formed becomes infiltrated with the foul discharges, and the mischief spreads along the jaw, piece after piece is taken away, until at last the entire jaw may have to be removed. We have removed the whole bone from condyle to condyle for this condition. Many surgeons believe that the disease begins as a periostitis and not as an ulceration of the gums, and that alveolar abscess is the starting-point; this may be so sometimes, though certainly not always.[1]

The child's health materially suffers from the discharge and foul state of the mouth. In one instance, after removal of the jaw, the child was sent home convalescent, but died suddenly, apparently from falling back of the tongue. Restoration of the jaw is very imperfect in these cases, for the new bone necroses as fast as it forms. The process closely resembles phosphorus necrosis, but is not due to that poison.

Treatment.—After every meal the mouth should be well rinsed with warm water or Condy's fluid, and the gums and teeth cleaned with a bit of absorbent wool or soft rag, not sponge, so that the same bit may never be used again; the gums should then be mopped over with the glycerine of borax 2 parts to tincture of myrrh 1 part. Of internal remedies, by far the most efficient is chlorate of potash, given in three to five grain doses three times a day or more. In the large majority of cases this if given early will quickly cure the disease—twenty or twenty-five grains in the twenty-four hours is a safe amount to give, but should not be continued for more than a week. It may be followed by an iron tonic. The diet should consist of fluids and sops, beef tea and other nourishing liquids being given freely, especially in those cases where the disease occurs in the poorly nourished and underfed. This treatment will usually suffice to arrest the disease; but once the bone becomes seriously involved, in some cases nothing seems to have any effect. Strong nitric acid, carbolic acid, &c., seem to have little power, and the purulent infiltration only ceases when the whole bone has been destroyed. These plans should, however, be carefully tried, chloroform being of course given, and subsequently there should be very frequent cleansing of the mouth with equal

[1] Dr. Angel Money has reported a case coming on after typhoid and affecting the upper jaw. The lower jaw is the one most commonly attacked.

parts of rectified spirit and water. As soon as the disease has ceased to spread, any loss of bone or teeth should be supplied by a plate with artificial teeth, to prevent falling in of the lips and the prematurely senile appearance thus produced. Even where the alveolus alone is destroyed, since no new formation of bone occurs the permanent teeth are often loosened and fall out. (F. 4, F. 3, F. 5.)

Alveolar Abscess is, as might be expected, a very common result of the neglect or mismanagement of carious teeth. After an attack of toothache the pain may completely subside, and swelling of the face over either the upper or lower jaw rapidly come on. This, of course, means that the inflammatory process—hitherto limited to the alveolus, and hence giving rise to great pain, because there is great tension on a large nerve—has extended to the soft parts covering the bone by escape of the pus from the alveolus. The pain is greatly lessened, or ceases altogether. The condition is thought of little importance, and no steps are taken to obtain advice, as there is no longer pain, and a swelled face is looked upon as the natural and proper ending of a toothache. No doubt most of these cases get perfectly well, at least for a time, for the abscess bursts either by the side of the tooth or more often through the alveolus and gum, and discharges itself into the mouth. Finally, the abscess closes up, and all remains quiet till some failure of health or some irritation rouses the carious tooth to another outbreak. In not a few cases, however, neglect to remove the source of irritation—i.e. the carious tooth—gives rise to one or other of the following troubles. Often a sinus remains inside the mouth leading through the alveolus to the fang of the dead tooth, and a constant discharge of a small quantity of foul pus takes place within the mouth. Such a condition cannot but be prejudicial to a child's health. The breath is foul, and the foul fluid is swallowed, poisoning alike the lungs and stomach, and often a child is kept ailing for months, for want of extraction of a carious tooth. In other cases, the abscess tracks to the surface and is allowed to burst there, giving rise often to a lifelong disfigurement, in the shape of a depressed scar over the upper or lower jaw. Or, again, a chain of enlarged lymphatic gland or a glandular abscess owes its origin to neglect of a carious tooth or alveolar abscess. Necrosis of the jaw often results from similar neglect. Occasionally, too, we see cases of *antral abscess* in children as a result of extension of mischief from a tooth, though it is perhaps less common in children than we might expect. There is a most unreasonable objection both on the part of parents and of some dentists to extraction of teeth, even if they are extensively carious, and even if they are only temporary teeth. It is difficult to believe that the retention of a dead or carious temporary tooth can do anything but harm to the jaw and the underlying permanent teeth. It is perhaps still more difficult to understand the principle on which objection is made to the removal of a tooth while there is an abscess present, yet it often happens that delay is urged till the abscess is well. In all cases a carious temporary tooth should be removed at the least sign of inflammation about it or if it causes foul breath. In all cases a tooth that has given rise to an alveolar abscess should be removed, and if its extraction does not empty the abscess a free opening should be made inside the mouth, and the abscess cavity and the whole mouth frequently washed out with some antiseptic lotion

till all is well again. On no account should an abscess be allowed to track towards the surface of the face, nor should any tooth be allowed to remain in the jaw with a sinus leading down to its fang. If antral abscess is met with, or necrosis of the jaw, they must be dealt with by the ordinary methods, bearing in mind the softness and thinness of children's bones. We had in 1895 under our care a child with extensive tuberculous disease of both antra, which probably arose from the irritation of carious teeth.

Gangrenous Stomatitis. Cancrum Oris.—Cancrum oris occurs almost invariably in squalid, half-starved children after some of the exanthemata; sometimes, however, it seems to have no such predisposing cause. The disease begins as an inflamed spot on the inner surface of the cheek or upon the gum, the mischief rapidly spreads, both in depth and area, and the whole thickness of the cheek and gum becomes involved. On the outer surface the cheek is swollen, shining, stiff, and pale, or sometimes dark red, its vessels are thrombosed, and soon a black spot appears in the centre of the pale waxy area; the cheek is perforated, the black spot becomes a definite slough which partially separates. Then the edges of the gap become black and the sloughing spreads, preceded by a zone in which the skin is pale and œdematous. In severe cases the whole side of the face is rapidly destroyed, the gums slough away, the jaw necroses, and the teeth drop out. There is intense fœtor of the discharge and breath, which poisons the child, frequently causing pneumonia and death before the process is complete. Sir S. Wilks considers that when the sloughing attacks the gum first, it may be only an aggravated form of the ulceration met with in a late condition of scarlet fever; this is seen usually in the lower jaw, while in true cancrum oris the upper jaw is attacked.[1]

Fig. 14.—Deformity resulting after recovery from cancrum oris; subsequently remedied by a plastic operation. Dr. Wilkinson's case.

In a fair number of instances the process is arrested and the sloughing ceases, the parts clean up and heal rapidly, leaving, of course, a more or less severe deformity. In fatal cases death is due to exhaustion or septic pneumonia. The amount of pain and distress suffered is variable, sometimes but little of either exists.

Treatment.—The treatment of cancrum oris consists in the free local application of the actual cautery, or, better, of pure nitric acid. The child should be put under chloroform and the parts carefully dried with lint; sticks dipped in strong nitric acid should then be rubbed well into the edges of the sloughing parts and over the surface of the gums, after cutting away any loose sloughs and removing sequestra. Care must, of course, be

[1] An excellent description and figure are given in Mr. Cooper Forster's book on the *Surgical Diseases of Children.*

taken not to allow the acid to run over the sound skin. Several applications of the acid should be made, the parts being dried after each. Afterwards, a little iodoform should be powdered on and the surface smeared well with carbolic oil. No less important than the local treatment is the free administration of stimulants and abundant nourishment. As much wine or brandy as the child will take (about 3–4 oz. of brandy in twenty-four hours for a child of five years), carbonate of ammonia and bark, eggs beaten up with milk, strong soup and meat extracts should be given. In these cases, as in phlegmonous erysipelas, patients seem to be able to take almost an unlimited amount and to thrive on it. Opium should be given, but with caution, as it is not always well borne. If the child recovers, the deformity is often remediable to a considerable extent by a plastic operation. Perhaps the most troublesome after-condition is closure of the mouth by adhesions ; an attempt to prevent this should be made during healing by the use of screw gags or mouth-openers, and later, by division of the scar tissue ; in some cases even section of the jaw and the establishment of a false joint may be required. It must be confessed, however, that the treatment of this cicatricial contraction is far from satisfactory, and often no permanent good result is obtained.

Some cases of cervical cellulitis (so-called angina Ludovici) closely resemble cancrum oris in their results. (See p. 262.)

Acute Tonsillitis.—It is hardly possible to exaggerate the importance of a thorough examination of the throat of a feverish child, especially when the cause of its illness is not obvious. A child, more particularly a young one, does not, like an adult, volunteer the information that its throat is sore and painful during the act of swallowing, and will even deny that it is sore when it is actually suffering from severe tonsillitis. Without a careful examination it is quite possible to overlook not only tonsillitis but scarlet fever or diphtheria, especially if there is some chest complication present to throw the observer off his guard ; or he may come to the conclusion that a case of submaxillary 'mumps,' or croupous pneumonia with physical signs delayed, is a case of scarlet fever. Any one who has had any experience of a fever hospital will be able to call to mind many cases where errors have been made through neglecting to examine the tonsils or from want of knowledge of their appearance in health and disease.

Children are very liable to tonsillitis in its broadest sense, and this is in harmony with the fact that the lymphatic system during childhood is extremely active and especially prone to inflammation. The use which the tonsils fulfil is uncertain, but, whatever their exact function, it is certain that they belong to the lymphatic system, and they have been justly compared to Peyer's patches, inasmuch as they resemble them in structure, consisting of congeries of lymph follicles or so-called 'solitary glands.' They have a large blood supply, and their lymph sinuses freely communicate with the lymphatics of the mouth and pharynx, and also with the deep cervical glands situated behind the angle of the jaw. Their surfaces are covered with deep clefts or crypts which serve to increase the surface of the mucous membrane covering them ; these are apt to become filled with thick yellowish secretion, and are then seen as yellow points scattered over the surface. One of the functions of the tonsils is probably the formation of

leucocytes, or white blood corpuscles, which are shed into the salivary secretion, and the cheesy secretion formed during inflammation consists principally of these bodies. Tonsillitis occurs under the influence of many different conditions during childhood, and possibly the proneness of the tonsils to inflame is, in part at any rate, the result of their position at the entrance of the fauces, where the various forms of aërial poisons, bacilli or other germs, would, when inhaled, be especially likely to lodge. Many of the zymotic diseases are accompanied, or, what is a very significant fact, are preceded, by tonsillitis. Thus the tonsils are the seat of inflammation in scarlet fever and diphtheria. Typhoid fever and influenza sometimes commence with sore throat, measles and rötheln are mostly attended with some congestion or catarrhal inflammation about the fauces. The tonsils are apt to become inflamed as the result of cold, as from a wetting or exposure to a draught or

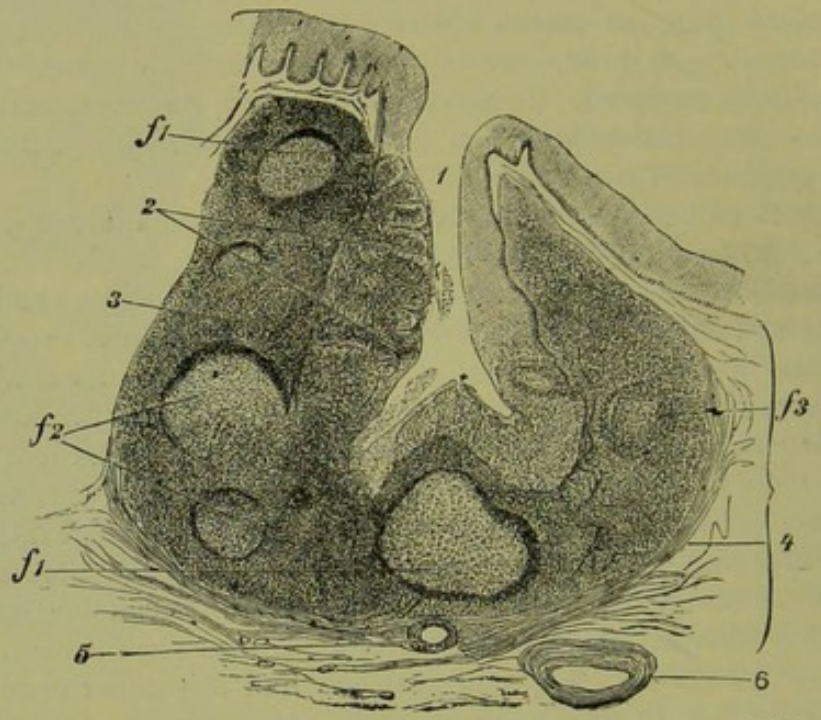

Fig. 15.—Vertical section of human tonsil (× 20), Landois and Stirling. 1, crypt; 2, epithelium infiltrated with leucocytes below and on the left, but free on the right; 3, adenoid tissue with sections *f*, *f*, *f*, of lymph follicles; 4, fibrous sheath; 5, section of mucous gland duct; 6, blood-vessel.

keen east wind, and possibly also from some gastric disturbance. Many believe that tonsillitis is at times due to inhaling sewer gas or unwholesome smells. It also appears sometimes to precede or accompany an attack of acute rheumatism, or peri-endocarditis.

The record of tonsillar complication is not complete without reference to the epidemics of sore throats which are apt to occur in schools, hospitals, and other public institutions, or wherever many children are brought together. Some of these epidemics have appeared to be modified scarlet fever, diphtheria, or influenza, as proved by their belonging to a scarlatinal or diphtheritic epidemic which was coexistent in the neighbourhood or preceded or followed the epidemic of sore throat. But in other cases it has been clearly shown that there is an epidemic or infectious form of sore throat which closely resembles both scarlet fever and diphtheria, but which, while

similar in many respects, is actually distinct, as shown by its not protecting from either of the above diseases.[1] In some of these attacks of tonsillitis, streptococci, pneumococci, colon-bacilli, and other organisms have been found, while the D-bacillus has been absent. Some cases of epidemic sore throat have apparently been traced to the consumption of the milk of cows suffering from 'foot and mouth' disease. Whenever sore throats occur in a household or school, the possibility that they are the result of the scarlatinal or diphtheritic poison should always be kept in view, while at the same time the milk supply and the sanitary condition of the establishment should be carefully investigated. In an epidemic of feverish sore throats occurring on one occasion at the Manchester Children's Hospital, one case was complicated with pneumonia and another had pericarditis. The epidemic was probably due to influenza.

To whatever cause the tonsillitis is due, whether sporadic or epidemic, the symptoms are mostly the same. The attack usually begins suddenly,

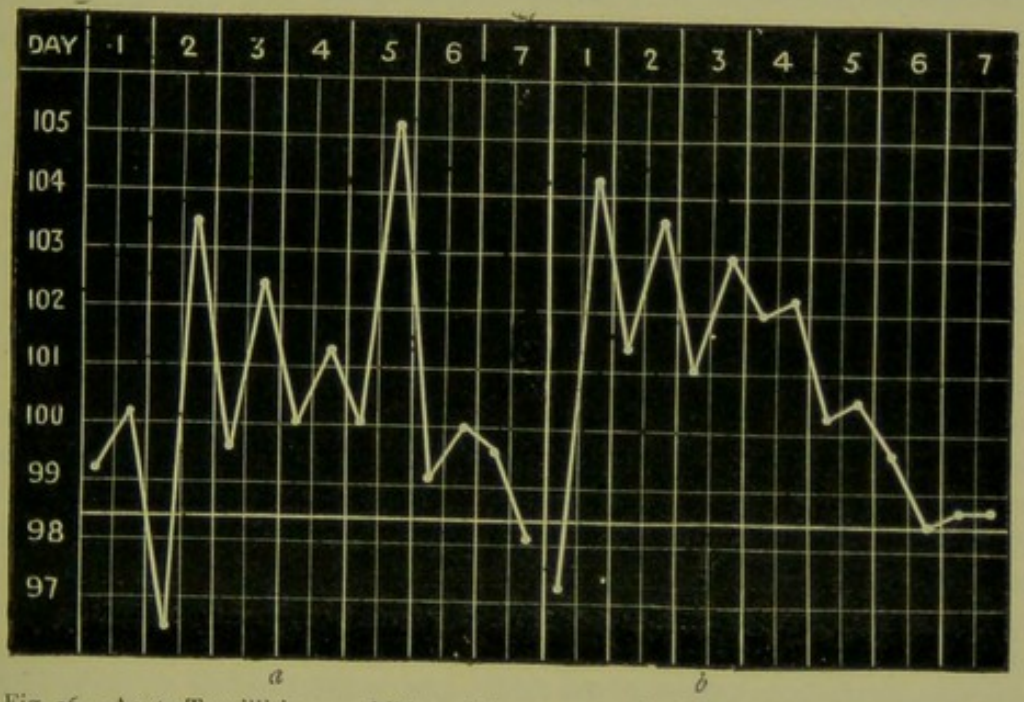

Fig. 16.—Acute Tonsillitis. *a*, child aged three years; *b*, child aged four years. These two cases belonged to an epidemic of sore throats; scarlet fever was not certainly excluded, but in no case was there a rash.

though it is often preceded for a few hours by a feeling of soreness in swallowing. Unlike scarlet fever, it is usually unattended by vomiting; the evening temperature runs up to 103° or more, the tonsils are swollen and red, there is much secretion of mucus, and in a few hours yellow points make their appearance upon the tonsils, the result of secretion retained in the crypts. (See fig. 15.) The tongue is furred, but does not become of a 'strawberry' appearance as in scarlet fever. In some cases, instead of the yellow points seen on the tonsils there is a yellowish exudation formed by the coalescence of the yellow spots on the inner surfaces of the tonsils; this does not adhere, as a rule, with any degre of firmness, and may be removed with a brush. The inflammatory lesion remains for the most part tonsillar, and shows but

[1] Vide *Tonsillitis in Adolescents*, C. Haig-Brown, M.D.

little tendency to spread and involve the nasal mucous membrane or the middle ear, and, while the glands at the angle of the jaw may become enlarged, they are not hard or surrounded by cellulitis. There is no true ulceration of the tonsils or sloughing of the palate. The temperature remains remittent for a few days, gradually returning to normal.

Such is the clinical history of an attack of acute catarrhal tonsillitis, but it must be remembered that many such attacks are exceedingly mild, and are accompanied by but little pyrexia, and may perhaps come and go without much complaint being made about them. Acute tonsillitis from any cause is apt to leave the tonsils enlarged, and the mucous membrane covering them in a condition of chronic catarrh. Repeated attacks in children liable to glandular swelling, accompanied as they are by catarrh of the naso-pharynx in many cases, give rise to various troubles which will be described later.

Diagnosis.—The most important question to consider, when called to see a case of tonsillitis, is whether scarlet fever and diphtheria may be excluded with certainty ; as, if they can, it is tolerably certain that the case is not one which will give rise to any anxiety either on account of the patient himself or his friends. Unfortunately, however, it is not often possible to express an opinion without misgivings ; that which appears to be a simple tonsillitis may be scarlatinal or diphtheritic in origin. It need hardly be said that the child suffering from tonsillitis should be stripped and a careful examination made of the surface of the body by a good light in order to detect a rash, and the faintest rash would necessarily arouse suspicion. In the absence of a rash a certain diagnosis is often impossible, but glandular enlargement, discharge from the nose, much redness of the fauces with yellow exudation on the tonsils, true ulceration of the tonsils or soft palate or otitis, if present, would make the diagnosis of scarlet fever a probable one. Should desquamation follow, if it is certain there has been no rash, it is of no diagnostic importance. If nephritis occur in the third week, it points to the scarlatinal nature of the attack as beyond doubt. A strawberry tongue is rarely present in the absence of a rash. The difficulty of diagnosis between mild diphtheria and tonsillitis accompanied by greyish exudation is hardly less than that between tonsillitis and scarlet fever in the absence of a rash. Albuminuria, nasal discharge, glandular enlargement and cellulitis, and the presence of Loeffler's bacillus in the exudation, all point to diphtheria ; if paralysis follow, the diagnosis of diphtheria is certain. In all doubtful cases swabs should be taken of the secretion and submitted for bacterial examination. (See DIPHTHERIA.)

Treatment.—Every attack of tonsillitis during childhood should be treated not only with respect but with suspicion, and the case should at once be isolated as far as it is possible to do so. It should constantly be before the mind of the practitioner that the case may be one of abortive scarlet fever or diphtheria, and that the next case to which he is called in the same household may be a genuine attack of one of the above zymotic diseases. It is always wise, when called to such cases, to give a guarded diagnosis and prognosis until the case has been under observation for a few days. The patient is to be confined to his room or to his bed, according to the severity of the attack, and his diet should consist of milk, beef tea,

and sops. If there is much pain in swallowing, hot fomentations medicated with belladonna or opium may be applied externally and renewed at frequent intervals. The tonsils should be painted with a solution of boro-glyceride in water (1–12), of iodine gr. ij, glycerine ℥j, and water ℥j ; black currant jelly or lozenges are also useful. Salines, such as the citrates or chlorates of the alkalies, combined with aconite or salicylate of soda, if there is much fever, may be given during the febrile stage ; acids and cinchona during convalescence. (F. 7, F. 8, F. 9, F. 10.) If diphtheria is prevailing in the district it is wise to inject antitoxin at once instead of delaying it till the results of a bacterial examination are to hand.

Chronic Tonsillitis.—So-called chronic tonsillitis, or tonsillar hypertrophy, is a very important child's disease, though by no means limited to childhood. The affection consists in an actual overgrowth of tonsillar adenoid tissue, so that the tonsils become greatly enlarged and project as rounded or irregular masses in various directions. Most commonly they grow inwards towards the middle line, and may reach such a size as to meet and be flattened by mutual pressure ; they may then almost completely block the orifice of the pharynx. In other instances they enlarge vertically and become large oval masses projecting far down into the pharynx and upwards and backwards towards the posterior nares. In other cases again they protrude outwards, separating the layers of the soft palate and forming a bulging mass on the roof of the mouth. Sometimes the surface is almost smooth, marked only by the orifices of the tonsillar crypts, and sometimes it is quite rugged and irregular.

The causes of chronic enlargement of the tonsils are probably the various irritations, mechanical and other, to which they are exposed, just as in the cases of masses of lymph gland tissue elsewhere.

The overgrowth is often accompanied by recurrent attacks of acute inflammation ; in other cases there is no pain or acute distress at any time. The secretion of the mucous glands may be retained, and thick pellets of inspissated matter be shut up in the crypts. Occasionally, on examining the region of the tonsil, instead of the usual appearance, a large yellow mass will be seen blocking up the whole of that side of the pharynx : it is soft and fluctuating and on incision gives exit to a large quantity of thick *débris* of mucus, pus, cholesterine, &c. This condition we have sometimes thought to be a congenital mucoid cyst. It is rather alarming at first sight, and looks like a large abscess on the point of bursting. The symptoms are those of tonsillar hypertrophy with more or less dysphagia.

The ordinary enlarged tonsil is usually pale, and in old cases hard and sometimes almost cretaceous. The enlargement may be found at any age from birth (being sometimes congenital) to puberty, or more rarely later ; it gives rise to a definite series of symptoms, all or most of which are usually present together. There is a vacuous, heavy look, from obstruction to breathing and consequent imperfect aëration of the blood, also imperfect development, and often stunting of growth ; the mouth is kept open, the breathing is stertorous and in sleep snoring. These children usually sleep heavily but restlessly, often starting in their sleep ; incontinence of urine is sometimes present, a result, no doubt, of the supply of imperfectly aërated blood to the nervous centres. There is usually chronic nasal and often

aural catarrh, from the extension of irritation from the tonsils to the neighbouring mucous surfaces. The speech is nasal and indistinct, the chest is often ill-developed, pigeon-breasted, or, as pointed out by Lambron, has the diaphragmatic constriction (M. Mackenzie). Recurrent acute tonsillitis is generally complained of, but there is seldom constant dysphagia ; there is an increase of the pharyngeal mucus due to catarrh, and the breath is often foul. The actual dwarfing and stunting from this condition is sometimes very marked.

It is in our experience true that enlargement of the tonsils is nearly always accompanied by the presence of the closely allied adenoid vegetation in the naso-pharynx, to be mentioned presently. Occasionally, however, either may exist without the other. The lingual tonsil appears to be much less often affected, or at any rate it very seldom gives rise to any symptoms. We think it is more common to find adenoid growths without enlargement of the tonsils than hypertrophic tonsils without adenoids.

Treatment.—Chronic tonsillar hypertrophy, when once well established, is little affected by mere local applications or constitutional treatment ; it is only during an attack of acute inflammation that good can be done by such means. In the early stages of the affection astringents, such as glycerine of tannin, and tonics sometimes succeed. The only efficient mode of treatment is by removal ; caustics and the actual cautery are inferior methods of obtaining the same result.

For that form of enlargement in which the tonsils project inwards, or inwards and downwards, nothing is so efficient, simple, or easy as removal with the guillotine.[1] Chloroform should be given as a rule. It is not only kinder, but it enables the operator fully to examine and deal with the adenoid masses as well as with the tonsils.

As much tonsil as can be readily removed should be taken away, but it is not necessary to remove the whole gland ; the part left behind usually soon shrinks. Both tonsils, if enlarged, should be removed at one sitting.

The guillotine cannot be satisfactorily used unless the tonsils project considerably towards the middle line ; in many cases, however, its use may be made easier by pressing the tonsil inwards with the finger applied to the neck just in front of and below the angle of the jaw.[2] Where the overgrowth is outwards and the guillotine cannot grasp the tonsil, the vulsellum and the blunt-pointed bistoury must be used, care being taken to keep the edge of the knife turned somewhat inwards. In some few cases even this is impracticable, and it is only in those rare instances that puncture with the Paquelin cautery should be employed ; the cautery may be thrust through the anterior pillar of the fauces, or directly into the gland between the pillars at one or two points ; shrinking is said usually to follow. Potassa fusa is sometimes used, but is dangerous and tedious ; scraping away the tonsil with a sharp spoon is the best plan if the gland is very friable and soft.

[1] Fahnestock's is the one that we prefer, though it is a somewhat delicate instrument and liable to get out of order; those usually sold are too large and clumsy for convenient use.

[2] The tonsil cannot be felt externally, but a lymphatic gland lies just on its outer side, and when enlarged is often mistaken for the tonsil (Treves).

Removal of enlarged tonsils while acutely inflamed is usually condemned. We have, however, done it with great relief to the patient ; it is, of course, very painful for a few minutes.

After removal some swelling often follows, and may last for a week or so, but then subsides. After free removal the enlargement rarely recurs. We have, however, seen two or three instances where a re-growth, larger even than the original one, has appeared after a lapse of some months. We should be inclined to look with suspicion upon such cases as possibly indicating a tendency to lymphomatous growth elsewhere.

We have unintentionally enucleated a tonsil with the guillotine on several occasions, the whole gland coming away entire instead of being cut through ; the result was, of course, satisfactory. It has recently been proposed to revive the old method of enucleation, but we think in the majority of cases it will not be found practicable.

After the operation iced milk only should be allowed for the first day, and milk and soft food for the next day or two ; after this the ordinary diet may be gradually resumed. Painting the tonsils with glycerine of tannin after the operation is perhaps useful. Sometimes a whitish deposit of lymph on the cut surface of the tonsil appears after the operation, and may cause unnecessary anxiety as to a diphtheritic infection of the wound.

We have never seen bleeding follow the operation to any serious extent ; when it does occur it usually arises from injury to the pillars of the fauces, which are sometimes stretched over the tonsil so tightly as to be indistinct. A little ice to suck is all that is needed in most cases ; should there be any severe bleeding, pressure or the application of the cautery might be required. Injury to the carotid is, of course, out of the question.

The argument against the excision of tonsils, that the overgrowth subsides as the child grows up, is altogether invalid in any severe case, for the mischief to the general development, and often to the hearing power, is done before the tonsils subside. There is no foundation for the idea that any wasting of the testes occurs from the removal of the tonsils ; it is much more likely that a lack of development should be due to the tonsillar enlargement than the reverse. The operation is an altogether harmless and beneficial one.

Tonsillar Calculus is a very rare condition due to collection of secretion of inflammatory material and subsequent calcareous degeneration ; the tonsil is enlarged, hard, and often painful, the calculus can be felt with a probe, and should be turned out of its cavity.

For the connection of tonsillitis with adenitis, the reader is referred to the chapter on Diseases of the Lymphatic Glands.

Enlarged Uvula.—The uvula is sometimes acutely inflamed as part of a pharyngitis or is chronically enlarged ; in the latter case it may require to be snipped off. We have also met with cases of papilloma of the uvula.

Nasal Adenoid Growths.—It often happens that a child is brought with all the symptoms of tonsillar hypertrophy—chronic nasal catarrh, pinched nose, nasal obstruction, snoring, nasal voice, deafness, stupidity, &c (*vide* CHRONIC TONSILLITIS), and yet the tonsils are little if at all enlarged, or if they are the removal does not cure the affection. In such cases there is probably overgrowth of the post-nasal adenoid tissue, the '*pharyngeal*

tonsil,' or '*Luschka's tonsil*,' so called. This condition, which was first described by Meyer, is very common in childhood and is often overlooked; it is, however, readily found out and treated if its symptoms are remembered. Since the 'pharyngeal tonsil' is a lymphatic structure, it is likely to become enlarged as a result of irritation in its neighbourhood. Chronic nasal catarrh with retained secretion or chronic pharyngitis with perhaps retention of mucus in the median naso-pharyngeal recess may cause or keep up such enlargement. When a child suffers from chronic nasal obstruction due either to the catarrh or the enlarged adenoid growths, the difficulties already mentioned as arising from overgrowth of the tonsil will occur. Further, the growth of the nasal cavities and of the palate and alveolar arch is often impeded, and a narrow high arch and compressed jaw may be the result. (G. A. W.)

The impediment to respiration, especially if tonsillar enlargement coexists, is considerable, and apparently croupy attacks and asthma may be due to or at least associated with the presence of adenoid vegetation. The question of the association of the adenoid growths and tonsillar enlargement with tuberculosis has been much discussed, and it may at least be said that the lymphatic tissue is markedly liable to suffer from irritation in the subjects of both conditions, and that respiratory obstruction is likely to affect injuriously, in a high degree, those who are tuberculous. Chronic tuberculosis of the cervical lymphatic glands is undoubtedly a result of the enlargement of the faucial and pharyngeal tonsils.

A finger passed back into the pharynx and turned up behind the soft palate to the posterior nares will feel the warty, sessile, or pedunculated masses about the upper surface of the pharynx and round the posterior nares, often almost completely blocking the apertures. An excellent opportunity of seeing these growths is afforded by cases of cleft palate, in which they are nearly always well marked.

These excrescences bleed readily, but are not tender to the touch. In such cases, the vegetation should be scraped away with a Gottstein's curette. Meyer's ring scraper and Löwenburg's forceps are sometimes useful, the latter especially if the growths are very tough. It is far better in these cases to give chloroform and do the operation thoroughly than waste time and trouble by incomplete scrapings with the finger-nail or applications of the cautery or other such means. If done thoroughly by the method recommended, it is very rarely necessary to repeat the operation, though occasionally growths so small as to escape removal subsequently enlarge and require treatment. It is best to operate with the child's head thrown well back over the end of the table so that no blood trickles into the air passages. This operation is one that should be strongly insisted upon; it removes the source of many troubles and much weak health. Though apparently a good deal of blood is lost at one of these operations, the amount is not so large as it seems, since a good deal of mucus and saliva is mixed with it. Occasionally, though very rarely, severe bleeding has followed the operation, and we were told, in a case operated on by ourselves, that bleeding came on in sufficient quantities to cause blanching of the child's face. Pressure with an astringent compress at once stopped the flow. It is always well to warn the friends after this operation that the child is

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likely to vomit blood which has been swallowed during or immediately after the scraping or excision, and it is only in the event of further bleeding that anxiety need arise.

The affection is an exceedingly common one, and may be met with at all ages. We have seen it in quite the first few months of life, and we believe it is sometimes congenital. No treatment except mechanical removal is to be recommended, though the application of caustics may in some cases be effectual. In early cases of adenoid growth and slight nasal obstruction, and in all cases after operation, exercises adapted to develop the nasal fossæ are desirable. The child should be taught to close the mouth and breathe deeply through the nose, practising systematically twice or three times daily for a specified and increasing number of inspirations. Improvement in chest capacity as well as in that of the nose will be gained by such exercises.

Pharyngitis Gangrænosa.—We have met with two cases of pharyngitis in which extensive ulceration occurred, and which did not appear to be due to diphtheria, scarlet fever, or other zymotic disease. One of these cases was a hitherto healthy boy aged nine years ; there was little fever, but much induration and cellulitis at the angle of the jaws. When seen by one of us, it was impossible even under chloroform to get a good view of the fauces ; there were one or two smart hæmorrhages from the mouth, presumably from ulceration. He was apparently recovering when a sudden hæmorrhage occurred, evidently from the throat, and proved fatal almost immediately ; no *post-mortem* was obtained. In the second case there were no hæmorrhages, but a deep ulceration of the tonsils and pharynx ; the disease much resembled in its onset and course gangrenous stomatitis, and proved fatal.

Post-pharyngeal Abscess.—Abscess in the prævertebral fascia is usually the result either of caries of the cervical spine (see SPINAL DISEASE) or of suppuration of the lymphatic gland in this region from irritation about the pharynx or posterior nares. The symptoms are dysphagia and dyspnœa, with pain and dribbling of saliva or mucus ; a peculiar nasal or palatal resonance in the cry is described by Politzer.[1] On examination a soft fluctuant swelling will be felt, and the posterior wall of the pharynx will be seen to project unduly, and possibly the yellowish colour of the pus may be seen through the mucous membrane. When the abscess is due to simple mucous irritation it should be opened through the mouth with a guarded knife, the child being turned on its face as soon as the incision is made, to allow the pus to flow out readily. We have seen post-pharyngeal inflammation, without any visible pointing, give rise to so much dyspnœa as to render tracheotomy necessary. Occasionally a large mucous cyst, such as that described as occurring in the tonsil, is found on the posterior wall of the pharynx ; free incision is all that is required for these conditions. In other instances suppuration tracks round the outer side of the pharynx from the tonsil or soft palate or from suppurating cervical glands or other neighbouring parts. Where there is external evidence of abscess, it is better to make the opening in the neck, behind the sterno-mastoid, so that the wound may be rendered aseptic, as in abscess from spinal disease. Other causes of post-pharyngeal abscess are injuries and pharyngitis ; it may also occur in the

[1] *Jahrbuch f. Kinderheilk.* B. xxi. H. 1, 2.

course of scarlet fever or be the result of a breaking-down gumma. Many cases are recorded by Bokai as idiopathic; it is not improbable that some of these were glandular. Wiel gives otitis as a cause. Convulsions, facial paralysis, great swelling of the neck, and spasm of the sterno-mastoid may sometimes occur (M. Mackenzie). The disease has been mistaken for many different affections, probably most often for croup. Examination of the throat by the eye and finger will always clear up a doubt in the later stages, though, as already pointed out, the diagnosis may be very obscure at first. Dr. Vere Pearson, 'Lancet,' October 26, 1901, in recording a number of these cases, points out that many of them are overlooked, and hence the mortality is high. He adds 'purulent nasal discharge' is a frequent symptom in addition to those mentioned.

We have met with these abscesses in quite young infants as well as in older children. All Pearson's cases except one were under two years old. In a case that we saw, a finger passed into the abscess cavity could find its way between the vertebra and the pharynx upwards nearly to the base of the skull, and downwards almost to the root of the neck. The abscess was probably the result of suppuration in a retro-pharyngeal lymphatic gland, and caused both dysphagia and dyspnœa.

Inflamed post-pharyngeal glands may cause symptoms some days before they suppurate. In this stage no fluctuant swelling can be found, and there will be no dyspnœa. In one case we saw in a schoolboy of twelve years convalescent from pneumonia, there was a temperature of 103° or thereabouts for nearly a week before a swelling appeared, there was deep-seated pain in the neck, pain on moving the head, and some pain in swallowing. When first seen the fauces were red but not swollen; later there was urgent dyspnœa, which was relieved by the pus being evacuated. The symptoms at first suggested otitis with suppuration in the middle ear.

Retro-œsophageal abscess sometimes occurs, and may give rise to dyspnœa necessitating tracheotomy, rarely to dysphagia; it may be due to spinal caries or extension of suppuration from other parts.[1] It is not so common in children as the retro-pharyngeal abscess. When it occurs there is swelling on both sides of the neck, dryness of the throat, tenderness and pain on movement, with fever and alteration of the voice. The abscess may burst into the œsophagus or burrow round the neck. We have met with three cases of abscess bursting into the œsophagus: in two caries of the spine, and in the other tuberculous gland disease was the cause of the abscess. According to Barthez and Rilliet, a form of dry coryza, with even coma or convulsions, may occur, and the onset may be sudden. After the abscess has burst, 'traction diverticula,' or stricture of the gullet, may result. Fomentations and feeding by enemata or an œsophageal tube should be the early treatment, with incision at the posterior border of the sterno-mastoid as soon as there is distinct evidence of suppuration.

Stricture of Œsophagus.—Apart from congenital malformations, œsophageal obstruction in children is due either to paralysis or to cicatricial strictures, resulting usually from swallowing hot or corrosive liquids, such as potash, hydrochloric acid, &c. In such cases there is immediate danger of suffocation from implication of the larynx, as well as more or less dysphagia

[1] Ripley, *Archiv. of Pædiatrics*, Feb. 1884.

from pain and swelling. These troubles, however, may be slight and transient, and yet after a time cicatricial strictures may appear, or the obstruction may be present from the first.

In cicatricial strictures there is a good deal of muscular spasm present, either constantly or from time to time, and this may be much increased by the passage of bougies. In some cases it is impossible to pass even a small instrument without an anæsthetic, and yet a fair-sized one may be admitted when the child is fully under chloroform. Sometimes at intervals the child is able to swallow fairly freely, while at other times the obstruction is almost complete. The profuse secretion of saliva and mucus is often very distressing. Such contractions are most commonly situated high up in the gullet, but they may be very extensive. The position of the stricture may be ascertained by auscultation during drinking, or by the passage of bougies,[1] after the history of the accident and the dysphagia have led to the discovery of the obstruction. A careful examination should be made of the œsophagus, to find out if possible the calibre, position, and number of the strictures, but bougies must be used with the utmost gentleness. We have had a case of perforation of the œsophagus and escape of fluid into the pleura in our own experience. In a case which we saw with Mr. T. H. Pinder he told us that at one time marked improvement in power of swallowing had followed entire deprivation of all food by mouth; the child was supported for some days entirely by enemata, and it is probable that absence of irritation caused relaxation of muscular spasm, though there was a possibility that the relief was due to a sloughing off of the edge of the constricting cicatrix at least in part, or it may have been merely that there was an interval in the progress of the contraction analogous to that occurring in cases of malignant disease. Mr. Pinder suggested that abstinence might also have diminished the size of the pouch which forms in these cases above the stricture, and so abolished the valve-like obstruction to some extent.

The best treatment of œsophageal stricture in such cases is usually that by gradual dilatation with bougies.[2] The drawback to it is that relapse is very apt to occur as soon as the daily passage of the instrument is omitted. Forcible dilatation by MacCormac's dilator and internal œsophagostomy have been employed; the former may be useful, the latter is too dangerous. Failing these œsophagostomy may be performed if the stricture is limited to the upper part of the gullet, or, if not, gastrostomy; the latter operation is the safer and the more generally applicable one. If an operation is to be done, it must not be put off too long. As soon as it is clear that dilatation is insufficient and the child is losing weight, no further time should be wasted. Done early, and done in two stages (Howse), some success may be expected from gastrostomy, and the rest given to the gullet by the operation may result in restoration of the canal subsequently (Davies Colley), or it may be possible to dilate or divide the stricture by instruments passed upwards from the stomach into the œsophagus. For details of the operation we must

[1] In new-born children the distance from the gums to the cardiac orifice is about seven inches (Sir Morell Mackenzie).

[2] Keller records thirty-five cases under two years of age with twenty-three cures, improvement in three cases, and five deaths, four remaining under treatment.

refer to the general text-books. In a case in which we performed gastrostomy there was much trouble from regurgitation of the food through the gastric fistula. The wound became unhealthy, and the child died of abscess between the liver and stomach.

Œsophageal stricture from congenital syphilis, and obstruction from pressure of abscesses outside the gullet or from traction by cicatricial tissue around (periœsophageal abscess), are occasionally met with, as in the following case, in which stricture of the œsophagus followed scarlet fever:

Hannah N., æt. three, had scarlet fever six months before admission. The attack was a severe one, with a bad throat and suppuration of cervical glands. She was admitted April 4, 1892, with stricture of the œsophagus, severe enough to have prevented swallowing solids for some time past. Takes milk and gruel. The obstruction was at the level of the cricoid, and even the smallest bougie could not be passed through it. The pharynx above the stricture was dilated, causing a protrusion on the left side of the neck. She was able to swallow milk and fine sop, and gained weight in hospital. She was taken out, and again admitted in the following October, when the symptoms, which had abated, became worse upon attempting to swallow some apple. There was then complete obstruction, but under chloroform a small catheter (No. 3, English) was passed through the stricture, which apparently extended for a considerable distance. When heard of two years afterwards, she could eat bread and butter and mashed potatoes very well, but could not swallow meat. She was well nourished.

Swallowing Foreign Bodies.—It is very common for children to be brought with a history of having swallowed a farthing or button, or something of the kind, and much alarm is caused to the child and its friends. In many cases the history is a mistaken one, in others the foreign body passes into the stomach, gives rise to no symptoms, and is voided in a day or two with the motions.

The only treatment required in such cases is to give the child plenty of bread, potatoes, suet pudding, &c., to provide a sufficient fæcal sheathing for the harmless passage of the body.

In some few instances, however, an angular mass such as a bone, or a sharp-pointed object such as a pin, may be swallowed, and may be arrested in the pharynx or œsophagus. In such cases there is usually some obvious sign of its presence, such as pain, dysphagia, retching, or vomiting; possibly some blood-stained mucus is brought up. Within the past few years or so we have had several cases under our care in which a halfpenny has been swallowed, and in each case it was clearly shown by a radiogram just behind the top of the sternum with the faces of the coin antero-posterior. In one instance the coin had been six weeks in the gullet, and in none of the cases were there any very severe symptoms. In each instance we removed the halfpenny by means of the 'coin-catcher,' while the child was under an anæsthetic: no trouble followed in any of them.

If there is no urgent dyspnœa, a careful examination of the fauces should first be made to see if the object is not lodged between the pillars; failing this, the finger should be passed to the back of the throat, and the root of the tongue and epiglottis be searched, care being taken not to mistake the cornua of the hyoid for a foreign body. If nothing is found, and the site of the body can be felt from the outside of the neck, and especially if the mass is hard, angular, and insoluble, an attempt should be made to remove it with the bristle probang or coin-catcher, or, failing these, possibly with

œsophageal forceps, though these are more dangerous. Failing these plans, the choice lies between an attempt to push the foreign body on into the stomach and the performance of œsophagotomy. The first plan should be followed in the majority of cases, and can be best managed by the gentle, steady use of a good-sized bougie. It is applicable to instances where the foreign body is soft, smooth, and rounded, and not likely to give rise to trouble in its passage through the intestines. It must be remembered that a feeling of soreness and irritation may remain about the fauces for some time after the passage and removal of a foreign body, and may give rise to the belief that there is still something there. In cases of swallowing fish-bones, and their becoming impacted, doses of hydrochloric acid or vinegar and water may be given, but the remedy is unpleasant and tedious. An anæsthetic may be used to lessen the discomfort of examination. Emetics, as a rule, are not good treatment. As in the cases mentioned, skiagrams are of the greatest value.

Œsophagitis.—Infantile œsophagitis, first described by Billard, is a rare disease, supposed to be caused by irritation from bad milk, improper feeding, or sore nipples. The symptoms are unwillingness to suck, crying and immediate regurgitation after beginning to suck, and often some tenderness about the neck on pressure. The inflammation may be local or general, and may give rise to ulcers or sloughing, and possibly to subsequent stricture. The prognosis is bad ; the disease may come on immediately after, or even exist at birth. It is not likely to be mistaken for anything except congenital malformation, in which the obstruction is absolute. Cleanliness, careful feeding, and the administration of glycerine of borax in small doses, constitute the treatment.[1]

Other rare conditions met with are congenital hypertrophy of the mucous glands and varix of the œsophagus.

[1] Sir Morell Mackenzie.

CHAPTER V

DISEASES OF THE DIGESTIVE SYSTEM (*continued*)

Examination of the Abdomen.—*Inspection.*—The abdomen in infancy is proportionately larger and more rounded in appearance than the abdomen of adults, and this is at once apparent on inspection as the infant lies stripped in its cot or on its mother's lap. An exaggeration of this condition is often seen in cases of chronic dyspepsia or intestinal catarrh; there is great distension of the intestines with 'bound wind,' the abdomen being much increased in girth and the skin stretched and shiny. If, as is often the case, there is more or less wasting of the fatty tissues, the large abdomen contrasts strangely with the wasted and shrivelled form of the infant, giving it a very characteristic appearance. The large liver of the infant is responsible to some extent for the disproportionate size of the abdomen. An inspection of the abdomen will reveal any enlarged veins on the surface, or the presence of large tumours or an excessive amount of fluid in the peritoneum. The umbilicus will be examined at the same time, and any hernia or local lesion here detected. Instead of a distended abdomen, the condition of flatness or retraction may be present, especially if there is acute cerebral disease. In many cases of pyloric stenosis in infants the peristaltic contraction of the stomach may be seen through the abdominal wall.

Palpation.—The muscular wall of the abdomen is comparatively thin, and less rigid in infants and young children than it is in adults, and consequently palpation yields more definite results, and is therefore of greater value as a means of diagnosis. Thus in young children the edge of the liver, an enlarged spleen or kidney, fæces in the colon, a distended bladder, a matted or thickened omentum, much enlarged mesenteric glands, may be felt by more or less deep pressure by the hand on the abdomen. It is needless to say that the conditions are not always favourable; distension of the intestines with gases so as to bulge and distend the abdominal walls will necessarily interfere with palpation of the abdomen; then, again, a fractious and crying child is necessarily difficult to examine in this way. But even under the most unfavourable circumstances the warm hand, laid on the abdomen and firmly pressed in, may detect a tumour, or some enlarged organ, or an invaginated piece of intestine, and information be gained which may be of great advantage in making a diagnosis. Even ascertaining the tenseness or laxity of the abdominal walls is of importance in forming a diagnosis between cerebral and gastric vomiting, as in cerebral disease there is mostly a relaxed state of the walls of the abdomen which enables the edge of the liver and perhaps other organs to be felt with abnormal distinctness; while,

on the other hand, in gastro-intestinal disorders there is usually more or less distension of the stomach and bowels, the distended organs interfering with a thorough exploration of the abdominal contents. It must be said, however, that in acute and continuous vomiting from any cause, the abdomen may be concave in shape from the contraction of the small intestines. Palpation may give valuable information with regard to pain and tenderness in the abdomen, provided the observer is alive to the fallacies which may arise through the fractiousness of his little patient.

We note here that palpation with the forefinger in the rectum may give valuable information in some conditions, as in invagination of the bowel, tumour, abscess, &c., in the abdomen.

By *percussion* the investigator is able to confirm the results obtained by palpation, and gain information not otherwise obtainable; thus he may map out by percussion the outline of a dilated stomach, or ascertain the limits of fluid in the peritoneum.

Anatomically the abdomen of the infant differs from the adult's in that the liver is proportionately larger in the newly-born infant, occupying at least half of the abdominal cavity. The inferior limit of the liver is consequently lower, and the left lobe covers the stomach to a greater extent in the infant than in the adult. The infant's stomach, so far as shape is concerned, does not differ in any important respect from the adult's; the cardiac curvature is perhaps less well marked, and it comes into closer relation with the liver and spleen. As a consequence of the thinness of their walls, the stomach and intestines are apt to become dilated during infancy from the pressure of gases given off from their contents, and to remain more or less constantly in a distended state. The large intestines—more especially the cæcum, ascending colon, and sigmoid flexure—are more movable, and consequently more easily dragged from their normal position, in infants than in adults. This is especially true of the sigmoid flexure, for sometimes at an autopsy the sigmoid flexure, if distended with gas or fæces, may be found much displaced towards the right side. This must be remembered in palpating the abdomen, for fæces which from their position may appear to be in the ileum or cæcum may in reality be in a displaced sigmoid flexure.

The Dyspeptic Diseases of Infancy and Childhood.—No infant, whether fed at the breast or with artificial foods, escapes having indigestion in one form or another; it is certain that sooner or later various dyspeptic ailments will supervene and form no insignificant part of the troubles of an infant's life. We have not far to go to seek an explanation of this. The alimentary canal of an infant is exceedingly intolerant of any form of irritation, while, with very slender resources to fall back upon, it has to perform a large amount of work in the digestion of food in order to make good the losses incident to life and supply suitable material for the rapid growth which is taking place. During the whole of infancy the digestive apparatus is worked to its uttermost capacity in digesting the food required for the infant's maintenance and growth, and any overtaxing of its powers is very likely to be followed by disturbed unction. The commonest causes of indigestion in infancy are practically the same as those in adults: the appetite perhaps is in excess of the digestive powers, and more food is taken than can be digested, or the food taken is of an improper quality; in both

cases the result is the same, the digestive juices are weakened, the food decomposes in the alimentary canal, toxic products are formed, and vomiting, colic, or diarrhœa occurs. In some cases the vomiting points to the stomach being most affected; in others the passage of loose stools containing undigested food, with much flatulence, indicates that the small intestines are involved, the large bowel when colic, tenesmus, and an excoriated condition of anus are present. In the mild cases there is a deficient secretion or impaired quality of the digestive juices, so that they are incompetent to digest the amount of food taken, decomposition products are formed, which give rise to discomfort, until expelled by vomiting or diarrhœa. In the severe or more prolonged forms there is a catarrhal condition of the mucous membrane which is more or less obstinate in its course. In discussing these dyspeptic conditions arising during infancy and childhood, it is convenient to consider the prominent symptoms separately, always bearing in mind, however, that they are only symptoms of morbid conditions and not diseases.

Flatulence and **Colic** may be present unaccompanied by either vomiting or diarrhœa, both breast-fed and bottle-fed babies alike suffering, though the latter do so more frequently. It is the result in many instances, perhaps most frequently, of the infant taking its food too quickly and in too large quantities; digestion is performed imperfectly, fermentation takes place in the small intestines, and gases are formed which distend the bowels. The abdomen is distended, the infant is restless and cannot sleep, it is constantly crying and tossing about, and if it brings up or passes large quantities of flatus, there is much relief. Ease for the most urgent symptoms may be found in giving the infant a teaspoonful or two of an equal quantity of lime water and cinnamon water, or small doses of carbonate of ammonia and soda in peppermint water, or a small piece of the compressed salts known as 'soda-mints,' dissolved in a little syrup. It will be necessary, temporarily at least, to lessen the amount of food which the infant is taking; this can be done in breast-fed children by giving them some sweetened barley water or whey before taking the breast, and not allowing the breast to be given for too long or too often. In artificially fed infants the amount of food, especially the amount of curd, must be reduced either by dilution with barley water, lime water, or by predigesting the curd. Large enemata of warm water (10–15 oz.) and hot fomentations to the abdomen will generally relieve the severer cases of colic due to flatulence, and a grain of mercury and chalk powder combined with half a grain of Dover's powder may be given by the mouth. Carbonate of magnesia with syrup of ginger is often useful. (F. 11, 14.)

Vomiting.—Vomiting is a very common complaint during infancy, and babies that vomit are among the most troublesome cases with which we have to deal. There is a hypersensitive condition of the mucous membrane of the stomach, excessive peristaltic movements take place, and the stomach contents are vomited with more or less force. In some of the minor cases vomiting is due to overfeeding, or the food is too rich in fat or proteid; in more serious cases there is mostly gastric catarrh, which is difficult to get rid of. The most frequent way in which food is rejected from the stomach is by what is termed by mothers 'posseting,' which consists of eructations of

small quantities of fluid from time to time without any effort, the food escaping from the corners of the infant's mouth in consequence of a too vigorous peristaltic action of the stomach. Fluid will also frequently regurgitate during the eructation of gases from the stomach. In true vomiting there is more or less retching, and the contents of the stomach come up with considerable force. Vomiting is especially common in infants who are taking cow's milk, and who are unable to digest the large quantities of hard curd contained in the milk, the stomach probably containing much decomposing curd and mucus. The stomach is perhaps dilated and toneless, does not completely empty itself, while its contents consist of decomposition products. Any milk food on entering the stomach quickly undergoes fermentation. Sometimes the vomiting is the result of over-distension, or the formation of excessive quantities of gases, or of coughing. The vomiting of breast-fed infants is often due to their being given the breast at too frequent intervals, or to some other cause, as the ingestion of unsuitable food on the part of the mother ; or she may be suffering some great anxiety, which is in itself quite sufficient to cause an alteration in the quality of the breast milk. Vomiting in infants a few days old may be the result of some congenital obstruction at the pylorus. It must also be borne in mind that vomiting in infants and children is frequently reflex, and not due to any lesion of the stomach, but the result of cerebral disease, as meningitis, or tumour, or of the irritation caused by cutting a tooth. Vomiting is sometimes the first, and for a time the only, symptom in tuberculous meningitis, and may precede for a week, or even longer, any marked cerebral symptoms. Reflex vomiting may at first be entirely undistinguishable from dyspeptic vomiting ; the condition of the tongue is no certain guide, and it is only as the cerebral symptoms become more marked, the abdominal walls either retracted or in a toneless, flabby condition, that a diagnosis can be made. In older children the vomiting of an acute gastric catarrh may last for a few days, but any long-continued or habitual vomiting is very suspicious of cerebral disease. The vomiting of a cerebral tumour is very erratic, comes and goes suddenly, there is usually headache and optic neuritis. Hysterical vomiting is occasionally seen in girls about puberty. Vomiting is usually an early symptom of scarlet fever and also of influenza.

The treatment of vomiting must necessarily depend upon its cause. Vomiting in the breast-fed infant, provided the mother's manner of life or diet is not at fault, is probably the result of too large quantities of milk being taken or it is too rich. It will generally be sufficient to insist upon regular hours of feeding at not too frequent intervals, and to give the infant a few teaspoonfuls of sweetened lime water before it has the breast, with a dose or two of hyd. c. creta to act on the bowels. If this is not successful, give the infant some whey or barley water for a few meals, while the mother's breasts are drawn by means of a pump. Do not be in too great a hurry to wean. Vomiting in the bottle-fed infant is more difficult to deal with especially when a gastric catarrh exists. The infant is under these circumstances very intolerant of cow's milk, even when largely diluted, the milk being quickly curdled in the stomach, and the hard lumps of curd are vomited in masses. In the milder cases it may probably be sufficient to resort to dilution of the milk, thus decreasing its richness, or to feed the

infant entirely on whey or barley water for twenty-four or forty-eight hours. Sterilised milk, condensed milk, or desiccated milk is nearly always retained more readily than fresh cow's milk by infants who vomit. Whatever food is resorted to, great care must be taken that too large quantities are not given at a time or taken too quickly. In severer cases, where no form of fresh milk is tolerated, milk peptonised by the addition of Benger's peptonising powders is frequently useful. If the vomiting is severe and continued, the bottle must be done away with and the infant fed by the spoon or pipette, or a wet nurse may be obtained. An alkali, such as carbonate of soda, may be given before meals ; or bismuth and nux vomica may be tried. Washing out the infant's stomach is often extremely useful, the infant ceasing to vomit after the acid mucus and decomposing curd have been removed. (F. 15, F. 16.)

Diarrhœa.—Looseness of the bowels is symptomatic of many different disorders and morbid conditions. An attack of diarrhœa frequently ushers in scarlet fever, or may be present in all stages of the malignant form ; it may accompany typhoid fever ; it is often present in septicæmia, empyema, uræmia, peritonitis. The commonest form in children is the result of an accumulation of undigested food in the intestines, or of some irritating matters taken in the food. Infants at the breast are liable to suffer from looseness of the bowels soon after birth on account of the colostrum not agreeing with them ; they are also liable to suffer from the taking of improper food on the part of the mother during lactation ; over-feeding or a fit of anger, or other strong emotion on the part of the mother, has been known to be followed by diarrhœa in the infant. Artificially fed infants are much more liable to suffer than infants at the breast. The difficulty with which the curd of cow's milk is digested overtaxes the digestive powers, the undigested curd irritates the bowels, and increased peristalsis is set up. An intestinal catarrh is soon established, the infant is restless, peevish, and cannot be got off to sleep, the abdomen is distended with gas, the legs are drawn up, and the infant passes perhaps five or six stools or more per diem. A severe chill may give rise to colic and diarrhœa.

An examination of the napkin shows, instead of the bright yellow homogeneous stools of the healthy infant, green and curdy motions, or one consisting of a yellowish or green slimy fluid. The infant is thirsty, takes the breast or the bottle vigorously at first, but is soon satisfied and pushes it away when offered. The tongue is coated and the mouth is often the seat of aphthous stomatitis. Vomiting may be present, but is mostly absent. In a day or two the infant begins to waste, the muscles of the limbs grow flabby, and the skin hangs about the thighs in loose folds, and the parts about the anus and genitals become red and frequently raw. Some infants are liable to such attacks especially during hot weather, and the result may be a more or less chronic condition of catarrh, to end in general malnutrition from gastro-intestinal atrophy. Rickets is a very frequent sequence of intestinal catarrh.

Not infrequently the symptoms point to a catarrh of the large bowel, and are more of a dysenteric character. Dysenteric diarrhœa may be primary, or follow an attack of simple diarrhœa, the general affection passing away and leaving a local inflammatory condition in the colon, sigmoid flexure, and

rectum. The same form of diarrhœa frequently succeeds whooping cough and measles. There is distension of the abdomen, with often more or less tenderness in the left iliac region on pressure, frequent passage of small liquid stools, consisting largely of mucus, biliary matters, and perhaps blood, preceded by much straining and forcing down and frequently followed by prolapse of the rectum. Older children often suffer from this form of catarrh of the large bowel, passing lumpy mucoid stools, and getting up perhaps several times in the night to sit on the vessel, only passing each time a little mucus streaked with blood. Dysenteric diarrhœa is apt to become chronic, alternately better and worse, until the patient is reduced to a condition of wasting. Sometimes dysenteric diarrhœa occurs in epidemics in winter as well as in summer. We have known several such epidemics.

Older children sometimes habitually suffer from what has been termed 'lienteric' diarrhœa, in which a loose stool is apt to follow the ingestion of food. Such children are generally subject to loose bowels, a diarrhœal stool following any form of excitement, especially a fright, the immediate cause being an exaggerated peristaltic action of the ileum and colon. There is often in such cases a catarrh of the large bowel, as evidenced by the excess of mucus which is passed: phthisical children also may suffer in this way. A form of diarrhœa which has been termed 'fat diarrhœa,' from the presence of an excessive quantity of fat in the stools, has been described; it is presumably due to catarrh of the duodenum and pancreatic duct.

In the slighter forms of diarrhœa in infants, where there is not much restlessness, distension of abdomen, and not more than four or five loose stools during the day, it will be usually sufficient to underfeed them for a day or two, and give them some mild laxative, as carbonate of magnesia or rhubarb and soda. Infants at the breast may be given a few teaspoonfuls of sweetened barley water in lieu of the breast, or after they have been partially satisfied at the breast.

If the purging is at all severe and curdy masses are vomited, or appear in the stools, it will be best at once to withhold all milk for a day or two, and to substitute some more digestible and less fermentable food, such, for instance, as—

Arrowroot water	2 ounces
Whey	2 „
White sugar	1 teaspoonful

or—

Barley water	10 ounces
White of egg	½ ounce
White sugar	1 or two teaspoonfuls

Either of these may be given out of a bottle every few hours, and in amounts according to age. Veal broth is also very useful.

The medicinal treatment in the early stage consists in giving a laxative for the first twelve or twenty-four hours. In these cases the diarrhœa is probably the result of a congestion of the mucous membrane of the intestine, and of the presence of irritating, perhaps putrescent materials, and it is wiser to assist elimination than attempt to prevent it by means of opium or astringents. To this end emulsion of castor oil or small doses of calomel

($\frac{1}{6}$ to $\frac{1}{2}$ grain) may be given, the latter being preferable if there is vomiting, on account of its being more readily retained by the stomach. (F. 17.)

By the end of twenty-four or forty-eight hours the laxative will have done all that can be expected of it, and if the stools are yellow, homogeneous, and less frequent, a sedative may now be useful, such as bismuth and small doses of opium. (F. 18, F. 19.)

In the majority of cases of simple diarrhœa the attack is arrested by these means—namely, a liquid diet in which milk is excluded or given sparingly, and a laxative for a day or two followed by bismuth or zinc. It not unfrequently happens, however, that a simple diarrhœa without urgent symptoms passes suddenly into the acute or inflammatory form, or, on the other hand, it may end in a more or less chronic condition of looseness of bowels with marked loss of flesh. As improvement takes place diluted milk may be allowed in small quantities, or, what is useful and readily prepared, milk diluted with twice its bulk or an equal quantity of arrowroot water (a teaspoonful to 10 oz.) and sweetened with white sugar. Malt extract may be added a few minutes before the food is taken. During convalescence, diluted acids with pepsine or astringents are the best remedies. (F. 20, F. 21.)

Constipation.—Constipation is one of the minor troubles which are of most frequent occurrence during infancy, and for which the advice of the practitioner is sought. Both breast-fed and artificially-fed infants suffer, though the latter far more frequently and severely than the former. The healthy infant passes two or three semi-liquid homogeneous orange-coloured stools daily without effort or straining, while some infants appear to have a difficulty in defæcation from want of expelling power, but at once pass a fairly healthy stool if the colon is reflexly stimulated by inserting a small suppository into the rectum. In the majority of cases, however, in which constipation exists, the stools are dry and pale with an excessive quantity of mucus, and an evacuation occurs only once a day, or perhaps once every two or three days. There is usually much straining before the stool is passed, and perhaps some mucus tinged with blood may accompany or follow the stool. Infants who suffer much from constipation are often anæmic, but they are by no means always badly nourished as far as fat is concerned.

In the majority of cases it is the result of a want of tone in the large bowel, which in chronic cases may be dilated, the peristaltic action being sluggish and not easily evoked ; perhaps also the intestinal juices are scanty and the bile deficient in quantity. In some cases constipation is due to a deficiency of fat in the food ; the fæces normally contain fat, and it appears to act as a natural purgative. Fluid fæces in the colon seem much more readily to excite peristalsis than solid fæcal matters. Infants who are constipated usually have abnormally distended abdomens, and fæcal masses may often be felt in the transverse and descending colon. In some cases constipation is distinctly hereditary ; mothers who suffer much from this trouble often have infants who also suffer in this way. It must not be forgotten that narcotics in small doses constipate, and bromides—though in less degree—have the same effect.

Constipation is a frequent trouble in children as well as in infants. Fat rickety children, who are late in walking, very frequently suffer in this way.

In some, constipation and looseness of bowels alternate with each other. It mostly, perhaps, occurs in those children where milk in too large quantities is given and is not well digested, as evidenced by the large solid pasty stools. In older children it occurs in those who take little exercise, and who have large appetites; though in some of these cases it appears to be hereditary. If an infant at the breast suffers from constipation, care should be taken first to inquire into the diet and habits of the mother or wet nurse. An analysis of the milk may be made to determine the amount of fat; it may be necessary for the mother to take more in the way of stewed fruits or some laxative medicine, such as confection of senna or cascara. In some cases the infant's stools may be fairly normal, and the infant appears to suffer from a want of expelling power; this may be overcome by gentle friction of the abdomen with the oiled hand, or it may be necessary to reflexly stimulate the colon and abdominal muscles by introducing into the rectum a small piece of soap or glycerine suppository. In artificially fed infants of feeble digestive powers, treatment is often much less successful. The first consideration is the diet; this will probably have to be changed in the direction of diminishing the quantity of curd, increasing the amount of fat, and adding some form of malted food or extract of malt. The best diet for constipation is one which is well digested and which contains the food elements in proper proportion. What is wanted is a better tone in the large bowel. Oatmeal water, or a small quantity of finely ground oatmeal added to each bottle, may have the desired effect. Persistent and carefully applied massage to the abdomen by a trained nurse is of much value in obstinate cases of habitual constipation. Enemata of glycerine and water (ʒss–ʒj) or olive oil are preferable to medicine for habitual use. Glycerine suppositories are often successful, or suppositories containing $\frac{1}{4}$–$\frac{1}{2}$ grain of belladonna may be used. Bitter and nauseous medicines are to be avoided as far as possible, for it is more than likely they will not be persevered with by the nurse or friends. In many cases two to three grains of carbonate of magnesia or a teaspoonful or two of fluid magnesia given several times a day in milk will be all that is necessary for infants. When these fail, small doses of calomel ($\frac{1}{4}$–$\frac{1}{2}$ grain) twice a day for a few days will, if aided by enemata, often succeed in bringing about a more satisfactory state of things, for a while at least. The aromatic syrup of cascara (B.P.) in doses of 15 to 30 minims three times a day is often of service. We have often found liq. helaline and pepsine or liq. euonymin and pepsine in 15 to 20 minim doses very useful in the constipation of infants and children.

In older children the diet must be carefully regulated; pastry, salt meat, and sweets must be forbidden, while oatmeal, green cooked vegetables, stewed fruit, orange juice, stewed prunes and figs, may be given with discretion. Sponging with cold water in the morning, plenty of outdoor exercise, and only a moderate amount of brain work, should be insisted on. Of medicines, the most efficacious are some of the mineral waters, such as Rubinat, Æsculap, Franz Josef, given in warm water or milk overnight or the first thing in the morning. Granules containing $\frac{1}{2}$ grain of aq. extract of aloes or calomel $\frac{1}{4}$ grain, with ex. coloc. co. $\frac{3}{4}$ grain, are useful; or $\frac{1}{2}$ grain of res. podophylli. But we frequently find in practice that children will neither take mineral water nor granules, and we have to fall back on such drug

sweetmeats as cascara chocolate bonbons, or 'tamar indien' lozenges, which are pleasant to take, and in some instances at least effectual.

The B. and W. tabloids of cascara or cascara comp. or bi-palatinoids (Oppenheimer) containing aloes, nux vomica, and belladonna &c. are readily taken by older children. In anæmia with constipation the old-fashioned mixture of ferrous sulphate and mag. sulph. is very efficacious, but nauseous. (F. 22, F. 23, F. 25.)

Acute Gastritis

If a child is suddenly attacked with vomiting and high fever, the probability is strong that the symptoms are due to the onset of some zymotic disease, such as scarlet fever or epidemic influenza, or some meat or milk poisoning. In infants the symptoms may indicate the onset of the so-called 'cholera infantum,' or zymotic diarrhœa. In any such case, inquiry must be made as to the food the child has taken during the few hours preceding the attack, as well as to the possibility of a scarlet fever infection, and the throat and skin must be carefully inspected. But, apart from any zymotic disease, some children seem prone to these fever-vomiting attacks, or 'bilious attacks' as they are sometimes called; there is headache, nausea, vomiting, and fever; the stomach may reject first some undigested food, then more or less bile-stained fluids. In a few days the attack passes off, and the child is perhaps better in health than it was before the attack, the vomiting and thorough emptying of the stomach having had a distinctly salutary effect. A few months after there is perhaps another attack.

In another class of case which is comparatively rare, acute vomiting of sudden onset is due to gastritis, often of an uncertain origin. Some of these cases are associated with epidemic influenza, others are due to the ingestion of some form of toxins in milk or meat. We have seen similar cases in children convalescent from scarlet fever and diphtheria. The vomiting begins suddenly and continues in spite of treatment, but at first creates no alarm, as it is looked upon as a bilious attack or gastric catarrh. There may be no fever, the abdomen perhaps becomes retracted, and cerebral disease is suspected. In the course of a few days signs of exhaustion ensue, the face becomes drawn and pinched, and there may be cramps and tetany. The vomit now contains dark blood and possibly the stools also; death follows from exhaustion. We have seen several of such cases and found at the *post-mortem* more or less marked signs of gastritis and dilated stomach, with more or less evidence of enteritis. In our cases no history could be got of food being taken which contained toxins, and no other member of the household suffered. In these cases small injections of morphia are beneficial.

Recurrent Vomiting

Gee was the first to describe periodical vomiting attacks occurring in children without there being any marked signs of indigestion or gastric catarrh. The term 'cyclic vomiting' or 'recurrent vomiting' is commonly used in speaking of these attacks.

Various explanations have been given; the vomiting has been attributed to excessive quantities of uric acid in the blood. Marfan has laid great

stress on the presence of acetone in the vomit and urine ; intestinal auto-intoxication has also had the credit of giving rise to the vomiting attacks.

There seems little doubt that these attacks occur in individuals who belong to neurotic families, as pointed out by Dr. H. L. K. Shaw, and in this respect they resemble those of 'recurring fever.' See *infra.*

The disorder is essentially one of early life, and after puberty there appears to be a cessation of the attacks.

The chief symptom is the continuous vomiting, which may last several days and reduce the patient to a condition of utter prostration. Then the vomiting suddenly ceases, and convalescence is quickly established.

The frequency of the attacks is subject to great variations, and no definite time elapses between the attacks, three to six months being a common time.

In a well-marked case there is no abdominal pain or tenderness apart from the muscular strain ; like all vomiting attacks which are continuous, the abdomen becomes retracted, often markedly so. The temperature is normal or near the normal line. The tongue for the most part is clean. There is rapid wasting.

An examination of the vomited matters is important. Irving Snow has shown that in some cases the vomited matters contain excess of free HCl, and he thinks that the attacks are due to the sudden excretion of this free acid in at least some of the cases. The urine should be examined for acetone.

The prognosis is favourable, though some fatal cases have been recorded.

The diagnosis is necessarily important in all cases in which vomiting is a prominent symptom. The history of a previous attack is the most important point, absence of grumous blood in the vomit or stools, and absence generally of any digestive troubles. The diagnosis between the early vomiting of tuberculous meningtis, if excessive, and recurrent vomiting may be difficult, especially as there may be a retracted abdomen in both instances, and for some days the diagnosis may be in doubt. The urine should be examined for albumen and casts, and the odour of the vomit and its reaction noted.

As regards treatment, Snow found bicarbonate of soda gave relief in some cases. Hypodermic injections of morphia or chloral enemata should be tried. No food will be tolerated by the mouth as long as the vomiting lasts ; rectal alimentation should be employed.

Acute Gastro-intestinal Infection. Inflammatory or Zymotic Diarrhœa. Cholera Infantum

With the commencement of the warm weather in June or July there is an increase in the number of cases of infantile diarrhœa ; and by the time the end of July or the beginning of August is reached—especially if the weather is close and dry—there is tolerably certain to be, in large cities, an epidemic prevalence of diarrhœa. It must be within the experience of all that the diarrhœal diseases are commoner in summer than in winter, and, moreover, that there is more diarrhœa in a hot dry summer than in a cold and damp one. The following figures show these facts in a forcible

manner; they are taken from the records of the Children's Dispensary, Manchester[1]:

Monthly Admissions of Cases of Diarrhœa for the year 1880.

—	No. of cases	No. of deaths	Mean lowest and mean highest temperature
			°
January	12	—	26-41 F.
February	24	—	34-52
March	19	—	34-57
April	26	1	37-59
May	19	—	39-64
June	45	2	47-72
July	89	4	52-72
August	362	33	55-75
September	264	43	51-73
October	62	13	37-58
November	18	—	28-53
December	13	—	33-52
Total	953	96	—

These figures show that there are at all times of the year a certain number of cases being brought for medical aid on account of diarrhœa, the number being fairly constant during the first five months and the last two months of the year; with the warm weather of June the number increases, reaching its maximum in the hottest weather of August, then declining to the normal number in the last two months of the year. The year 1880 was a more than usually hot summer for this country, but other years show the same relations between the diarrhœal disease of the winter and summer months, though in cooler summers the disproportion is not so great.

The same story is told by the mortality tables of diarrhœa in Berlin (Baginsky), in New York (Siebert), and also in Baltimore (Miller); but in these cities the greatest mortality is in July, which is their hottest month, while in this country August is usually the hottest month, and the month when diarrhœa is most prevalent. The above table bears out the general statement that diarrhœa begins to be prevalent whenever the average temperature of the twenty-four hours reaches 60° F., and whenever this average temperature is exceeded by only a few degrees, diarrhœa prevails in a widespread epidemic.

Summer diarrhœa is much more prevalent and fatal in large cities than in country districts, and among the poorest classes who live in back-to-back houses in crowded courts and low-lying districts; while it is much less common among the better-housed classes of society, especially among those who live in the country or suburbs and upon a high and bracing site.

It is most prevalent between the ages of three months and two years.

[1] By 'diarrhœa' is meant those cases in which diarrhœa was a prominent symptom.

The infants who suffer most are the weakly and dyspeptic ones, who are perhaps already suffering from an intestinal catarrh, and who are badly fed and improperly cared for—such, for instance, as the illegitimate class of infants who are put out to nurse. The infants who suffer least are the breast-fed infants; thus out of nearly 2,000 fatal cases recorded by Emmet Holt, only some 3 per cent. had been breast-fed; the same result has been arrived at by the investigations of Dr. Niven of Manchester.

The epidemic prevalence of summer diarrhœa has been attributed, with more or less plausibility, to the ingestion of sour milk, unripe fruit, inhalation of sewer gas, emanations from the soil; and possibly each of these may contribute to the cases of diarrhœa. That they are not the constant and invariable cause is certain, as infants fed on sour milk by no means invariably suffer from diarrhœa, and the epidemic is too widespread to be explained on the unripe fruit theory; and, moreover, diarrhœa is not especially prevalent in some towns where sewer gas is constantly present in the houses (Ballard). While it is certain that the ordinary lactic acid changes occurring in milk when it turns sour are not the cause of diarrhœa, yet there is a strong probability that milk often is the vehicle by means of which certain micro-organisms or poisons enter the system, and give rise to the symptoms which are present in diarrhœa.

That the diarrhœal diseases are epidemic in hot weather is certain. Are any of the forms also infectious? In some recorded cases it certainly appears this has been so. Dr. Bruce Low[1] gives an account of four different outbreaks of diarrhœa in which it appears that the disease was communicated by contagion. It is certain that the stools of infants suffering from diarrhœa may infect others.

There can be little doubt that the immediate cause of infantile diarrhœa is an infection of the alimentary canal by toxin-producing bacteria contained in milk or other food, and that the disease may spread in households or hospital wards from one patient to another by means of the fæcal matters contaminating the food.

Bacteriologists are by no means agreed as to the identification of the bacteria which are the cause of infantile diarrhœa. Délépine believes that some members of the B. coli group are the chief factors in the commoner forms of diarrhœa. The B. enteritidis, B. proteus, and various streptococci have all been suspected. Shiga, in 1898, isolated the B. dysenteriæ, and demonstrated it as the cause of acute dysentery as it occurred in Japan; and Flexner, in 1900, confirmed this discovery by his researches on dysentery in the Philippine Islands. The investigations of Flexner and his associates in the Rockefeller Institute have shown that this bacillus and its allies are also found in the intestinal discharges of children and infants suffering from infantile diarrhœa in between 60 and 70 per cent. of the cases. The bacilli are mostly found in the mucus discharged from the intestine and in the substance of the mucous membrane itself, in smaller numbers in the fæcal matters. Two types of the B. dysenteriæ have been noted, the commonest being known as the Flexner-Harris type, and the least common the Shiga

[1] Supplement to the Seventeenth Annual Report of the Local Government Board, 1881–1888.

type ; less marked types have also been observed. The blood of children suffering from the diarrhœal diseases agglutinates the bacillus of dysentery in high dilutions, with some exceptions. In a few instances the B. dysenteriæ has been found in the intestinal mucus of healthy children after a laxative had been given, and it cannot be said at present with certainty if the bacillus in small numbers may not normally exist in the intestines. It is clear, however, that when present in large numbers it is responsible for the pathological changes found in the intestines of infants dying from acute diarrhœa. Streptococci in large numbers are found associated with the B. dysenteriæ. The latter bacillus has not been found in food ; or, indeed, it has only been found in the intestines or their discharges.

Holt records that the most characteristic clinical type, and the one in which the dysentery bacillus is almost invariably found associated, is the acute febrile form in which the stools contain much mucus streaked with blood.

Symptoms.—The symptoms may supervene suddenly in an infant in apparent health, though more frequently an infant is attacked who has already suffered for a day or two from intestinal disturbance or has had an attack of diarrhœa a week or two before. The first symptom is generally vomiting ; this is followed by a loose motion and accompanied by more or less fever ; at the same time the infant is restless and irritable, the abdomen is distended with gas, and the legs are drawn up. The vomiting in the severest cases is very distressing, everything taken being rejected immediately, the vomited matters consisting of undigested food, and subsequently of simple mucus tinged with bile ; the stools are watery and consist of undigested food ; they are usually at first yellow and frothy, or green, containing lumps or flocculi of curd. Later, in severe cases, they consist of little else than slightly coloured water, or resemble the rice stools of cholera, and as the attack becomes more chronic they are of a dirty brown colour and very offensive. In other cases which are more of the dysenteric type the discharges largely consist of mucus streaked with blood. The tongue becomes coated with a thick white fur, the thirst is mostly extreme, the child eagerly taking the bottle or spoon, but vomiting immediately afterwards ; there is great restlessness ; the child may doze for a short time, but rarely manages to get off into a sound sleep.

The fever is seldom high and mostly intermittent, varying from 99° F. to 102° F., in exceptional cases 105° F. or still higher. The stools become more and more frequent as the disease advances, sometimes being passed every few minutes, perhaps escaping unconsciously or being preceded by a short cry or an expression of pain in the infant's face. Very often more or less erythema or excoriation occurs about the anus or genitals. After a longer or shorter period, according to the acuteness of the case, symptoms of collapse make their appearance. There is a change in the infant's face which strikes the most casual observer ; the eyes are sunk in the head and kept partly closed, the fontanelle is depressed, the face is pallid or of an earthy tinge, the muscles of the neck and limbs lose their tonus, and the head rolls about when the infant is moved. There is no longer any great restlessness, the infant is generally listless and drowsy, and takes little or no notice of its friends. In this stage the vomiting usually ceases, the stools become less

frequent and are smaller, and the abdomen becomes sunken and its walls flabby.

The further progress of the attack depends upon whether improvement sets in ; if so, the diarrhœa ceases, more or less colour returns to the infant's face, it takes notice of its friends, and, though still weak, begins to use its limbs and take its food. In other cases it becomes more exhausted, it wastes rapidly, parasitic stomatitis makes its appearance, and frequently convulsions occur, which quickly bring the end. The fatal event is often preceded by the occurrence of cerebral symptoms, such as coma and Cheyne-Stokes respiration, a condition which has been termed 'false hydrocephalus' from its resemblance to meningitis, and indeed it is often believed by the friends and others that death has occurred through 'water on the brain.' In this state the coma is profound, the pupils dilated, and at times unequal, the respirations irregular, the child is pulseless, and there may be twitchings of the face or limbs. The state of the fontanelle will generally assist the diagnosis in deciding whether the cerebral symptoms are due to arterial anæmia of the brain, as in false hydrocephalus, or to meningitis ; in the former case the fontanelle is depressed below the level of the cranial bones, inasmuch as the brain occupies less space than normally, in consequence of the arterial system being nearly empty, the result of a failing heart.

The length of time the disease lasts differs considerably. So rapidly fatal are some attacks that the term cholera infantum has been applied to them, and indeed in a few instances this resemblance to Asiatic cholera is very close indeed. Such cases occur much more commonly in the large cities of the continents of Europe and America than in our own cooler climate.

The following case may be taken as an instance :

A boy of five years of age was taken suddenly ill with vomiting and purging at 1 A.M. and died at 2.45 P.M. on the same day. When admitted to hospital at 11 A.M. he was completely collapsed ; the pupils contracted, the conjunctivæ nearly insensible, the lips were pallid, the pulse could hardly be counted, the temperature was 104° F. In spite of brandy, ammonia, and nitrite of amyl, he failed to rally. The *post-mortem* examination showed the body to be well nourished and rigor mortis strongly marked. The intestines were distended with gas, and contained a small quantity of pale gelatinous fluid, the mucous membrane of the whole length of the alimentary canal was pink with minute extravasations of blood, and the solitary glands were enlarged. The tissues generally were pale and dry. The case occurred in August 1880, a summer which was unusually hot, and during which zymotic diarrhœa was very prevalent.

In a few cases, convulsions supervene during the first few days, and bring about a fatal termination. In the majority of fatal cases the duration is somewhat longer, perhaps a week to ten days, the infant passes through the acute attack, the symptoms then assume more or less of a dysenteric character, and it succumbs through exhaustion and inanition from failure of the alimentary canal to recover its normal functions. Many infants who escape with life in August, die in September or October from gastro-intestinal atrophy, which has followed as the result of the acute attack.

Complications.—By far the most common complication of acute intestinal catarrh is broncho-pneumonia, or bronchitis and collapse of lung. The symptoms are apt to be latent, but any dyspnœa or high temperature would necessarily call for careful examination of the lungs. Thrombosis of the

cerebral sinuses occasionally takes place in the later stages, but it is comparatively rare; the symptoms consist in distension of the veins emptying into the cavernous sinus with œdema of the forehead and eyelids; there is also tonic spasm of the limbs and neck, and convulsions. Albuminuria frequently occurs during acute diarrhœa; nephritis and uræmic convulsions have been described by some authors; but we do not think the convulsions which frequently occur towards the last are uræmic. Peritonitis occasionally occurs, hyperpyrexia may also.

Sequelæ.—Should the infant recover from the acute attack, it is by no means certain that complete recovery will take place; for it is extremely probable that gastro-intestinal atrophy may supervene, or a chronic diarrhœa remain, the result of chronic catarrh with follicular ulceration of the colon, sigmoid flexure, and rectum. In the latter case the symptoms are those of dysenteric diarrhœa; defæcation is frequently accompanied by much pain and straining, the stools consist of mucus, often tinged with blood, or are dark brown and liquid. The rectum becomes prolapsed, and is sometimes returned with difficulty, and the child rapidly wastes. Not infrequently we see children, usually under two years of age, who have gone through a severe attack of diarrhœa, extremely anæmic, and whose subcutaneous tissues, including the face, are œdematous. In such cases a trace of albumen may be found in the urine, but it is usually free. They have been described by some authors as suffering from nephritis. Our own experience is that the kidneys in such cases show very little pathological change, and moreover urine is freely secreted during life. This sequela, whatever may be its pathology, is, we are inclined to believe, the result of ptomaine poisoning.

Diagnosis.—The principal difficulty in diagnosis occurs in the acute form of the disease, as it may be confounded with acute scarlet fever, sunstroke, or irritant poisoning, such as from eating poisonous fungi. We have several times been requested by a coroner to make a *post-mortem* on a child who has been seized with vomiting, purging, and high fever, with great depression, followed by death in a few hours; and we have been unable to say for certain, from the *post-mortem* appearance, whether the death has been due to malignant scarlet fever or acute inflammatory diarrhœa. The problem has been solved in some instances by the occurrence of scarlet fever in the same house shortly afterwards. In the majority of cases the appearances seen in the throat would suffice for diagnosis. The diagnosis between sunstroke and acute cases of cholera infantum may be difficult, as there may be a high temperature in both; but in most instances the gastro-intestinal disturbance is much more marked in the latter than the former. It must be borne in mind that some consider cholera infantum to be caused by 'heat stroke.'

Prognosis.—Acute intestinal catarrh must always rank as a serious disease, not only from its tendency to prove fatal during the attack itself, but because it so frequently passes on into a subacute or chronic form of catarrh, to be succeeded by atrophy. The younger the infant, the more serious the prognosis becomes, especially if it has been artificially fed; in older children, though the attack may be severe and the depression produced very great, the disease usually terminates favourably. The onset of cerebral symptoms is of very unfavourable augury, and the chances are against the infant,

though the case is not hopeless. Convulsions are generally followed by death. In those cases in which infants lapse into the chronic stage the prognosis is serious, as they are already exhausted by the acute attack.

Morbid Anatomy.—If death has taken place early in the disease, the body is well nourished and perhaps even plump, but the face retains the same expression it had during life, the eyes and cheeks being sunken. On opening the body, minute hæmorrhages are usually present on the surface of the lungs and heart, and there is hypostatic congestion at the bases of the lungs. The mucous membrane of the stomach and bowels is swollen and pink from capillary congestion, the congestion often being present in patches, and minute hæmorrhages may have taken place. The mucous membrane of the large intestine is congested, especially along the summit of the folds of the membrane. An excess of mucus is generally present, and the contents are liquid. The Peyer's patches and solitary glands are most frequently swollen ; the kidneys are pale, the cortex frequently enlarged. In the later stages, the body is more or less emaciated, the lungs are semi-solid at their bases from the presence of catarrhal pneumonia, the mucous membrane of the small intestine is swollen and congested ; but the principal changes will be noted in the large intestines. Here the mucous membrane is generally much congested, especially about the cæcum and descending colon ; there may be superficial ulceration or excoriation at the summits of the folds of mucous membrane, or the bowel may be pitted with deep but small ulcers from the results of breaking down and discharge of the solitary glands. Microscopical examination of the intestines shows a distension of the network of capillaries of the villi and mucous membrane, and an exudation of leucocytes is mostly present in the submucosa and between the tubules or crypts of Lieberkuhn. Numerous micro-organisms are present. The solitary glands, especially in the large bowel, are very often in a state of softening in their centres, or their contents have discharged, giving rise to sharply cut ulcers.

On examining the brain, no constant or indeed definite lesion is found ; in most cases the sinuses are distended with blood or occupied by a firm pale clot, but this condition of engorgement appears to be the result of death taking place through cessation of respiration, or during a convulsion, and is due to mechanical causes from interference with the return of blood to the lungs. The symptoms referable to the brain during the last few hours of life, coma, Cheyne-Stokes respiration, &c., have been attributed to exhaustion, and an anæmic (arterial) condition of brain due to diminished arterial tension. The suggestion that they are due to uræmia is improbable, though it is not unlikely they are due to the absorption of ptomaines from the alimentary canal. Meningitis is extremely rare ; in one case, however, which came under our notice, lymph was found about the optic commissures.

Treatment.—The most important part of prophylactic treatment is connected with the food which the infant takes and the purity of the air which it breathes. No weakly infant who is being reared on artificial food and who has previously suffered from intestinal catarrh ought, if it is possible to avoid it, to remain in the crowded part of a large town during the hot weather, but should be sent away to a bracing seaside place, or country quarters should be selected among breezy hills. The greatest care should be exercised in

the selection of pure milk and in its storage before it is taken by the patient, as there is little doubt that milk readily absorbs noxious gases, is easily contaminated by micro-organisms present in the atmosphere, and changes are set up which render it unfit for food. All milk taken by infants and children during the summer months should be carefully sterilised in one of the milk sterilisers sold for the purpose. Care must also be taken that the infant is not given food in excess of its digestive powers, as undigested curd or other foods are exceedingly likely to decompose in the alimentary canal and give rise to irritation and diarrhœa. The stools, both of infants at the breast and bottle-fed children, should be carefully watched, and any traces of undigested food, or of unusual foulness or looseness of bowels, should be the signal for lessening the amount of food taken. No infant at the breast should be weaned during the continuance of the hot weather, and if diarrhœa makes its appearance the infant ought, if possible, to return to the breast.

The indications for treatment when the diarrhœa has commenced are in the first place to give a laxative to clear away all irritating or decomposing foods and relieve the congested bowel, and secondly to give food only of the blandest character and in small quantities. The first indication can be fulfilled by giving castor oil, as long ago advocated by Dr. Geo. Johnson, or by a dose or two of calomel. The former may be given in emulsion in combination with an unirritating antiseptic, as boric acid or salicylate of soda; the latter helps to prevent decomposition in the emulsion, and perhaps also plays a similar part in the stomach in checking putrefactive changes. (F. 28.)

The oil may be given by itself in half-teaspoonful or teaspoonful doses, but it is apt to cause sickness. Instead of the castor oil, especially if there is much sickness, small doses of calomel may be given, and on account of its small bulk and tasteless character it is in many respects to be preferred. It is better, if the attack is a sharp one, to give it in small and repeated doses, especially in weakly infants; $\frac{1}{4}$ to $\frac{1}{2}$ grain may be given to infants and young children every two hours, until one or two grains have been given, In the course of twelve hours or more, according to the intensity of the diarrhœa, all appearances of undigested food will have disappeared from the stools, the latter perhaps continuing frequent and watery. Stomach washing and irrigation of the large bowel have been largely practised both on the Continent and in America, and have the great advantage of removing at once the contents of the stomach and large bowel, but no irrigation can reach the small intestines.

Unless the infant be at the breast, all milk or milk foods should be stopped, and barley water with white of egg or weak chicken broth substituted (p. 89). The most troublesome symptom at first is the vomiting; this may be constant, following every attempt at feeding, and it will be necessary to desist from all attempts for some hours, only moistening the child's mouth with a small brush dipped in iced water. Counter-irritation and hot applications to the abdomen at this stage are undoubtedly serviceable. For this purpose a liniment composed of five drops of oil of mustard to an ounce of camphorated oil may be gently rubbed over the abdomen, or spongio-piline or several folds of flannel wrung out of water at 110° in which

mustard has been diffused (in the proportion of two tablespoonfuls to a gallon) may be applied.

The medical treatment of acute diarrhœa is unsatisfactory. The vomiting may continue, the stools in spite of the most careful dieting may be loose and frequent, and the child rapidly lose ground. It must, however, be borne in mind that the disease is something more than a congested irritable state of bowels, in which the contents are rapidly passed downwards into the colon and rectum, but the diarrhœa is rather the result of a form of irritant poisoning by toxins, which must be got rid of as soon as possible. There cannot be the least doubt that in many cases with the cessation of the diarrhœa the child becomes no better, but rapidly passes into a condition of collapse with cerebral symptoms, due in all probability to toxæmia ; or the temperature rises and pneumonia supervenes.

The drug which has appeared to us the most successful in the vomiting in the early stages is carbolic acid, the glycerine of carbolic acid being given in drop doses every two hours or even oftener. Carbolic acid has a sedative action on the stomach, and helps also to check the decomposition changes which go on. Other drugs of a similar class, namely salol, creosote, resorcin, naphthalin, have been given as antiseptic remedies in the hopes of checking the putrefactive changes in the bowel and preventing the formation of toxic products. Salicylate of soda has been used by A. Jacobi, of New York, and also by Dr. Emmet Holt ; it is given in doses of one to three grains every two hours according to age. Resorcin may be given in $\frac{1}{2}$ to 2 grain doses dissolved in water every two hours. But these antiseptic drugs are disappointing in the worst class of case. Both bismuth in the form of subnitrate and oxide and zinc oxide (F. 30 and 19) are usually of undoubted service. Five-grain doses may be given every hour to an infant of twelve months. Opium, during the first twenty-four or forty-eight hours, is useless and harmful, more especially when there is undigested food in the stools and where the vomiting is persistent. After twenty-four or forty-eight hours, if the stools continue small and numerous, especially if they approach the dysenteric type—the large bowel being chiefly involved—this drug is of much value in soothing the patient and diminishing irritability. It is best given by enema. The advantage of this method is that it is slowly absorbed and its topical effects are useful ; one or two enemata of laudanum during the twenty-four hours will mostly relieve the irritative diarrhœa, when accompanied by straining and colicky pains, without the necessity of omitting or altering the medicine given by the mouth. Two to five drops of laudanum may be given in warm decoction of starch per rectum to an infant of six months to twelve months, the effects carefully watched, and repeated in the course of six to twelve hours if necessary ; $\frac{1}{30}$ of a grain of morphia may be given subcutaneously to a child over three years of age ; or Dover's powder may be given by the mouth, $\frac{1}{2}$ grain every three or four hours, or oftener if the pain and griping are severe. If there be much fever, tepid sponging, or in cases of greater severity sponging with ice-cold water, may be practised.

Stimulants may be required from the first, but it is wise to reserve them for a later stage, especially as they are apt to give rise to sickness. Brandy, a sound port, or champagne, are the forms of alcoholic stimulants most useful

and they are usually required to be given freely in the later stages if collapse is threatened. Ammonia, camphor, and musk are valuable remedies if symptoms of collapse have made their appearance. Camphor may be given in the form of spirits of camphor, three or four drops every second hour ; or musk. (F. 29.) Camphor and musk are not agreeable medicines to take, and are apt to cause nausea.

Irrigation of the large bowel is certainly useful in severe cases, especially in the later stages. The ulceration and inflammation are mostly below the cæcum, and can be reached by fluid injected per rectum. A soft rubber catheter is passed some six or eight inches into the rectum and attached to a Higginson's ball syringe. Twenty to thirty ounces are injected so as to get as high up as possible ; the injection may be continued, allowing the fluid to flow back by the side of the catheter. We should not be inclined to irrigate the large bowel more than once a day or twice at the most, as to disturb the child too much is prejudicial.

Even when convalescence is established great care must be exercised for many weeks in the management of the patient ; the child is certain to be left with impaired digestive powers, and liable to gastric or intestinal disturbance. A severe attack will often affect the child's health and development for many months, so that it is late in talking or standing and at 18 months or two years of age resembles a child of 12 months old or less. Moreover, the diarrhœa may become chronic or return in a subacute form, and a child may thus be lost who has managed to struggle through the primary attack. The diet during convalescence requires the most extreme care, and a return to milk diet should not be allowed until there is evidence of much improved digestive powers. Broths and beef tea made with barley or some light starchy food, meat juice, scraped underdone chops, and whey, may be given in moderation.

The mineral acids, pepsine wine, decoction of pomegranate bark, the vegetable bitters and astringents, will be useful as the child improves.

Summary.—Place the child in the coolest room of the house, and sponge frequently if there is much fever.

Stop all forms of milk food, giving barley or arrowroot water with white of egg, and veal broth ; if there is much vomiting stop all food for some hours.

Apply hot fomentations or counter-irritation to the abdomen.

Give castor oil or calomel till all undigested food has disappeared from the stools, followed by salol, zinc, bismuth or carbolic acid. Later, if there is much restlessness or colic, give opium by the rectum. In severe cases brandy or other stimulants will be required, but it is apt to cause vomiting.

In infants at the breast lessen the quantity of milk taken and give some barley water.

Acute Ileo-colitis. Dysenteric Diarrhœa

Diarrhœa of a dysenteric character is sometimes secondary to acute catarrhal diarrhœa, or it may follow measles, whooping cough, or other zymotic disease. In these cases it is mostly chronic or at the most subacute. There is straining at stool : the evacuations contain much mucus and are streaked with blood. Prolapse of the rectum is common. In some cases

which occur almost entirely in older children, ileo-colitis is an exceedingly acute and fatal disease. Cases of this description have been recorded by Henoch, Goodhart, and Eustace Smith. The onset is sudden, with vomiting, colic, and fever, the latter usually not high ; there is much straining at stool, followed by the passage first of fæcal matters, later blood and mucus only. There is mostly some abdominal tenderness, and in some instances a purpuric or petechial rash on the skin. There is certain to be great depression and rapidly increasing weakness. There is often delirium at night. At the autopsy the last foot or so of the ileum is found to be involved, while the changes are more marked in the colon, but most of all in the sigmoid flexure and rectum. The mucous membrane is swollen and intensely injected, with patches of thin membranous exudation, or if the child has lived some days there is ulceration of a superficial character. The etiology of these cases is obscure. The possibility of meat poisoning must be kept in mind. They occur in the hot weather of summer, but their occurrence is not limited to this time. One of our cases occurred in April, at the height of an epidemic of influenza. (See below.)

In one case coming under our notice in a girl of twelve years, who was admitted to hospital under the care of our colleague, Dr. Hutton, the attack commenced with vomiting and diarrhœa, followed by delirium, petechiæ on the skin, and bleeding from the nose. She was admitted to hospital on the sixth day of her illness in a collapsed condition, with a pulse of 190 and a temperature of 102° F. ; she passed loose stools containing some hard lumps with blood and mucus ; later, the epistaxis again supervened, the temperature rose to 104° F., and she died exhausted on the ninth day of her illness. The *post-mortem* showed the folds of the mucous membrane of the colon to be of an ashy-grey colour with well-defined ulcers varying in size from a pin's head to half an inch in diameter : all the changes were more marked below the sigmoid flexure.

In another case of a somewhat similar nature coming under our care, the symptoms so closely resembled those of an invagination of the intestines, that an exploratory incision was made into the abdominal cavity. Cases of intussusception are not infrequently diagnosed as 'dysentery,' but it is rare for the opposite mistake to be made. The case was shortly as follows :

Acute Ileo-colitis—Death.—A boy of nine years of age was suddenly seized (April 22, 1891) with pain in the abdomen whilst at school, followed by the passage of blood and mucus by the bowel ; he continued in this way during the succeeding night. He was admitted to hospital next day, and, in spite of fomentations and opium, he passed twelve stools, consisting almost entirely of blood and mucus. Temperature 99–100° F. April 24.—The tenesmus and bloody stools continued, in spite of large enemata of warm water ; the latter brought away a small quantity of fæcal matters. No tumour could be felt ; the abdomen was not distended nor tender to the touch. Temperature 97–99·6° F. In the evening, as no improvement had taken place, and the boy seemed rapidly sinking, it was decided to explore the abdominal cavity, in order to relieve an invagination of the bowel if present. This was done ; but no invagination was found, only an intensely congested colon. Death followed about eight hours after. At the *post-mortem* the stomach and small intestines, to within twenty inches of the cæcum, were found normal ; the last foot or two of ileum was found congested, with patches of thin membranous exudation. The mucous membrane of the colon, sigmoid flexure, and rectum was intensely injected, the changes in the lowest parts being most marked, the rectum being hæmorrhagic. There were patches of thin membranous exudation, but no ulcers.

These acute cases of dysenteric diarrhœa appear to occur in children of over eight or nine years rather than in younger children.

Diagnosis.—Tenesmus, with passage of blood and mucus by the bowel, in an infant under a year old, should certainly suggest intussusception rather than ileo-colitis ; and a careful exploration of the rectum and palpation of the abdomen should certainly be made. In older children these symptoms indicate ileo-colitis rather than invagination ; fever, delirium, vomiting, also point the same way.

Treatment.—In acute ileo-colitis only the blandest food should be given, such as arrowroot, veal broth, or white of egg mixture, and if there is vomiting, the less food given the better. Hot fomentations containing opium should be applied to the abdomen, and every effort made to allay the inflammatory condition of the colon by small starch and opium enemata. Five to six ounces of warm starch mucilage and boric acid with 10 minims of laudanum may be administered to a child of ten years. Anything that can possibly irritate, such as purgatives or indigestible food, must be avoided, as likely to increase the peristalsis and tenesmus. Stimulants are certain to be required sooner or later. In mild or chronic cases irrigation of the bowel is often of the greatest service. Thin starchy mucilage may be used with lac bismuthi, and the amount employed should be sufficiently large to reach the cæcum. Laxatives, as rhubarb and soda or castor-oil emulsion, are also useful in the early stages. Great care must be taken in the diet, and all rich foods avoided.

Meat Poisoning. Infection with Gaertner's Bacillus

Under this head we refer to the acute gastro-intestinal disturbance which follows the ingestion of some form of animal food which is infected with the Bacillus enteritidis, first described by Gaertner. Besides this bacillus and its varieties other organisms have been described (B. botulinus), but Gaertner's is by far the most common. The diseased animal is usually either the cow, calf, or pig, and the infection of human beings is the result of eating imperfectly cooked beef, veal, veal or pork pies, sausages, and in some cases raw milk. No cases appear to have occurred after using mutton. An exposure of one minute to a temperature of 158° F. is sufficient to destroy Gaertner's bacillus, and the toxins associated appear to be destroyed by a boiling temperature (H. E. Durham).

The infection is due to the ingestion of the bacillus itself and the consequent development of toxins in the system, and not to the ingestion of the toxins themselves : in all fatal cases the bacilli have been found (H. E. Durham). The diseased animals appear to have suffered from septicæmia, diarrhœa, and localised suppurations.

The symptoms set in within a few hours, and include rigors, vomiting, diarrhœa, with excessive griping and sometimes blood in the stools, fever often high, followed in severe cases by subnormal temperature, and marked collapse with weak irregular action of the heart. Herpes occurs in some cases.

In an epidemic which we had an opportunity of observing, it was the milk which was at fault. Upwards of 160 individuals ,were attacked within a few hours of one another, in several families as many as twelve, the children

suffering the most. All the families were supplied with milk from the same farm. The outbreak was investigated by Dr. Niven, who traced the outbreak to a cow suffering from inflammation of the udder.

The diagnosis in such cases is aided by the possibility of tracing the cause of the illness to some form of food such as veal or pork pies, sausages, milk, &c. It must be borne in mind that the meat or milk is not obviously bad or stale, and only a bacterial examination by an expert will prove it to be at fault. Blood should be taken from the individuals attacked for 'serum reactions,' and forwarded to an expert. It must be remembered that influenza may sometimes give rise to a febrile gastro-intestinal disturbance, but the fact that many people are attacked within a few hours of one another, and then no others are attacked, would arouse the suspicion of meat or milk poisoning.

The treatment is practically the same as already given under Gastro-intestinal Infection. The intense griping may require full doses of opium for its relief.

CHAPTER VI

DISEASES OF THE DIGESTIVE SYSTEM—(*continued*)

Chronic Gastro-intestinal Catarrh. Gastro-intestinal Atrophy

IN some cases a gastric catarrh exists with but little evidence of the intestines being in any way affected, and in other cases the intestines may be the only part of the alimentary canal which appears to suffer ; but in perhaps the majority of cases, especially in infants and small children, there is no sharply defined limitation between the two, the whole of the alimentary canal appearing to be involved.

The terms **chronic vomiting, chronic diarrhœa, simple atrophy, marasmus, malnutrition, athrepsia** are sometimes applied, according to the most prominent symptom which is present ; thus, chronic vomiting is the most marked and striking symptom which may be present in catarrh of the stomach, diarrhœa is mostly present, or at least more or less looseness of the bowels, in the early stages of an intestinal catarrh, though the latter may exist without any marked diarrhœa, or in the later stages there may be constipation. If the only marked symptoms are dyspepsia and wasting, then the term simple atrophy has been applied. In all these conditions, while the symptoms may differ, the anatomical groundwork is the same—namely, a chronic gastro-intestinal catarrh, which in later stages passes into a gastro-intestinal atrophy.

Thus, an infant soon after birth, or perhaps when a few moments old, suffers from repeated and frequent vomiting, or it suffers from diarrhœa, or if these are absent there are other chronic dyspeptic troubles, such as flatulence and colic ; it fails to thrive and gradually wastes, and after a more or less protracted illness, during which the wasting becomes extreme, it dies exhausted or is carried off by some intercurrent disease. In some cases the course is very short, perhaps only a few weeks, but in the majority the disease is chronic and the infant lives for months, suffering constantly from dyspepsia, unable to digest its food, and wasting to a mere skeleton. The less severe cases, especially if they come under treatment, gradually improve, and after months of the most careful feeding and nursing completely recover, though such cases usually become rickety or are otherwise weakly. Recovery is only possible during the earlier stages ; if the catarrhal stage has passed on into one in which there is advanced atrophy of the mucous membrane of the stomach and intestines with the secreting glands, recovery is hardly possible.

Experimental research has shown that in these cases there is a diminution in the amount of hydrochloric acid and pepsin secreted, whilst there is an excessive formation of mucus, lactic, acetic, and butyric acids. Much gas is given off from the decomposing food.

This gastro-intestinal atrophy rarely occurs in children over eighteen months of age, and indeed is most common in infants under six months. Older children suffer from chronic intestinal catarrh, which rarely goes on to atrophy, though it is frequently the precursor of tuberculosis of the mesenteric glands.

In the majority of cases, chronic gastro-intestinal catarrh is the result of improper feeding and unfavourable life conditions. Infants who come of a healthy stock and are nursed at the breast of healthy mothers rarely, if ever, suffer from it. It is the infants who are fed from the first on cow's milk or the various forms of starchy foods that chiefly suffer. The infant may go on fairly well for the first few weeks or more, suffering more or less from dyspepsia ; then comes an attack of diarrhœa or vomiting, and forthwith it begins to go downhill ; no food seems to suit it, however often changed, and it never recovers its digestive powers, which appear to have been hopelessly damaged. Some infants appear to get on fairly well till they suffer from an attack of broncho-pneumonia, or measles, or whooping cough, which they survive only to begin gradually to waste. In some few instances, more especially in dispensary practice, atrophic infants may be seen of a few months old, who have been, according to their mothers' accounts, entirely breast-fed. In these cases the infants have been congenitally weak or premature, and probably the mother's milk has been deficient in quality and quantity, and they have been exposed to all the insanitary conditions which prevail in the crowded dwellings of the poorest and most ignorant of our citizens.

Symptoms.—**Infants.**—The history which is generally obtained from such cases is that they were suckled for a few weeks or months after birth, then the mother had to go to work or her milk failed, and the infant was made over to a friend or hireling to be artificially fed, and from this time it began to waste. On cross-questioning the mother or caretaker, it is found that it has been fed on sopped bread or biscuits, because cow's milk did not appear to satisfy it, or it vomited the milk curdled, and it has constantly suffered from colic, vomiting, or more commonly diarrhœa. On the other hand, there is sometimes constipation, but this usually has been preceded by diarrhœa ; the diarrhœal symptoms being most marked in those suffering during the summer months. If the symptoms be analysed, three stages in the course of the disease may be recognised as first clearly pointed out and emphasised by Parrot, whose description of these cases under the name of athrepsia leaves nothing to be desired. The early symptoms or first stage are those of a simple gastric or intestinal catarrh, in the second the progressive wasting becomes the prominent phenomenon, and in the last stage the infant passes into an exhausted condition in which cerebral symptoms make their appearance. *First stage.* The infant suffers from a simple diarrhœa or looseness of the bowels ; the stools, instead of being bright yellow and homogeneous, are liquid, curdy, and often green in colour, or contain an excess of mucus ; sometimes they consist almost entirely of stinking decomposing milk ; the abdomen is distended with gas and remains constantly in this condition, the

tongue is coated, and patches of aphthous stomatitis appear in the mouth. The infant is restless, constantly whining, and will not sleep at night. Frequent vomiting may be a prominent symptom, the milk being returned curdled. The tissues become flabby, and then wasting commences. In the *second stage* all the symptoms are intensified and the characteristic wasting becomes manifest. The stools for the most part are loose and frequent, and consist of undigested food, being often pale and putty-like, with a peculiar odour; at other times they are of a dark brown colour from the presence of altered bile. The infant is mostly voracious, liquid food does not appear to satisfy it, and by the mistaken kindness of its friends it is fed with sopped bread or some thick food, a diet which has the great merit in their eyes of keeping it quiet for a longer time than liquid food or diluted milk; at times it cries incessantly, hardly ever appearing to sleep or only dozing for a short time unless under the influence of a 'soothing syrup' supplied by its nurse. The mouth becomes the seat of parasitic stomatitis, the skin is harsh and dry, small boils or a lichenous rash make their appearance, the buttocks and genitals are raw and excoriated. Its temperature is below normal, the feet and hands are congested, the face has a pallid earthy tint, and a sickly lactic acid smell is given out from the body, especially the abdomen. The wasting is extreme, the face being shrivelled, the skin wrinkled and hanging in folds about the thighs and arms. In the *third stage* the infant passes into a moribund state; it is too feeble to cry loudly, it is heavy and drowsy, taking little notice of anything. It becomes more and more somnolent, and death ensues, probably preceded by muscular twitchings, strabismus, or general convulsions.

If we analyse the principal symptoms of the disease, we shall find that sometimes one symptom, as diarrhœa, sometimes another, as vomiting, is the most prominent. In the majority of the cases there is more or less diarrhœa throughout the whole course, so that such cases would come under the category of **chronic diarrhœa,** or this chronic condition may alternate with the acuter forms. The stools at first are yellow, liquid and frothy, with flocculi of semi-digested curd; later they become green, the acid contents of the intestines acting on the bile pigments; when the diarrhœa has become chronic the stools are either liquid and of a dirty brown colour, or more often, especially if milk is being taken, they are white and semi-liquid, the bile pigment having disappeared, and they consist of decomposing foul-smelling curd and mucus. Sometimes the stools consist almost entirely of mucus, the mucous membrane both of the small and large intestine secreting large quantities; the child is constantly passing stools of mucus and undigested food.

In some cases **chronic vomiting** is the most troublesome symptom, there being no diarrhœa, but sometimes constipation. Cases of chronic vomiting with the consequent malnutrition are at times most difficult to deal with. So great is the irritability of the stomach that everything is rejected, either immediately after being taken, or after the lapse of perhaps half an hour. Diluted milk, peptonised preparations, meat juice, cream, and a variety of patent foods are tried one after another, separately or mixed; each change only ends in disappointment, the infant becoming more and more wasted. Under such circumstances among the poorer classes the infant is given some thick food, as sopped bread or cornflour. Vomiting in many cases

appears to be the result of the rapidity with which cow's milk is coagulated in the infant's stomach and of the hard lumps of curd which are thrown down, this occurring even where the milk is reduced to one part of milk to five of water. In other instances it appears to be due to the rapid changes occurring in the sugar of milk, lactic acid being formed ; the contents of the stomach are rejected, having a strong smell of sour and decomposing milk. In the catarrhal condition of the mucous membrane of the stomach much mucus is formed, while the gastric juice is weak, but its curdling power undiminished. Many such cases go from bad to worse, no food appearing to agree, all forms coming up alike.

As the child wastes the skin becomes rough and harsh and hangs in folds upon the limbs and trunk, and very frequently, as the anæmia increases, the face, hands, and feet become œdematous. This œdema is due to anæmia rather than to any kidney complication. An erythematous rash is apt to make its appearance about the anus in those cases where there is much diarrhœa, and spread over the perineum and thighs.

It must not be forgotten, in a case of constant vomiting, that it may be due to cerebral disease or some congenital defect. The prognosis in chronic vomiting is unfavourable if it commences in an artificially reared infant, and becomes thoroughly established, and is associated with progressive wasting.

Complications.—Broncho-pneumonia is very common. Tuberculosis of the mesenteric or mediastinal glands may occur, or there may be a more general distribution of tubercle throughout the body. It must be borne in mind that it is only in the more severe and neglected cases that intestinal catarrh passes on into atrophy ; in the majority of cases the course of the disease is intermittent, sometimes better, at other times worse, and as the child grows older the symptoms of rickets become grafted on to those of a chronic catarrh of the bowels.

Older Children.—A chronic intestinal catarrh is not so serious a disease in children over two years of age as in infants, as it is rarely followed by an atrophic condition of the glandular apparatus of the stomach and intestines, but takes rather the form of habitual indigestion than anything else. It is, however, apt to be exceedingly chronic in its course and to be followed by various evil consequences, the most serious of which is tuberculosis of the lymphatic glands, or there is a constant state of health below par, which in itself is a source of danger. Chronic catarrhal affections of mucous membranes, either of the nose, mouth, respiratory tract, or intestines, are exceedingly apt to be followed by swelling and caseous degeneration of the lymphatic glands, with which the mucous membrane is connected. The intestinal lesion finds its origin for the most part in unsuitable food ; the mucous membrane of the stomach and bowels is kept in a constant state of irritation by food which is too great in quantity or of too indigestible character. Weakly children are especially apt to suffer, particularly those who are brought up in our large cities and whose time is spent either indoors or playing in the street. Children who suffer habitually from rhinitis, chronic tonsillitis, or chronic disease of the strumous type, are the chief sufferers from chronic gastro-intestinal catarrh. It is very common in rickety children. Both the children of the well-to-do and of the poor classes suffer.

Symptoms.—There is habitual indigestion with perverted appetite, the child refusing its bread and milk and craving for 'tasty' bits from its parents' table, or altogether refusing its meals unless its food is highly seasoned; at other times the appetite is excessive. The abdomen is invariably rounded from the constant distension of the stomach and intestines with gas given off from the decomposing half-digested food. This distension is very frequently accompanied by more or less pain. The face is generally pale with dark areolæ around the eyes, fat is absorbed as the disease progresses, the muscles become flabby, and the emaciation of the child contrasts markedly with its large tumid abdomen. Such children have usually coated tongues, at other times the tongue is red and glazed, showing the enlarged fungiform papillæ more distinctly than usual and resembling the 'strawberry tongue' of scarlet fever. Sometimes the surface has a worm-eaten appearance, being coated with a thick fur except in irregular sinuous patches where the surface is red and glazed. The bowels are generally confined, the stools being frequently pasty with much mucus; there are apt to be intercurrent attacks of vomiting and diarrhœa. There is very frequently more or less feverishness at night, especially in the subacute cases. Headaches are common, there is often restlessness at night, grinding of teeth, and night terrors. Sometimes when the disease is subacute, and there is some feverishness towards evening, the symptoms resemble mild typhoid fever and constitute what at one time was called 'infantile intermittent fever.' It is important to bear in mind that subacute intestinal catarrh may be present with an evening exacerbation of temperature as the principal symptom and with no vomiting or diarrhœa. An intermittent fever during early childhood with no pulmonary symptoms is probably, if typhoid can be excluded, due to an intestinal catarrh. It will not fail to be noticed that diarrhœa is a prominent symptom in the majority of cases of infants suffering from chronic intestinal catarrh, while in older children not only is the diarrhœa not present, but there is usually constipation. The explanation of this is perhaps not very clear, but it must be borne in mind that those cases where diarrhœa is present and excessive are more acute in character and run a more rapid course than those where the bowels are less irritable; there is also more likely to be diarrhœa in the early stages where the mucous membrane is congested, than in the later stages where the bowels have become more tolerant of irritation and the muscular walls wasted through long illness.

In some cases of intestinal catarrh, more particularly when it complicates or follows whooping cough or measles, there is an excessive formation of mucus from the intestinal walls, especially the large bowel; Dr. Eustace Smith has called special attention to these cases under the name of **'mucous disease.'** The bowels are usually loose, the stools consisting largely of mucus, or an aperient may bring away large quantities of mucus. In the worst cases, when this form of disease complicates whooping cough, the prognosis is bad.

Diagnosis.—The disease most likely to be confounded with chronic intestinal catarrh is tuberculosis of the mesenteric glands, or the early stages of tuberculous meningitis. During the first three or four years of life, it happens very frequently that infants or young children are thought to have 'consumption of the bowels,' because they have capricious appetites, 'pot-bellies,' and

have lost much flesh, when in reality they are suffering from a chronic intestinal catarrh. That the diagnosis is often difficult is only what is to be expected when it is remembered that an intestinal catarrh of more or less severity is the exciting cause of mesenteric tuberculosis ; and in an advanced case, it may be quite impossible to say if a tuberculosis of the glands has supervened. Mesenteric disease is, however, much less common than simple intestinal catarrh, and is infinitely less so during the first six months of life than gastro-intestinal atrophy. Any evidence of tubercle in the lungs, or enlarged veins on the surface of the abdomen, or the detection of rounded masses by palpation in the abdomen, would favour a diagnosis of tuberculous disease. In older children the fact that those suffering from intestinal catarrh grind their teeth, are restless at night, are subject to night terrors and headaches, is sufficient for most parents to become alarmed, fearing that the child is commencing with tuberculous meningitis.

Morbid Anatomy.—Chronic Gastro-intestinal Catarrh.—In the early stages there is swelling, and injection of the mucous membrane of the stomach, and small and large intestine. The surface is grey, streaked with red, and there is an excess of mucus : the changes are usually most marked in the ileum and colon, especially about the sigmoid flexure ; in these places the solitary glands are enlarged, the mucous membrane is raised in folds, and often much injected, and follicular ulceration may be present. The microscopical appearances somewhat resemble those already described in acute catarrh. The surface of the mucous membrane of the stomach is covered with masses of leucocytes and micrococci embedded in mucus. The capillaries are everywhere distended, the gastric glands are separated from one another by columns of leucocytes effused between them, the whole mucous membrane is swollen and the muscular layer thickened.

Similar changes are seen in the intestines, leucocytes are present in large numbers in the submucosa and between Lieberkuhn's glands ; the latter are compressed and finally disappear, so that in places only masses of round cells are seen taking the place of the glands. A stage of atrophy succeeds that of chronic catarrh, and the appearances presented are those of a wasting of the mucous membrane, and a destruction of the secreting glands. The chronic swelling of the mucosa, and infiltration with leucocytes, have led to a wasting and cicatrisation of the tubular glands ; but death usually takes place before this stage is reached.

In *gastro-intestinal atrophy* the stomach and intestines are distended with gas, the former is frequently dilated, the mucous membrane is everywhere pale, the intestines are thin and translucent. This is especially marked in the more advanced cases, the intestinal walls are exceedingly thin, the solitary glands and Peyer's patches are wasted and have almost disappeared, with perhaps brownish spots or streaks where minute hæmorrhages have taken place. These appearances will be varied with those of chronic catarrh according to the amount of atrophy that has taken place. The microscopical appearances show the mucous membrane of the stomach to have undergone wasting, being reduced to perhaps one-quarter its normal thickness. The gastric glands in places have completely disappeared, in other places they are compressed and partly destroyed by round cells and young connective-tissue fibres. In the small intestines the appearances

will be those of chronic catarrh, or these with the addition of destruction of the glandular apparatus. The tubular glands in places are atrophied or are compressed or dilated by a connective-tissue growth, the villi have completely disappeared, or only their remains are present, the solitary glands are atrophied. Similar changes may be found in the colon. Parrot has described various other lesions in the alimentary canal of infants dying within a few weeks of their birth ; such as a spread of the parasitic growth from the mouth to the stomach and intestine, usually the cæcum. The same author has found minute circular ulcers in the stomach, from which hæmorrhage has taken place, less often larger and irregularly shaped ones ; he has also seen the mucous membrane of the stomach to be the seat of a diphtheroid exudation. In the later stages, when the blood is profoundly altered, thrombosis of the renal veins, pulmonary veins, or sinuses of the brain may take place. Fatty degeneration (*steatose* of Parrot), softening, or meningeal hæmorrhage, may take place in the brain. The kidney may be the seat of uric-acid infarcts.

Treatment.—The treatment of chronic gastro-intestinal catarrh in **infants** consists principally in careful feeding ; the blandest and least irritating forms of food must be selected, while frequent weighings of the infant should be resorted to in order to ascertain if any progress is being made. In infants under four months a wet nurse should be obtained if possible. Where there is much diarrhœa, milk must be used sparingly or altogether omitted for a while, as the hard curds formed in the stomach are beyond the digestive powers of the weakened stomach and intestines. Small quantities of whey and barley water, with the addition of the juice of an underdone chop, may be given at short intervals during both day and night. Improvement having taken place as regards the diarrhœa, milk in some form or other must be given. Milk modified so as to reduce the proteids to ·5 or ·75 per cent., with 2 per cent. fat and 5 per cent. sugar, may be given, or one of the forms of desiccated milk already referred to. The amount of proteids should be gradually increased, if they appear to be digested well. It may be worth trying milk which has been predigested by pancreatine. Every care must be taken that the feeding bottle is clean, and the food prepared with the most scrupulous care. Whenever the weather permits, the infant must be taken into the open air as much as possible. The medicines given must be selected according to the most prominent symptoms. If the stools are loose, contain much mucus and curd, and are foul or stinking, small doses of castor-oil emulsion or calomel should be given, to be followed by bismuth and small doses of opium. If the stools are dark brown or yellow and very liquid, astringents in the form of extract of logwood, catechu, or pomegranate will be of most service, especially if small doses of opium are given by the bowel. (F. 20, 32.) If the diarrhœa approach the dysenteric type, much mucus and blood being passed with straining and forcing down, irrigating the bowel with a warm decoction of starch and boric acid (20 to 30 oz.) or small enemata of starch and opium may be used with advantage.

The treatment of chronic gastric catarrh in infants when it has become confirmed is very often extremely discouraging. In the milder forms of vomiting the importance of modifying the milk so as to reduce the quantity of curd, or of peptonising the milk to gain the same end, must be insisted

upon ; milk foods containing much fat are usually badly borne. It is also of much importance not to give food too frequently, but to allow the stomach a complete rest for several hours. In severer cases in which milk or whey, in whatever form given, returns sour and curdled in a few minutes, other food must be substituted, at least for a time. In such cases barley water, made with weak veal broth (half a pound to the pint), may be given ; the bottle being discontinued and the infant fed with a spoon. Instead of veal broth, raw meat juice or 'liquid meat' may be used. After a few days, milk may be again tried, or small quantities of cream may be added to the barley water in lieu of the meat juice. In this acid condition of stomach small doses of sodii bicarb. and pepsine are often very useful. (F. 34, 35.)

In **older children** careful dieting is of the utmost importance, and the first difficulty encountered will probably be that the child has been over-indulged and so spoilt by its parents that it is difficult to get it to take a carefully selected and restricted diet. In arranging a diet it must be borne in mind that the child should take only such quantities as the impaired state of the digestive juices can deal with, any excess being liable to undergo decomposition in the intestines, and give rise to flatulence and other troubles. It is also most important to give the stomach a complete rest during the intervals between meals ; sweet biscuits taken during the morning, or a run on the kitchen at frequent intervals during the day, are fruitful sources of chronic indigestion, and the plainest and most peremptory directions should be given to the parents by the medical attendant that nothing whatever should be taken except at regular meals. If the child refuses or only half gets through its breakfast, this should by no means be supplemented by a second edition at the parents' table, or a tasty lunch to make up for the morning's deficiencies. It is wiser by far, if the breakfast is but half taken, to let the child wait till the next meal ; a little starvation can do no harm, at any rate much less than over-indulgence and the formation of bad habits. The importance of fresh air and change of scene in cases of habitual indigestion can hardly be over-estimated. The worst kind of exercise is a 'constitutional' taken with the nurse or governess ; outdoor games of various kinds, gymnastics, riding, or driving, or some form of recreation which will occupy the mind and give an interest to the exercise, are far preferable to any dull routine. A change to the seaside, or some bracing elevated inland site where there is a keen cool air, will often work wonders in these cases. It must, however, be remembered that such cases are often worse, or there is no improvement, at first ; children when first removed to the seaside are apt to do too much and eat too much ; they are over-tired and fretful at night, and attacks of dyspepsia and urticaria or other eruptions occur. A caution is often necessary to prevent this.

It is wiser in most cases to lay down a complete diet chart for the guidance of the parents, though a certain latitude must necessarily be permitted on account of varying tastes. The following diet tables may be taken as samples, which can be modified according to circumstances :

Diet for a child of five to seven years, indigestion not severe :

Breakfast, 8 A.M.—A breakfast cupful (8 oz.) of bread and milk, made from whole-meal bread ; a teaspoonful of malt extract may be added ; this

may be followed two or three times a week by the yolk of a lightly boiled egg on strips of toast, or a piece of toast and dripping or bacon fat.

Dinner, 12 to 1 P.M.—A broiled mutton chop, *finely minced*, or fresh white fish, with mashed potato, spinach, or French beans; to be followed by ground-rice pudding or a baked apple. Milk to drink.

Tea, 4 to 5 P.M.—A cup of cocoa and milk, with toast or stale bread.

Supper, 7 P.M.—A cup of beef tea or mutton broth.

In the more severe and protracted cases it is well to avoid farinaceous food as much as possible, as recommended by Dr. Eustace Smith.

Breakfast, 8 A.M.—Half to three-quarters of a pint of fresh milk, alkalinised by twenty drops of the saccharated solution of lime; a slice of toast with yolk of egg, or fresh fish.

Dinner, 12 to 1 P.M.—A small mutton chop or boiled sole, a thin slice of stale bread, with half to a wineglassful of sherry or bitter beer, well diluted.

Tea, 4 to 5 P.M.—Same as breakfast.

Supper, 7 P.M.—A cup of beef tea.

In some of these cases of chronic dyspepsia, especially where the stools are pale, the amount of milk which the child takes must be lessened in quantity—the milk given being much diluted with cocoa made with water, or peptonised milk may be given.

In all cases of habitual indigestion it is of much importance to sponge every morning with cold or tepid water (60°–70°), keeping the child's feet in warm water during the process, if it is subject to cold feet or has a sluggish circulation. A shower bath is often of much service. After the morning's bath friction with as rough a towel as the child's skin can stand should be used. The child's dress should consist of woollen garments next to the skin, and every chance of getting cold should be avoided.

The medicines which are of the greatest value in these cases are nitric acid in combination with helaline and pepsin (ℳxv to ℳxxx of the liq.), or euonymin and pepsine may be given. Arsenic is often of much value, but requires to be given in increasing doses to bring out its full value. For a child of seven years, three-drop doses may be given, and gradually increased to six drops, or it may be given in small granules, which are readily taken by children, preferably an hour after food. At the same time it is well to order a saline purgative, in order to keep the bowels relaxed rather than loose. Alkalies with senna or rhubarb are often prescribed with much advantage. (F. 38, 39.) Later, when convalescence is established, acids and bitters should be given. (F. 36, 37, 40.)

If the bowels keep confined, a small granule containing half a grain of aqueous extract of aloes may be taken at dinner-time daily; in many cases a grain will be required to keep the bowels well open. This may be supplemented, especially if the stools are pale, by an ounce or two of Hunyadi water, to which an equal quantity of warm water has been added, to be taken two or three times a week before breakfast, or Rubinat or Friedrichshall water, half a wineglass to a wineglassful in warm water, or a teaspoonful of effervescing Carlsbad salts, may be taken before breakfast two or three times a week, and decreased or increased according to the state of the bowels.

Congenital Stenosis of the Pylorus

Since Landerer in 1879 called attention to a form of stenosis of the pylorus in infants, many contributions have been made to the subject by Hirschsprung, Finkelstein, John Thomson, E. Cautley, Still, and many others.

The pyloric orifice is provided with a sphincter formed by circular muscular fibres, which is normally closed, but is inhibited from time to time during digestion to allow of the stomach contents to be forced into the duodenum. The thickness of the band of fibres forming the pylorus differs considerably in normal stomachs. The normal lumen of the pylorus in infants under a year usually readily admits a sound 3·5–4 millimetres in diameter (Still).

In cases of stenosis of the pylorus with hypertrophy of the sphincter, there is an elongated 'tumour' at the situation of the pylorus, which feels more or less hard. In some cases the lumen of the pylorus will only admit a probe, in others a small sound can be passed; possibly different states of spasm of the sphincter may account for the difference. If a longitudinal section be made of the pyloric tumour (see fig. 17), it will be noted that the pyloric orifice consists of a canal 2–2·5 centimetres long, surrounded by a wall made up of swollen mucous membrane and muscular tissue, which perhaps in the fresh state measures 5 millimetres thick. In many cases there is dilatation of the stomach and more or less hypertrophy of the muscular coat. Often a ridge of mucous membrane occupies the pyloric canal, and doubtless aids in the obstruction. It is certain during life there is obstruction to the escape of the fluids as the result of spasm of the hypertrophied sphincter and swelling of the mucous membrane lining the pyloric canal.

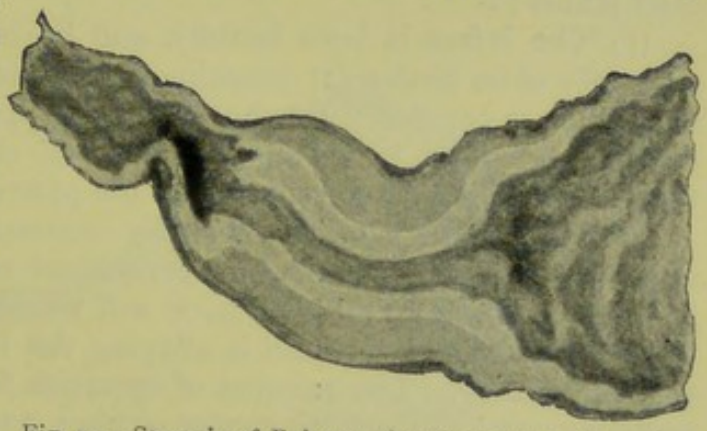

Fig. 17.—Stenosis of Pylorus, showing narrow channel, hypertrophy of muscular fibres, and hyperplasia of the mucous coat; death at six weeks. (Life size.) (From a drawing by W. E. Fothergill.)

The cause of this hypertrophy is unknown. Some writers look upon it as a local overgrowth, or an over-production of muscular fibre occurring before birth (Cautley). Others that there is a neurosis, which gives rise to an exaggerated activity of the pylorus and a secondary hypertrophy (J. Thomson).

In the majority of cases vomiting begins within a week or two, or within six or eight weeks of birth. The vomiting persists in spite of change of food, and treatment such as washing out the stomach. Several meals may be kept down and then vomiting begins, and large quantities of fluid with food remains are vomited up. The stools are scanty, and only contain bile or very little curd or food remains. The loss of flesh is very rapid, the infant gradually becoming reduced to a skeleton, with sunken eyes and anxious face. The abdomen is usually flaccid from the collapse of the small

intestines, which are practically empty of contents. The vomit is ejected with some force, especially if there is much hypertrophy of the muscular walls of the stomach. The dilated and hypertrophied stomach comes in contact with the abdominal wall below the left lobe of the liver, and its peristaltic movements may be seen through the flaccid and thin abdominal wall. There is a wave or contraction that runs from the cardia to the pylorus, which is seen perhaps very distinctly. The enlarged pylorus may in many cases be felt by palpation to the left of the umbilicus below the edge of the right lobe of the liver. Death ensues from exhaustion in the course of a few weeks or months.

While the above description holds good in typical cases, the symptoms in others are far less well marked and definite. The vomiting may cease for awhile, and the stools contain milk remains. No tumour can be felt, and there may be no peristalsis visible. In some cases improvement takes place under treatment, and apparently complete recovery.

The diagnosis is often difficult or impossible. The following are the chief points :—

(1) The infant is born healthy, and begins to vomit within a month or six weeks of its birth ; (2) vomiting persists in spite of treatment ; nearly all food taken is vomited ; (3) the stools are spare, and consist of bile and mucus ; (4) there is visible peristalsis of the stomach ; (5) a movable tumour is felt, which corresponds to the pylorus.

The treatment consists in daily stomach washing and giving small quantities of food, such as whey, peptonised milk, or some form of dry milk food. Sugar water and beef juice will sometimes be retained. Nepenthe in half-minim doses is useful in allaying the irritability of the stomach and relieving spasm. The question of operation for the relief of the stenosis will probably come to the front sooner or later, and some successful cases have been reported.

The operative treatment of pyloric stenosis, which is called for in cases where other methods of treatment have failed, consists in the performance of pyloroplasty or of Loreta's operation of dilatation or of gastro-jejunostomy. Of these the last is probably the most certain to give a permanently good result, but it is a rather more severe tax upon the powers of a weakly child, and if the case has been left too long, the mortality in any operation is likely to be high.

Dilatation of Stomach.—Dilatation of the stomach during infancy is commonly the result of a long-continued gastric catarrh ; in rare cases it is secondary to a congenital stenosis of the pylorus or duodenum, or upper part of the small intestine. In the minority of cases the dilatation takes place rapidly, as in acute gastric or gastro-intestinal catarrh, or in 'cholera infantum,' but it is far more frequently found in weakly infants or children who have suffered for months from chronic dyspepsia and who are probably anæmic and rickety. It is easy to understand that, if the digestive fluids are weak and insufficient to digest the food properly, the curd of milk and starches decompose in the stomach, and gases are given off in large quantities. The constant distension of the stomach keeps the muscular walls on the stretch, the muscular fibres become thin and atrophic, and the distended condition tends to become permanent. The gastric mucous membrane,

including the glandular elements, is wasted. The effect of a dilated stomach is to add to the dyspeptic troubles ; like a dilated and powerless bladder, its contents become stagnant and decompose ;· it never thoroughly empties itself, but always contains much mucus and decomposing curd of milk. These dilated stomachs sometimes reach an enormous size. Henschel records a stomach of an infant two weeks old with a capacity of 190 cc. (normal 70 cc.) ; an infant of three months with a stomach of a capacity of 485 cc. (normal 150 cc.) ; another of four months, of 500 cc. (normal, 180 cc.) ; and another of ten months of 650 cc. (normal, 300 cc.). The symptoms are not very definite, and we have on several occasions discovered *post mortem* a considerably dilated stomach, which we had not detected during life. There is chronic dyspepsia, discomfort after food, distension of the stomach with gases, coated tongue, and in some cases chronic vomiting. The diagnosis may be difficult ; in some cases the limits of the dilated stomach may be mapped out by percussion, but this can only be done if the colon and small intestines are not distended. If the colon is

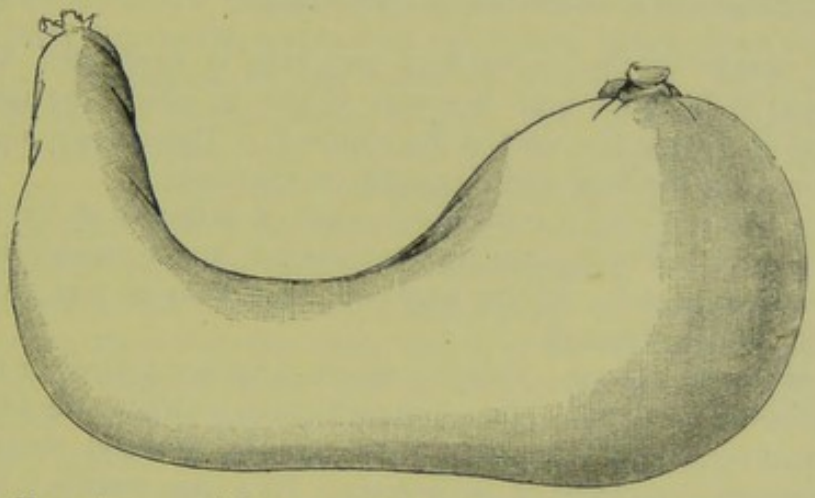

Fig. 18.—Hour-glass constriction of stomach, from an infant of five months. The muscular walls of the narrowed part were much thicker than the walls of the rest of the stomach. (Natural size.)

much distended, it will probably be impossible to distinguish between the tympanitic note produced by percussing the stomach and that produced by percussing the colon. A splashing sound may sometimes be produced by shaking the child, in cases of dilated stomach, if there is much fluid in the stomach. The prognosis is not necessarily bad, as there can be little doubt that under favourable conditions the stomach may recover itself. The treatment is that of chronic dyspepsia : washing out is useful but not easily practised in children, though readily enough performed in infants.

Dilatation of the stomach, sometimes extreme in degree, is present in congenital obstruction of the duodenum and ileum. (See p. 158.)

Hour-glass Constriction of the Stomach.—At times a well-marked constriction is found *post mortem*, situated at the junction of the cardiac and pyloric antrum and apparently the result of a spasmodic contraction of the muscular fibres at this spot. (See fig. 18.) In the case figured there was probably no malformation, but a condition of spasm which did not disappear with death.

Carcinoma of the Stomach.—New growths in the alimentary canal are exceedingly rare in early life. We have met with one case, but the new growth was more duodenal than gastric. The case was shortly as follows :

Oliver G., aged 8 years, was admitted to hospital Sept. 1, 1890. He was a thin boy, with distended abdomen and symptoms of cystitis. There had been no vomiting, pain, or diarrhœa. The abdominal distension was considerable : the coils of intestines could be distinctly seen through the abdominal walls. There was no tenderness, and no tumour could be felt. He was discharged February 21, 1891, somewhat improved, having made flesh during his stay. He was re-admitted April 23, 1891. The abdomen was distended and tender, and a tumour could be felt below the edge of the liver, to the right of, and about the same level as, the umbilicus. There were frequent attacks of severe colicky pains. He gradually emaciated, and died May 15. The *post-mortem* showed that the transverse colon near the hepatic flexure, the duodenum and omentum, were matted together ; the stomach was dilated, and its walls thickened. The pyloric opening just admitted the forefinger ; on the cardiac side of the pylorus were two small growths, the size of peas ; on the duodenal side there was an irregular cavity, the walls of the first part of the duodenum having been destroyed by a new growth ; lower down were some polypoid-looking growths ; below these the mucous membrane was normal. Microscopical examination showed the growth to be a columnar epithelioma.

Primary cancer of the stomach is very rare in early life. Cases have been reported by Scheffer and Norman Moore in which the new growths were situated at the cardiac end of the stomach. The chief symptoms were anæmia, œdema of the face and dyspnœa on exertion.

Finlayson has reported a remarkable case of sarcoma of the stomach in a child of $3\frac{1}{2}$ years. The patient became anæmic and vomited once or twice a brown-coloured liquid. At the *post-mortem* a tumour was found on the posterior wall of the stomach.

Ulcers of the Stomach.—Gastric ulcers whether simple or tuberculous are rarities during early life. In some rare cases a child suffers from gastric symptoms and occasional vomiting, then vomiting of blood commences and death occurs with symptoms of peritonitis. In a case reported by J. Porter Parkinson, in a child of two years a punched-out ulcer was found in the posterior wall of the stomach which had perforated into the peritoneal cavity. The opening was the size of a pin's head. There was a second small ulcer. We have seen one case of ulcer of the duodenum in a child which gave rise to hæmorrhage which ended fatally. Cases of ulcer of the duodenum have been recorded in newly-born children (T. Fisher). See also p. 32.

Tuberculous ulcers of the stomach are also rare ; Still found tuberculous ulcers of the stomach 6 times in 270 autopsies of tuberculous cases in children.

Intestinal Worms

The worms which most commonly infest children are the thread worms, round worms, and tape worms, of which the former are the most common.

Thread Worms (Oxyuris).—These troublesome pests inhabit the lower bowel, i.e. cæcum and appendix, colon, sigmoid flexure, rectum, and the vagina ; an unhealthy state of the mucous membrane with sluggish bowels appearing to favour their development. To the naked eye they appear like short pieces of white thread : under a low power the females, which are the more numerous, are seen to taper at each end, and their uterine ducts will be seen to contain numerous oval-shaped ova, some of the latter containing embryos.

These parasites gain entrance into the system by the ova being taken in the food, or perhaps more frequently by means of the ova adhering to the fingers of those already affected; they are thus conveyed directly or indirectly to others. The extreme fertility of these worms makes it certain that any one who is affected with thread worms and is not of scrupulously cleanly habits will have ova adhering to the neighbourhood of the anus which may be transferred by the fingers to the individual's own mouth or to others. The symptoms are very uncertain, the diagnosis being usually made by the patient's friends detecting the parasites in the chamber vessel used by the

Fig. 19.—*Oxyuris vermicularis*, female. Highly magnified. (Quain's 'Dictionary of Medicine.')

child. The most common symptom to call attention to the presence of thread worms is the irritation and itching which they are apt to give rise to at the anus or entrance to the vagina. Girls will suffer from excessive discharge of mucus from the vagina, sometimes containing blood, from the presence of oxyurides in the vagina or the result of scratching. In many cases the presence of thread worms seems to give rise to no symptoms whatever. Weakly anæmic children with sluggish bowels are most often affected. The treatment consists in expelling the worms, preventing their re-entrance, and in improving the health of the child so that it is less likely to provide a favourable cultivation ground for these unwelcome guests. The first indication is best fulfilled by a sharp purge to expel or else to drive them into the lower bowel, to be followed by enemata to destroy those present in the colon and rectum and wash away any excess of mucus present; a grain to two grains of calomel, in combination with two or three grains of resin of scammony, may be given to children of three to eight years of age overnight; and the following evening, if the bowels have been well acted upon, an enema of infusion of quassia as large as can be given should be used. It will be well to repeat the enemata every other evening for a week or two. Great care should be exercised to see that the child is washed about the genitals with soap and water after each stool to prevent re-infection. Injections should be used repeatedly to free the vagina from any of these worms, if there is any vaginitis or irritation. Weak carbolic acid lotions will answer very well, and some dilute red oxide of mercury ointment (1–3) may be smeared at the entrance to the vagina. The general health of the child must also be thought of, and a careful diet prescribed, excess of sweets and starches being avoided. If constipation exist, Rubinat or Hunyadi water should be given every other morning before breakfast, in sufficient quantity to produce a soft stool without purging; sulphate of iron, gr. ½–j, with spirits of chloroform and orange-flower water, twice a day, is often very useful. Cod-liver oil in selected cases is of great service.

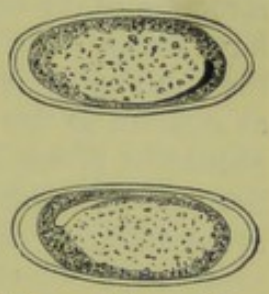

Fig. 20.—Eggs of *Oxyuris vermicularis* enclosing embryos × 450 diam. (Quain's 'Dictionary of Medicine.')

Naphthaline is an effective anthelmintic for thread worms, but it is disagreeable to take. It may be given as suggested by Schmitz in doses of two

to five grains four times a day till eight doses have been taken ; repeat in a week's time. If necessary, the dosing must be repeated after a week's interval. Enemata of corrosive sublimate (1–1,000) after the bowels have been freely moved is an effectual local application.

Round Worms (**Ascaris lumbricoides**).—The common round worm measures from four to twelve inches in length, the females being somewhat longer than the males ; they are reddish white and have more or less resemblance to common earth worms. They mostly inhabit the small intestines, but are apt to wander into the stomach, large intestines, or even into the gall bladder. Several may exist in the intestine at the same time, in exceptional instances many hundreds may be present. They gain entrance into the system by means of their ova, which are swallowed with the food ; the shells surrounding the ova are dissolved by the gastric juice, setting free the embryos. The symptoms produced by the presence of round worms cannot be certainly distinguished from those of dyspepsia or intestinal catarrh, with which the ascarides are so commonly associated. The passage of a round worm per rectum is often the first thing to call attention to the subject ; on the other hand, mothers often dogmatically assert that their child has worms because he 'picks his nose' and his 'food appears to do him no good.' The latter symptoms, it is needless to say, are not diagnostic of the presence of worms, but of an unhealthy state of the alimentary canal. The presence of one or two round worms rarely produces any symptoms *per se*, unless they pass into the stomach or bile duct. In larger numbers they may give rise to colicky pains, especially at night ; diarrhœa, vomiting, and symptoms of obstruction of the bowels have occasionally resulted. In rare instances worms have found their way into the peritoneal cavity and been discharged with the contents of an abscess through the abdominal wall. The treatment is not as difficult as the diagnosis. Santonin combined with calomel or castor oil should be given, and is almost certainly successful after a dose or two has been given. Santonin, gr. j–iij, calomel, gr. ½–j, may be given overnight, and some fluid magnesia or other saline next morning before breakfast. Or the santonin dissolved in two or three teaspoonfuls of castor oil may be given before breakfast. The santonin may be repeated once or twice, but not oftener, until the physiological effects (if any have been produced) have passed off. If the santonin cause vomiting, smaller doses should be tried or compound scammony powder substituted.

Tape Worms are as common in children as in adults, both the *Tænia solium* and *T. mediocanellata* being found. Infants and young children less often act as hosts for tape worms, but they have been found in infants under a year old. Attention is first called to the fact by the passage of the joints or proglottides in the stools. Older children will often complain of pain in the epigastrium, and peculiar movements are felt inside ; they are apt also to lose flesh and suffer from various dyspeptic symptoms. The difficulty of dislodging the greater part of the creature is not great, but the head is not so easily expelled, especially that of the *Tænia solium*. The success of the treatment by means of the administration of male fern depends upon the intestine containing as little food as possible. A dose of castor oil should be given overnight sufficiently large to act freely before morning ; twenty to thirty drops of etherial extract of male fern (freshly prepared) should be given

in half an ounce of mucilage and water before breakfast ; breakfast should consist of some light refreshment such as beef tea : at noon another dose of castor oil should be given, which will act in the course of the day, bringing away the intruder. Careful search should be made for the head, bearing in mind that the joints are likely to break about an inch from the head, that the latter is about the size of a large pin's head, and the thickness of the worm itself near the head is only that of a stout thread.

If, after careful search by a competent observer, the head is not discovered in the stools, after a few days the treatment may be repeated, but it is not wise to continue to repeat the male fern, as toxic symptoms are apt to arise. Decoction of pomegranate root may be substituted if it is necessary to continue the treatment.

Ascites

Fluid is sometimes present in the peritoneal cavity of the child without dropsy elsewhere, and it may be difficult to decide as to its cause. The diagnosis of ascites when it forms part of a general dropsy, as in cardiac disease or renal disease, is easy and does not call for special comment.

An ascites which is primary in a child is usually the result of some lesion of the peritoneum, as chronic peritonitis, or the result of portal obstruction such as mediastinitis, cirrhosis, or perihepatitis. The detection of a large or moderate quantity of fluid in the peritoneal cavity is not difficult, the percussion note being dull in the flanks, while the region round the umbilicus is tympanitic in consequence of the distended intestines floating upwards when the patient is lying on his back ; change of position on to the side will float the intestines to the highest point, and the flank which is uppermost will now be resonant. While change of the patient's position will thus cause the fluid to gravitate to the lowest point if it is free in the peritoneal cavity, it must be borne in mind that in chronic peritonitis there may be a matting together of the intestines which prevents them from floating upwards, and consequently there may be no alteration in the percussion note after change of position. The amount of dulness to percussion may vary from day to day according to the varying distension of the intestines. In ascites the superficial veins of the abdomen are usually enlarged, the skin becomes shiny and stretched if the fluid is excessive, and often the umbilicus is protruded and pouched out, containing fluid which can be pressed back into the abdominal cavity. The detection of a small quantity of fluid in the abdomen is difficult, especially when the intestines are much distended with gas and the large bowel is loaded with fæces, the latter giving a more or less dull percussion note in the flanks. Fluctuation may be felt by passing the finger into the rectum ; fluid may thus be detected in the pelvis. A careful observer is hardly likely to mistake simple distension of the intestines with gas for ascites ; the thrill imparted to the contained fluid by gently tapping the flank is absent in the flatulent distension, and on percussion the abdomen is universally tympanitic. The diagnosis of the cause of the ascites is often difficult, as a large accumulation of fluid may be due to chronic peritonitis and closely resembles an ascites due to portal obstruction. Chronic peritonitis may be quite unaccompanied by pain or tenderness from first to last, and the fluid may be excessive. Any matting or

induration of the omentum or intestines to be felt through the abdominal walls, or a slight evening rise in the temperature or sign of tuberculosis elsewhere (as in the testis), or chronic diarrhœa, would be in favour of chronic peritoneal tuberculosis. A normal temperature, the ascites fluid freely movable, the general health good, slight jaundice or bile pigment in the urine, would be in favour of portal obstruction, as cirrhosis or mediastinitis. If the fluid is localised by the presence of adhesions, and does not occupy the whole peritoneal cavity, it is probably due to tuberculosis. The possibility of hydatids of the peritoneum must be borne in mind. An enlargement of the spleen with ascites suggests cirrhosis of the liver.

CHAPTER VII

DISEASES OF THE DIGESTIVE SYSTEM—(*continued*)

Acute Peritonitis

ACUTE general peritonitis is not an uncommon disease during infancy and childhood. It occurs as a primary disease, but more often the inflammation spreads from some organ or structure with which the peritoneum comes into relation. It sometimes follows a blow or some injury to the peritoneum. The fœtus also suffers from peritonitis, perhaps more subacute than acute, and the adhesions which are left surrounding and matting the intestines are apt to interfere with the growth and development of the gut, and lead to stenosis or obstruction by narrowing the bowel or tying it up in coils. Acute peritonitis occurs in the newly born, secondary to arteritis or septicæmia ; but such cases are rare in private practice. Apart from these cases, peritonitis is not common in infants and young children. We have seen one case of purulent peritonitis ending fatally in a breast-fed infant of seven months. The source could not be traced. It was probably due to infection with the pneumococcus. We have known it in infants and young children to spread from a suppurating mesenteric gland. Acute peritonitis occurs in older children by no means infrequently, supervening, without known cause, in the midst of apparent health ; in other cases there is a history of a chill, or a blow upon the abdomen, and at the *post-mortem* there is nothing to indicate where the inflammation commenced, though in all such cases there is no doubt invasion of the peritoneum by one of the pyogenic organisms, most commonly the bacillus coli, and this most frequently gains access through some area of lessened resistance in the bowel wall. In other instances, as described later, pneumococci are the cause of the mischief. Not infrequently the peritonitis is the result of some lesion in the cæcum, vermiform appendix, or mesenteric glands. It sometimes occurs in tuberculous subjects : thus a phthisical boy of nine years old was suddenly seized with pain in the abdomen and vomiting, and died in ten days : at the *post-mortem* an acute general peritonitis was present, and also adhesions from old peritonitis and some calcified mesenteric glands. Acute peritonitis may be caused by the spread of inflammation from other parts, as from the pleura, an empyema bursting through the diaphragm, from the pericardium, ulcers in the stomach, duodenum, ileum, or cæcum, or from intussusception. It may occur in the course of typhoid fever from perforation of the

intestine and extravasation of fæces. It is rare in the course of scarlet fever, but it is not uncommon in the last stages of the succeeding nephritis, when uræmic phenomena have set in; it is then mostly of a purulent character. We have seen peritonitis *post mortem*, which was associated with an acute enteritis, and it is certain that, in some cases, an apparently idiopathic peritonitis is set up by a bacterial infection from the intestines.

Gonococcal Peritonitis.—Acute peritonitis has been observed in association with and apparently due to vulvo-vaginitis in little girls; in some of these cases the infection has been found to be gonococcal, but in others no gonococci were found. It appears that the prognosis is usually good in this form of peritonitis and early operation is uncalled for.

Pneumococcic Peritonitis.—It is probable that many cases of acute peritonitis formerly classed as idiopathic or of obscure origin were really due to the presence of the diplococcus of pneumonia. Pneumococcic peritonitis may occur as a primary lesion or in association with infection elsewhere. It may be diffuse or localised. It is in some cases characterised by the outpouring of a large quantity of lymph and turbid serum, or of thick viscid pus, and this quantity may be so great as to produce a very high degree of intra-abdominal tension; we have seen the fluid spurt out to a distance of several feet on opening the abdomen.

The symptoms of this form of peritonitis are not so severe as in those of streptococcic infections, and the prognosis is certainly much better, especially in the localised variety.

Pneumococcic peritonitis is much more frequent in children than in adults, and attacks girls much more often than boys and is especially frequent in the pelvis. It is possible that infection sometimes occurs directly through the pelvic organs, in other cases it follows an enteritis or arises by direct extension from the pleura or from blood infection. It is not very common and is usually apparently primary, i.e. the peritoneum is first attacked. In early stages the fever is high, with diarrhœa and abdominal tenderness, but the active symptoms often subside for a time and the process becomes localised and the abscess often points at the umbilicus.

Pneumococcic peritonitis is most likely to be mistaken for appendicitis or for a tuberculous inflammation, with which it may occasionally be combined. Pneumococcic appendicitis is a recognised lesion, and we have met with cases we believed to be of this nature, though they were not verified by bacteriological examination.

The prognosis in this form of peritonitis appears to depend upon, first the presence or absence of associated lesions in the organs; secondly, upon diffusion or localisation of the inflammation; and, thirdly, upon early incision and drainage. In a case of our own, already alluded to, though the pleura contained pus with the characteristic diplococci, the fluid in the peritoneum showed a micrococcus tetragonus. The case was carefully examined and recorded by our friend Dr. Bythell. It recovered well after drainage of the pleura and the peritoneum, the latter through the umbilicus.

In brief, a very acute and severe generalised peritonitis coming on without assignable cause in a girl under 10 years old, marked by rapid and great distension, great pain and tenderness, with high fever and diarrhœa, and proving rapidly fatal, is very likely to be a diffuse pneumococcic infection,

and on inspection, pus, white or yellow or green in colour, variable in quantity, and either dispersed in many small foci or generally diffused, will be found.

Or, on the other hand, a less severe condition with little marked constitutional disturbance, and a hard swelling limited to the region below the umbilicus, at which pointing and spontaneous discharge occur with satisfactory recovery, is probably an encysted pneumococcic peritonitis, and if some complication causes death, a thick layer of lymph will be found shutting off a cavity in front of the intestines and enclosing yellow or green viscid pus. The treatment consists in early incision and drainage, and the prospect is good.

Symptoms and Course.—The symptoms of acute peritonitis in the infant and child are by no means always as characteristic as they are in the adult, and cases will sometimes occur where extensive peritonitis is found at the *post-mortem* which was not suspected during life, especially when it supervenes in the course of some other disease.

The attack usually begins with vomiting, sometimes diarrhœa, and great pain and tenderness in the abdomen referred to the region of the umbilicus : the amount of tenderness on pressure varies even in cases where no opium has been given, and where the patient is under the influence of this drug pain may be entirely absent. Constipation after the onset is a marked feature when the attack is established, no fæces and often no wind passing by the bowel ; the vomiting is constant, the distension of the bowels very great, so that the coils of distended small intestines may be seen through the abdominal walls, and the case may readily be assumed to be obstruction of the bowels from some mechanical cause. Though no complete obstruction exists, yet the coils of intestine are seen *post mortem* to make sharp turns on one another, 'kinks' being formed, which, with the layers of lymph on their surface, must seriously impede the passage of their contents. The paralysis of the muscular coat of the bowel, by diminishing or arresting the normal peristaltic movements, further prevents the onward movement of the intestinal contents. The vomiting is mostly constant as long as food is given ; undigested food, bile, and sour-smelling intestinal contents may be brought up, but the vomited matters are seldom fæcal as they are in hernia or in intussusception. There is usually moderate fever, the temperature being 101° to 102° F., but a normal or subnormal temperature may persist throughout the case, and distension is not always present. The pulse is nearly always considerably quickened.

In the later stages the abdominal distension is often extreme, the coils of distended intestine may be readily discernible through the walls of the abdomen, the face becomes pinched and blue, the pulse quick and thready, and the patient dies collapsed, often suddenly at the last. While this is the all but universal ending of a case of general peritonitis, when the symptoms have fully declared themselves, cases undoubtedly occur in which the diagnosis of peritonitis is made, on account of the distension and pain in the abdomen, which gradually improve under treatment, and finally recover. There is reason to suppose that cases of acute peritonitis will occasionally get well, even when the attack has been a general one. In other cases the symptoms of a local suppuration, hectic, local tenderness, and swelling, succeed to those

of a general peritonitis. In such cases, presumably, there may have been a local peritonitis from the first.

The following cases will illustrate some of the above remarks :

Acute Suppurative Peritonitis.—John C., aged 7 years. The family history was good. He had been a strong boy up to the time of his fatal illness. No cause could be assigned for his sickness. Four days before admission to hospital he complained of a pain in the 'stomach' ; there was vomiting and constipation. On admission to hospital on the fifth day of his illness, the face wore an anxious expression, as if he was in pain ; the abdomen was distended and tense, and tympanitic and tender to the least touch ; his legs were drawn up ; he constantly vomited dark, sour-smelling, almost fæcal stuff. The urine, drawn off by a catheter, contained albumen. All food and drink by the mouth were stopped, and he was given ten-minim doses of tinct. opii every second hour till three doses had been given. He passed a restless night, yet was drowsy from the effects of the opium. He gradually sank, dying on the evening of the sixth day of his illness. At the *post-mortem*, on opening the abdomen, a few ounces of offensive pus escaped ; the surface of the intestines was injected ; the bowels were matted together with lymph ; there was no strangulation. The cæcum and vermiform appendix were normal ; there were patches of intense congestion on the mucous surface of the ileum, and a sharply cut ulcer (not perforating), half an inch in diameter, some two feet above the cæcum. No certain cause for the acute peritonitis was found, unless it be assumed—which indeed is not improbable —that an enteritis existed in the first instance, and that the peritonitis was secondary.

Acute Peritonitis.—Boy, 13 years, said to be delicate, but had never been ill. He played with his brothers on Wednesday afternoon, tumbling about on the floor—no definite history of a blow. Thursday he did not eat his breakfast, and said he felt sick ; vomited several times during the day, and was thought to be upset from a disordered stomach. Friday morning vomited, and in much pain ; bowels acted slightly ; not much distension ; child died same evening, 6 P.M. *Post-mortem, Monday, July* 29, 1889.—Some decomposition ; omentum normal ; surface of small intestines intensely injected, most marked below umbilicus ; some lymph, not excessive quantity ; bloody serum between intestines, a few ounces in pelvis. Vermiform appendix : external surface injected ; no evidence of past inflammation. Slitting up of intestines showed them to be normal, except the lips of the ileo-cæcal valve, which were injected ; the appendix seemed thickened and œdematous, and contained some mucus only. Lungs were normal ; heart also normal ; the blood dark and fluid, and there were small extravasations of blood on the surface of the heart. In this case the boy died in two days from acute peritonitis. No cause could be assigned, unless it resulted from a blow when playing with his brothers the day before he was taken ill. There was no bruising of the abdominal wall.

In the following case the symptoms closely resembled acute obstruction of the bowels from strangulation :

Acute General Peritonitis.—John C., aged 9 years, was healthy up to February 9, when he was injured by a blow in the abdomen ; but the injury does not seem to have been very severe. He complained of pain in the belly, and vomited the same evening. He continued to vomit five or six times a day till his admission to hospital (under Dr. Hutton) on the fifth day of his illness. He had passed nothing per rectum except a small stool after an enema, and it was supposed he was suffering from an intussusception. On admission his face was flushed, the eyes sunken ; the abdomen was tightly distended, the coils of intestines being plainly seen. He complained of paroxysms of pain in the abdomen. He vomited fæcal matter shortly after admission ; there was pain on deep palpation in the right iliac fossa, but no marked tenderness. Full doses of opium were given. The next day (the sixth of his illness) it was thought advisable to make an exploratory opening into the abdomen (which was done by Mr. Wright) ; the intestines were deeply coloured, and matted together with lymph ; no constricting band or invagination was detected ; the wound was closed and a drainage tube inserted. The boy gradually sank, and died suddenly the next day. At the *post-mortem* a general acute peritonitis was found ; no cause for it was made out after a careful search.

In the light of the *post-mortem* examination, it would seem that saline purgatives or purgative doses of calomel would have been worth trying in the above cases.

In the following case the peritonitis was secondary, occurring in the course of scarlatinal nephritis :

Acute Nephritis : Peritonitis.—Sarah W., aged 8 years, was attacked with scarlet fever, the initial symptoms being vomiting, high fever, and rash. She was admitted to hospital on the third day. The tonsils were sloughy ; there was much glandular enlargement and high fever. The temperature varied from 100° to 101·6° F. till the twelfth day, when it reached 102·6° F., and a trace of albumen appeared in the urine. On the thirteenth day the temperature was 104° F., and only two hundred and fifty cubic centimetres of urine were passed. From the fourteenth to the sixteenth day the urine passed was only from seventy to one hundred cubic centimetres daily ; urine contained fibrinous and epithelial casts. Eighteenth day, vomiting, temperature 103° F. ; only seventy cubic centimetres of urine. Nineteenth day, no urine passed ; severe abdominal pain, respirations shallow and thoracic, abdomen distended and tense. Twentieth day, temperature 98° to 99° F., patient collapsed. Twenty-first day, death. At the autopsy a general sero-purulent peritonitis was found ; pleurisy of left lung ; acute glomerular nephritis.

In the following case the cause of the peritonitis was doubtful, but there is no doubt it was very extensive, and it is a good illustration of the value of operation even in extreme cases of purulent peritonitis. This boy had the livid blue colour and general aspect of illness so far advanced that it was only by special wish that it was thought desirable to operate.

Acute Purulent Peritonitis : Operation, Recovery.—Fred A., aged 12½. Six weeks before admission was kicked by a horse in the right side of the abdomen. He was apparently not much hurt, and was allowed by his doctor to get up on the following day. Five weeks after the accident, on May 27, 1894, he had slight abdominal pain, supposed to be due to eating cucumber. Vomiting and pain soon followed, and tenderness in the right iliac fossa a day or two later. The pain spread upwards, vomiting increased, and extreme tenderness appeared in the left hypochondrium, with collapse. He was admitted on June 4. At that time he looked very ill ; anxious face ; pulse small ; abdomen full, moves very little with respiration ; legs moved freely ; abdominal walls rigid, tenderness most marked on left side ; nothing specially to be felt on right side. A few hours later, face dusky and blue ; rectal examination revealed greater resistance on the left side than on the right. The abdomen was opened in the middle line below the umbilicus, and a large quantity of fæcal pus escaped. The abscess filled up the left iliac fossa, and appeared circumscribed, but there was resistance in the right side also. He gradually improved ; the quantity of pus escaping from the tube and its fœtor lessened, and though for some time there was tenderness in the right iliac region, he steadily got well, and was heard of in good health four or five months later.

Diagnosis.—A pleurisy of the base of one or other of the lungs is often mistaken for peritonitis, as the sharp stabbing pain is apt to be referred to the abdomen where the intercostal nerves terminate. In some cases, especially if the pleurisy involve the diaphragm, the similarity to peritonitis may be great, and it is common to find that hot fomentations or mustard poultices have been placed upon the abdomen by the friends under the idea that there is peritonitis. Where pleurisy exists there is no real tenderness of the abdomen on pressure, and the physical signs of pleurisy or pleuro-pneumonia will be detected in the chest. An attack of colic is not often likely to be mistaken for peritonitis ; in the former there is pain and distension of the abdomen, but no tenderness or elevated temperature. An intussusception may be mistaken

for peritonitis; but the attack of pain is more sudden in the former, and there is not often much tenderness; the detection of an elongated tumour would usually decide the diagnosis; an intussusception and peritonitis may be present together. Acute peritonitis is apt to be mistaken for acute obstruction of the bowels, such as results from the constriction of a knuckle of bowel by a band. The distension of the intestines with flatus, the vomiting of sour-smelling intestinal contents, as well as complete obstruction to the passage of wind, may be present in both; there may be little tenderness, and but slight or no fever. The diagnosis may be very difficult or impossible, though the history of the case, the absence of fæcal vomiting, and the less complete obstruction to the passage of both flatus and fæces in the case of peritonitis, will usually help the decision. It is hardly necessary to add that it is only in some cases of acute peritonitis that the difficulty exists, as usually the pain, tenderness, and distension of the intestines are diagnostic of peritonitis. The presence of 'tormina' with a fixed painful spot at which the spasms seem to focus is perhaps the most characteristic sign of obstruction, though it is of course more marked in cases of acute supervening upon chronic obstruction than in cases acute from the first.

In cases of peritonitis it is a good rule in the absence of some obvious cause always to suspect the appendix.

Morbid Anatomy.—The tendency to pus formation, which all inflammations in children exhibit, is noticeable in peritonitis, as in acute cases the fluid found in the peritoneum is thick and turbid, or it may rank as pure pus. The amount of lymph and fluid varies in different cases; pus or turbid serum will often be found in meshes of lymph between the coils of intestines, a larger collection being present in the pelvis. In all cases of apparent idiopathic peritonitis, a careful search should be made for a local starting point; the cæcum, mesenteric, and retro-peritoneal glands being carefully examined, and the probability of pneumococcic infection must be remembered.

Prognosis.—This is always grave; the more acute the symptoms, the more rapidly the fatal result occurs. The prognosis in any case mostly depends on the diagnosis, for, if acute general peritonitis is present, a fatal result is almost certain unless operation can relieve.

Appendicular Peritonitis.—Instead of a general peritonitis taking place, a local inflammatory action may be set up, which goes on in many cases to the formation of an abscess, or a general peritonitis may supervene. The commonest local peritonitis is appendicitis, as it is generally called. The cæcum is especially apt to be the seat of irritation, a peculiarity which it doubtless owes in part to the fact that it is in some sense a cul-de-sac, and also to the change in the character of the intestinal contents which takes place in this portion of the bowel. But further than this the appendix itself is still more often the seat of morbid change from either obstruction to the escape of its normal secretion, or from extension of inflammation from the cæcum to the lining membrane of the appendix. Much more rarely the entrance of fæcal or other foreign matter into the lumen of the smaller tube causes irritation. Rheumatic and other forms of appendicitis are described, but the name is of doubtful value. The appendix from its richness in adenoid tissue may be looked upon as the tonsil of the large intestine, and like the faucial tonsils may become inflamed as a result of direct infection with

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poisonous matters. Inflammation of any part of the appendix is apt to cause a cicatricial narrowing at that spot, and extension of the process through the walls gives rise to adhesions and often to sharp bends or kinks, which narrow or obliterate the lumen. Hence obstruction may arise from swelling of the mucous membrane throughout, from thickening of adenoid follicles locally, from retention of inspissated secretion, from stricture or even obliteration of the lumen, or from kinking, or rarely from a foreign body. In any case retention of secretion occurs, and under those conditions the bacillus coli becomes either alone or in conjunction with other organisms pathogenic, and an attack of 'appendicitis' is set up. The symptoms presented by this disease in the child resemble those present in the adult. The attack may begin with diarrhœa and perhaps vomiting, with more or less obscure pain and tenderness in the abdomen, and feverishness. It is often extremely difficult to localise the pain and tenderness in a small child, and it may be quite impossible at first to refer the tenderness to any one spot, especially as the abdominal muscles are apt to be rigidly contracted, and the child cries directly it is touched. The state of the bowels varies; sometimes they are relaxed, at other times obstinately constipated. In the course of a few days, during which time the pyrexia continues, if a satisfactory examination can be made, more or less resistance may be detected by palpation in the iliac or lumbar region, and a dulness on gentle percussion, though this may be masked by the distension of the small intestines. The patient may now, especially if he has been judiciously treated, gradually improve, and all pain and tenderness disappear in the course of a week or two. On the other hand, the tenderness may increase, a distinct hardness and induration may be felt in the right iliac region, the right leg is drawn up, and the child cries with pain if it is moved. The subsequent course of the attack is uncertain: there may be a gradual subsidence of all the symptoms, or, if the abscess is not opened, the hectic fever may continue, the child gradually emaciate, while the pus which has been formed is making its way to the surface, and the abscess may point in the iliac region, may discharge into the bowel, or, in rare cases, into the bladder or vagina. Fæces may be found in the pus discharging from the iliac abscess, and a fæcal fistula result, or all the signs of general peritonitis, abdominal distension, extreme tenderness, and collapse, may come on.

The diagnosis of appendicitis is often by no means easy, and yet of much importance, inasmuch as a mistake in diagnosis may readily cost a life. In the early stages, the diseases most likely to be confounded with it, especially in small children, are coprostasis or accumulation of hardened fæces in the cæcum, and invagination of the intestines; in a later stage, when the patient is seen for the first time after an abscess has formed, there may be uncertainty as to the source of the pus. Children who have just begun to run alone, and are able to make frequent excursions into the kitchen, or who are fed on all sorts of indigestible food, are especially liable to suffer from an accumulation of hardened fæces in the cæcum, which may set up more or less irritation, and give rise to symptoms exceedingly like those of appendicitis. There are distension of the abdomen, colicky pains, vomiting, slight feverishness, constipation, or, on the other hand, diarrhœa; and it must be borne in mind that looseness of the bowels is quite compatible with

a loaded cæcum or large intestine. It may be possible to detect a fæcal tumour in the right lumbar region. The diagnosis in a fretful spoilt child may be exceedingly difficult, but the symptoms of impacted fæces in the cæcum will be rather those of colic, the pain coming on spasmodically, with no pain or tenderness in the intervals; while in appendicitis the pain will be constant, and the tenderness on deep pressure unmistakable. In any given case it is far better to err on the safe side, and to mistake colic for typhlo-peritonitis, than to fall into the more serious error of overtreating a child suffering from a local peritonitis with purgatives and enemas. An ileo-cæcal invagination with its symptoms of sudden obstruction of the bowel is probably not very likely to be mistaken for appendicitis; the sudden attack in an infant in perfect health, the colicky pains, the straining, and passage of blood and mucus, and the presence of a painless tumour, would in most cases prevent a mistaken diagnosis. To make a diagnosis, an examination under chloroform may be necessary with the finger in the rectum.

The value of rectal examination was well shown in a patient of Dr. Denholm's, in whom, with signs of peritonitis, no evidence at all conclusive could be found of the locality of the mischief till an examination of the rectum was made while the child was under chloroform. A mass was then felt filling up the pelvis on the right side, and a diagnosis of appendicular peritonitis, with the appendix hanging over the brim of the true pelvis, was arrived at. An incision as for ligature of the external iliac artery allowed the peritoneum to be turned forward, and the abscess was with some difficulty reached, and opened without soiling the general cavity of the peritoneum, which must have been inevitably done if the abscess had been sought by the usual route. The appendix was felt lying in the abscess cavity. The child did perfectly well.

It is of great importance to remember that in older children who are able to describe their symptoms it is usual to get a complaint of general abdominal or umbilical pain before there is any local suffering in the right iliac fossa, and, further, it is so common, both in adults and children, to have a complaint of pain in the *left* iliac area that we look upon this as almost a symptom of appendicular mischief. It must be remembered that this left iliac pain is not *necessarily* a 'referred' pain, for we have more than once found an abscess dependent upon disease of the appendix tracking across the abdomen, below the attachment of the mesentery, to the left side, and have actually opened such an abscess in the left groin and afterwards removed the appendix from the right groin.

Peritoneal Abscess. Intestinal Fistula.—Apart from the suppuration which is liable to take place as the result of a typhlo-peritonitis, other abscesses are liable to occur in the abdomen, due in the majority of cases to tuberculous disease in the mesenteric, retro-peritoneal, or rectal glands. Local abscesses may also occur as the result of a blow or following a perforation of the intestine in typhoid fever or tuberculous ulceration. As an instance of a glandular abscess in the abdomen the following case may be taken as an example:

Abdominal Abscess: Discharge of Pus at Umbilicus.—A girl of 7 years of age was admitted to hospital, having suffered for thirteen days with pain in the abdomen, fever, and vomiting. On admission there was some dulness below the umbilicus and great tenderness; the temperature varied from 100° to 102°. The day after the umbilicus

oecame prominent and the skin red; it gave way and pure pus was discharged. The wound continued to discharge for some time—on one occasion a cheesy mass was removed from the sinus, followed by a fresh discharge of pus; the sinus finally closed on the forty-eighth day. At the end of ten weeks the girl was fat and strong; there was some induration, but no pain or tenderness below the umbilicus. On one occasion there was some pus in a stool.

Abdominal Abscess: Operation.—A girl of 12 years was seized with vomiting, fever, and abdominal tenderness; sordes formed on the teeth, the tongue was brown, there was extreme distension of the abdomen; the bowels did not act, and no flatus was passed. On the eighth day there was a crisis, the temperature fell to normal and the pulse from 120 to 80. At the same time a slight prominence was noted just below and to right of umbilicus; this was cut down upon and 2 oz. of fæcal pus escaped. The recovery was uninterrupted.

Tuberculous Abscess.—In an infant, seen with Dr. Noble, of Kendal, it was noticed a week or two after birth that the abdomen was more rounded and distended than usual. When five weeks old the abdomen was intensely distended, shiny, with enlarged veins on the surface, and with redness and protrusion of the umbilicus; the abdomen was resonant all over, and nothing could be felt on palpation. A few days later the skin at the umbilicus gave way, and pus discharged freely. The infant a few days after died in convulsions. A large abscess cavity was found at the autopsy, and caseous mesenteric glands. Apparently this was a case of congenital tuberculosis.

In other cases with somewhat similar but more chronic symptoms, there has been evidence that an abscess had formed, probably in a mesenteric gland, and had opened into the bowel, pus being discharged with diarrhœal stools. Other cases occur which are by no means so satisfactory in their terminations, being in many instances associated with a chronic tuberculous peritonitis or mesenteric disease. There are symptoms of abdominal trouble, attacks of vomiting and diarrhœa, hectic fever and wasting, an induration, and at length an inflammatory blush around the umbilicus; the latter becomes perforated and pus discharges. Frequently, sooner or later, the discharge becomes fæcal from the presence of intestinal contents, a fistulous opening having become established. In the majority of such cases the abscess apparently originates in a mesenteric gland, an abscess cavity is formed, which is surrounded by coils of small intestine matted together, and the abscess opens both at the umbilicus and into the bowel in some part of its course; but as such cases are mostly chronic, opportunities for *post-mortem* examinations are not frequent, and when an opportunity presents itself there is so much matting of parts that it is difficult to make out the origin of the abscess.

The following case illustrates this difficulty:

Abdominal Abscess: Fæcal Fistula.—A girl of 4 years of age was in hospital, June 1879, with obscure abdominal symptoms, hectic and wasting; in the following December she was admitted with a sinus at the umbilicus; discharging pus and intestinal contents, an abscess having broken ten weeks before. The fistulous opening continued to discharge pus and liquid yellow gaseous fæces till her death in October 1880. At the *post-mortem* the liver and spleen were lardaceous. The umbilical sinus was connected with an abscess cavity containing one or two ounces of pus and fæces, and surrounded on all sides by intestines matted together; this cavity communicated with the ileum a foot and a half above the cæcum by two openings large enough to admit a little finger. On the peritoneal surface of the small intestines were cretaceous nodules, apparently the remains of a past tuberculous peritonitis. In the ileum were many cicatrices and calcareous remains of old ulcers and cheesy solitary glands.

In this case the perforation of tuberculous ulcers or the suppuration of mesenteric glands had been the cause of the abscess and fistulous openings. In several cases coming under notice the fistulous openings have closed up permanently, one after discharging for seven months, and in some others the fistulous opening has closed, but the patient has died of general tuberculosis.

Occasionally an abscess due to a breaking-down tuberculous gland may form a well-defined mobile swelling instead of pointing at the umbilicus. In 1901 we saw a child of five years old with Mr. Dabbs, who gave us a history that a swelling had been noticed in the abdomen a month before. The swelling was to the right of the middle line, freely movable, and of the size of a swan's egg, it was tense and elastic, and we formed the opinion that it was probably omental or mesenteric in origin. There was a phthisical family history, but the child itself seemed well. On opening the abdomen a large cyst containing pus was found apparently enclosed by or between the layers of the omentum and mesentery. Other caseous glands were present. The abscess was opened and drained, and the child got quite well.

Treatment.—The treatment of peritonitis will naturally depend upon its cause, and unfortunately we are constantly in doubt about this, or indeed if peritonitis exists at all, especially in the early stages of the disease. In any case of peritonitis or doubtful case, we must feed with the greatest care, allowing only small quantities of readily absorbed forms of nutriment, such as Brand's essence or bovril, and only small quantities of fluid of any sort. These may be given iced. If the vomiting is severe and continuous, all fluid must be withheld by the mouth and rectal feeding adopted. Hot fomentations applied to the abdomen relieve pain and comfort the patient. Some prefer to apply an ice-bag, but it is not as comforting as moisture and heat. Opium given with a free hand has been our sheet-anchor hitherto in the treatment of peritonitis, but of late years there has been a considerable revulsion of feeling, especially on the part of abdominal surgeons. There can be no doubt of its value in relieving pain and checking the intense griping which often occurs, but on the other hand it masks the symptoms and makes diagnosis more difficult, helps to paralyse the intestinal walls and so lock up the intestinal contents and favour the formation of toxines in the stagnant fluids in the bowel. In suitable cases there can be no doubt that saline purgatives are of the greatest value in clearing out the bowels and getting rid of flatus. There can hardly be a doubt that in past times we have been too much afraid of purgatives, and have erred too much on the side of keeping the bowels at rest and thus locking up their contents. In any case of obstruction of the bowels from a constricting band or an invagination, it is clear that purgatives can do nothing but harm, but on the other hand, at the onset of general peritonitis secondary to enteritis or intestinal infection, they afford the best chance for the patient. In any case seen early in which we can exclude invagination or strangulation of the bowel, we should certainly give a purgative, preference being given to salines or calomel to secure a free evacuation of the intestinal contents. An enema containing sweet oil and turpentine should be given to clear away the contents of the large bowel ; it is seldom that an efficient enema is given by the patient's friends, and it is better for the medical man to see for himself

that it is done thoroughly and efficiently. Nepenthe or morphia should be given only to relieve intense pain, and it is best given in association with belladonna. The amount to be given and further treatment of the case must depend upon the decision come to as regards operative interference.

Since acute purulent peritonitis is practically certainly fatal if it becomes generalised, it is of the utmost importance to provide an outlet for a localised abscess rather than allow it to go on and rupture into the general peritoneal cavity. Hence, as soon as it is clear that a local form of inflammation is not subsiding under medical treatment, the safest course is carefully to cut down upon and let out the pus. In perityphlitic abscess ('appendicular peritonitis') when with fever there is local pain, tenderness, and induration and drawing up of the leg, an incision should be made just internal to the anterior superior spine of the ilium and the muscular layers separated; the neighbourhood of the abscess may be made clear either by the sense of fluctuation or by the œdematous condition of the tissues. The incisions should be made parallel to the fibres of the external oblique, and on exposing the internal oblique and transversalis their fibres should be separated and not cut across. By this proceeding the abdominal wall is not weakened and the liability to ventral hernia is practically prevented. A director is then thrust in the direction of the suspected cavity, and if pus appears the opening is enlarged with dressing forceps and the cavity drained and treated on ordinary principles (antiseptics being used unless the pus is foul). There is little danger in such an operation; even if no abscess is met with and the peritoneal cavity is opened, no ill result is likely to follow, while the danger of rupture of an abscess into the general peritoneal cavity is very great. Local peritoneal abscess elsewhere is much more uncommon, though it may be met with on the left side (perisigmoid abscess), and this can be made out at times by rectal examination. The treatment is that of the perityphlitic condition. It is of little importance in such cases to make out whether the abscess is really a local peritonitis or a collection of matter in the cellular tissue outside the peritoneum, since, if peritoneal, it is usually completely shut off by adhesions from the general cavity, and there is no fear of pus flowing from the wound into the peritoneum. Local abscesses elsewhere must be treated on similar principles. Should a general purulent peritonitis already exist, the question of treatment is more uncertain and the prospect far less hopeful; there is, however, little doubt that the right course is to open the abdomen, sponge it or wash it out with some unirritating antiseptic, such as boracic lotion, and drain the peritoneum. Should there be general fæcal extravasation from perforation of the cæcal appendix, or from a typhoid ulcer, the case must be looked upon as well-nigh desperate; the attempt, however, must be made to expose the perforation, suture the intestine, and in the case of the appendix remove it and close the end. Cases of iliac abscess of uncertain origin are not uncommon, and operation is almost always successful, and though it may be said that these are a different class altogether from the local peritonitis group, it is difficult to distinguish between the two, and there is certainly a risk of perforation into the peritoneum. In appendicular abscess nothing more should be done than simple incision and drainage; no attempt should be made to remove the appendix or look for the cause of the suppuration except that

the finger may be gently passed into the abscess and any foreign body removed. We have several times found a fæcal concretion lying loose in one of these cavities. The greatest care must be taken not to break down the wall of adhesion round the abscess. The opening of a *local* appendicular abscess is in our experience almost always a successful operation in children, but it is of course far otherwise if the suppuration has been from the first, or has been allowed to become general; in such a case, too, a full search must be made for the source of the trouble, and an attempt made to remove it, whether by ligature and excision of a perforated appendix, or such other means as the particular case may require. We are distinctly opposed to the plan which finds favour amongst some surgeons of removing the appendix in cases of acute abscess. It is undoubtedly true that occasionally—though in our experience very rarely—recurrent attacks are met with after an abscess has been drained—i.e. in such cases the source of irritation has not been completely removed. The risk of the manipulations required for removal of the appendix in cases of acute localised abscess, however, far outweighs the advantages, and it is better to be satisfied with drainage at the time and remove the appendix subsequently in the rare event of such a step being required. This rule, of course, does not apply to the cases where a gangrenous or perforated appendix is lying loose in a case of *diffused* suppurative peritonitis.

In cases of recurrent 'appendicular peritonitis' removal of the appendix is undoubtedly the proper course to pursue, since life is in constant danger as long as the source of the mischief remains. The operation is best done about a fortnight after the attack has subsided. Recurrent appendicitis, so common in young adult life, is not very frequently seen in children; in them the more delicate tissues seem to suppurate more readily, and abscess is the rule. We cannot emphasise too strongly the desirability of early operation in these cases. If with a high temperature a child has a distinct induration or sense of resistance in the right iliac region, the sooner the swelling is explored the better. We have never regretted operating, and never failed to find pus in these cases, even where its presence seemed doubtful. We feel sure from observation that in many instances in which it has been supposed that 'resolution' took place there has really been an abscess which discharged into the bowel.

Iliac Abscess.—The occurrence of iliac abscess, right or left, is frequent in children, and the various causes of such mischief should be borne in mind; the principal ones, some of which have been already mentioned, are caries of the spine, tuberculous disease of the mesenteric glands—in this case the abscess is more often umbilical—disease of the hip, innominate bones, or sacro-iliac joint, perinephritic abscess, rare in children, and the still rarer cases of hydatid cysts. Empyemata, superficial abscesses and abscesses the result of injury, 'simple psoitis,' &c. are to be thought of in addition to those already described as resulting from irritation of the cæcum or appendix. But, besides all these, it is common to find iliac abscesses the cause of which remains obscure, and we are satisfied that in many of these cases the suppuration is simply due to inflammation of lumbar, iliac, or pelvic lymphatic glands, just as cervical abscesses occur from irritation of the glands of the neck. The source of irritation is often doubtful, but is sometimes due to the

presence of worms or other irritating matters in the bowels ; sometimes to extension from the more superficial lymph glands. The diagnosis can usually be made by careful exclusion and by the history ; rectal examination is often of much value, by enabling the extent and position of the abscess to be made out, as well as sometimes by revealing a source of irritation. These abscesses should be opened antiseptically and drained in the usual way : it will often be found that they extend for long distances upwards or downwards into the pelvis. The limb on the affected side should be steadied by a splint or by extension. The prognosis is good, provided no permanent source of suppuration be present. Almost every case that we have seen has recovered, and we believe this is largely due to early opening of the abscesses.[1]

Chronic Peritonitis.—Chronic peritonitis is a comparatively common affection during childhood, and in the vast majority of cases is tuberculous. A few cases of chronic non-tuberculous peritonitis in which the diagnosis has been confirmed by a *post-mortem* have been recorded, notably one by Henoch which ran a course of six weeks ; at the *post-mortem* cloudy fluid and organising lymph were found in the peritoneal cavity. This case seems to have originated in a blow. Cases frequently occur in practice of chronic peritonitis with ascites, in which there is no evidence of tubercle in any organ, and which completely recover ; this, however, is no bar to the acceptance of the belief that such are tuberculous, as there is ample *post-mortem* evidence to show that tubercles and lymph on the surface of the peritoneum may become cretaceous or be converted into fibrous tissue. Two forms of chronic tuberculous peritonitis are met with in practice, in which for the most part a well-marked clinical difference exists, one distinguished by the large amount of ascitic fluid and in which probably ascites is the only symptom present, and the chronic cicatrising form in which there is induration and thickening of the great omentum and a matting together of all the abdominal organs with little or perhaps no fluid. The same tuberculous process is going on in both cases, but produces in one a large amount of effusion, in the other less or perhaps no fluid, but the effusion of lymph and its gradual organisation and cicatrisation.

Ascitic Form.—Chronic peritonitis is by far the most common cause of ascites, or rather dropsy commencing in the peritoneal cavity during childhood, while, as well known, some form of portal obstruction is the commonest cause in adults. Ascites due to chronic peritonitis is not common during the first year of life ; not that it does not occur, but the infant dies before the chronic stage is reached. It is not uncommon during the second year of life, and occurs with some frequency up to and beyond puberty. There is generally a history of pain in the abdomen of a more or less obscure kind which has been regarded as due to indigestion, probably also both feverishness and diarrhœa, and then the belly begins to swell. In some cases the enlargement of the abdomen is the first symptom which leads the friends to think anything is wrong with the child. On examination a rounded and distended abdomen is found, there is dulness and fluctuation to be felt in the flanks if the patient is lying on his back ; while there is a more or less

[1] For details of some of these cases we may refer to a paper in the *Arch. of Pædiatrics*, vol. i. 1884, and to the *Children's Hospital Abstracts* ; also *Lancet*, February 1891 ; and also *Pneumococcic Peritonitis*, supra.

extended region of resonance around the umbilicus where the distended small intestines are buoyed up to the surface. The fluid may, however, be localised by adhesions. The abdomen is often greatly distended, the skin tense and shining, the abdominal veins enlarged and tortuous, and in young children the skin at the umbilicus is protruded, and contains fluid which can be pressed back into the abdomen. There is usually complete absence of pain and tenderness, the disease is frequently feverless during the greater part of its course, and the patient looks rather as if he were suffering from ascites due to some obstruction in the portal system. The course of the disease is essentially chronic, and recovery frequently takes place if the tuberculous disease remains local.

Thus in one case a girl, aged 13 years, who was in hospital for some five months, and from whom eight to nine pints of ascitic fluid were removed through one of Southey's cannulas, completely recovered, and was four years after a strong girl, supporting her mother and family by her work. In many similar cases we have seen recovery take place ; one suffered from a tuberculous testis which discharged through the scrotum and healed. On the other hand, such children are apt to be carried off by a tuberculous meningitis, or the mesenteric glands become cheesy, or a tuberculosis of the lungs takes place. In any case it will, of course, be necessary to examine the lungs carefully, and a long-continued hectic and wasting would suggest a more extended area of tuberculosis. In cases which end in recovery there is probably a matting together of the intestines, and frequently more or less induration may be felt about the great omentum or cæcum. In cases which are of long standing it occasionally happens that a perihepatitis with more or less cirrhosis of the liver takes place. This was the case in a boy of $3\frac{1}{4}$ years who was admitted to hospital, under the care of Dr. Hutton, with ascites, œdema of the feet and ankles, jaundice and enlarged liver ; at the *post-mortem* the liver weighed 15 oz., the capsule was thickened and the surface was irregular and granular ; on section there was a great excess of fibrous tissue, old and recent peritonitis and tuberculosis of the lungs.

Cicatrising Form.—In many cases of tuberculous peritonitis there is little or no ascites from first to last, but lymph is effused on the surface of the peritoneal covering of various organs, and if the patient live long enough, fibrous adhesions are formed. On the *post-mortem* table, local or general peritonitis is frequently found in children dying of tuberculosis ; thus, out of 105 *post-mortems* of tuberculous children made during the four years 1882–85, there was peritonitis in 38, though in comparatively few of these was the peritonitis an early and important lesion. While this form of peritonitis is mostly chronic, yet some cases run a more active and subacute course. The early symptoms are pain in the abdomen, usually referred to the umbilicus, often attacks of sickness and diarrhœa, hectic, and the presence of induration or irregular-shaped masses felt through the abdominal walls. The amount of tenderness on pressure differs greatly ; it is most marked in the acuter cases, and absent in the chronic ones. But in cases wasted and exhausted by acute disease, even a purulent peritonitis may be present without any pain or tenderness. The state of the abdomen varies, it is sometimes distended with gas, at other times more or less retracted ; often no distinct tumour can be felt, but on very gentle percussion a distinct loss of resonance,

or a muffled resonance, may be detected over the umbilical region in consequence of the thickening and induration of the great omentum, or a resistance may be felt on palpation, or hard irregular tumours can be detected, the result of matting together of the omentum or intestines. Hectic fever is mostly present, the temperature rising to 102° or 103° at night and falling to normal in the morning, and more or less general wasting of the body ensues ; but the amount of fever and wasting present will depend upon the extent to which the mesenteric glands and thoracic viscera are affected. Diarrhœa is not usually a marked symptom unless tuberculous ulceration has taken place. The subsequent course of these cases differs much ; in the minority, after several months of hectic, improvement slowly sets in and the patient improves, for a time at least appearing fairly well. In the majority the fever continues, the wasting becomes more apparent, diarrhœa, and perhaps cough, come on, and the child sinks. In others, the lungs remain free to the end, but mesenteric disease ensues, ulceration of the bowels takes place, perhaps local abdominal abscesses form, and the liver, spleen, and kidneys become lardaceous. In only four of the thirty-eight cases of fatal tuberculous peritonitis mentioned were the lungs and mediastinal glands found entirely free from tubercle.

Prognosis.—The course of chronic tuberculous peritonitis is usually long, unless some intercurrent disease, as tuberculous meningitis, supervenes. Children may be under observation for many months, with either ascites or induration of the omentum, with more or less hectic, and with no evidence of any active disease of the lungs, and finally to all appearance completely recover. On the other hand, the onset of diarrhœa, hectic, progressive emaciation and cough, with evidence of lung mischief, points to the existence of more or less generalised tuberculosis, which necessarily shortens the duration of the illness. Albuminuria, as pointing to lardaceous disease, would be of bad omen.

Diagnosis.—When a child is brought with an ascites which has made its appearance gradually without pain or fever, it is perhaps not unnatural to attribute the collections of fluid in the abdomen to obstructed portal circulation. In an adult the commonest cause of ascites is cirrhosis of the liver, in a child by far the most frequent cause is chronic tuberculous peritonitis. In a given case it is perhaps quite impossible to make a certain diagnosis, inasmuch as for a while the ascites may be the only symptom present ; there may be a complete absence of pain or tenderness, and the most careful palpation fail to detect any induration of the omentum. The bowels may float up and cause a resonant note on percussion at the umbilicus when the patient is on his back, the resonance shifting to the flank which is uppermost when he lies on his side. It may be impossible to feel the edge of the liver, or map it out by percussion. In other cases, however, there will be less difficulty, for there is hectic fever, or diarrhœa, or abdominal pain and tenderness, or after paracentesis lumps or masses of induration may be felt. A family history of tuberculosis would naturally favour the view of tuberculous peritonitis ; and occasionally the presence of a cheesy deposit in a testis will decide the diagnosis. The fact that the fluid is encysted is in favour of tuberculosis.

Morbid Anatomy.—Fluid varying in quantity will be found in a few cases ; it may be clear or cloudy serum or pus, in which latter case it is

usually localised : it is not uncommon, on separating the intestines, to find small local collections of pus. Tubercles and lymph are usually present on the great omentum and mesentery, matting the intestines together, also between the liver and diaphragm and around the spleen ; where there is no large collection of fluid, the adhesions are frequently very extensive ; the intestines and stomach may be adherent to the abdominal wall, so that on opening the abdomen the intestines are cut into. The intestines, mesentery, great omentum, liver, and spleen may be so matted together, partly by lymph, partly by fibroid adhesions, that it may be impossible to separate them. The intestines may be so adherent and bound down as to form bends and kinks that it is impossible to unravel. Cheesy mesenteric glands and tuberculous ulcers will very likely be present.

Treatment.—Any pain and tenderness in the abdomen in a child with tuberculous tendencies should excite apprehension and never be neglected. Rest in bed must be enjoined, and a diet consisting of beef tea and milk should be given. The pain may be relieved by applications of belladonna and glycerine covered with cotton wool, or by fomentations. The bowels ought to be relieved by enemata and laxatives rather than purgatives. In the chronic stages, when the abdomen contains fluid or there is evidence of thickened and indurated omentum or cheesy masses, mercurial applications are of service. An ointment of yellow oxide of mercury (20 grains to the oz.), with an equal quantity of ung. belladonnæ, may be applied, with cotton wool to cover it. Lin. hydrarg. may be used, but salivation is likely to follow if continued for too long a time. Tonics and cod-liver oil emulsion should be given. Chronic purulent peritonitis, whether tuberculous or not, should be treated by incision and drainage, if the child's health is failing ; and there is good evidence to show that not only may temporary relief be thus given, but long lasting, if not permanent, recovery may take place as the result of incision. Even where the fluid is not purulent in obstinate cases drainage is of service ; it appears to cause adhesions and thus to prevent the re-collection of fluid, while at the same time cicatrisation takes place. We have little doubt that, in all cases of tuberculous peritonitis in which there is any considerable collection of fluid, whether purulent or not, the abdomen should be opened and drained as soon as it is evident that in spite of treatment extending over some months no improvement is taking place. We have successfully employed this method, and are impressed with its value.

It is not necessary or even desirable to drain the cavity in these cases unless the exudate is purulent. In the serous form of tuberculous peritonitis it appears to be sufficient to open and empty the abdomen of fluid and then close the wound. Mere tapping is apparently not sufficient. Even in the cicatrising variety operation is sometimes useful.

Acute Obstruction of the Bowels.—Children occasionally suffer from acute obstruction caused by twists in the bowel, constricting bands, impaction of foreign bodies, and internal hernia ; by far the most frequent cause is, however, an intussusception.

Internal Strangulation in an Acquired Pouch.—In November 1903 we saw, with Dr Orr, of Eccles, a boy aged 8 who had always been subject to slight colicky attacks. Four days earlier, after a meal of pork, he, with all the rest of the family, was seized with

gastric pain accompanied by vomiting, but without diarrhœa or distension, or any serious rise of temperature. The day before we saw him he became worse; there had been no action of the bowels, the vomiting of coffee-ground material continued, and there was still no distension. On the day of our visit rapid distension and rigidity of the abdomen appeared. We found him looking very ill, with a pinched face and tense, very hard abdomen. He was rolling about the bed in agony, and vomiting brown material. Nothing could be found externally to account for his condition. The abdomen was at once opened, and the small bowel found much distended and congested, with patchy ecchymoses. A cord was found running from the mesentery at the back and tying down a loop of bowel; the cord was not very tight, and was brought up and divided. The intestines still failed to come up freely, and on further examination a crescentic opening was found at the back of the abdomen opposite the umbilicus, with a coil of gut fixed in it. On manipulation a caseous gland broke down, and it was found that the tight arch was due to matting of tissues under which the bowel had become strangled. With a little trouble the bowel was drawn out with a jerk and was found to be very dark coloured. It was necessary to open the gut to relieve the distension, and a tube was fixed in the bowel opening. No recovery from the collapse followed, and he died the same night. Here it appears that the irregular peristalsis caused by the unwholesome food had forced the bowel under the arch formed by the old adhesion, and so produced strangulation.

Intussusception

The commonest cause of obstruction in infants is the presence of an invagination of the bowel. Many reasons have been given for this somewhat frequent accident. There is no doubt that one cause is to be found in the great reflex irritability of the muscular coat of the infant's bowel; vigorous peristalsis is easily set up, and, moreover, the intestinal walls being thinner during infancy than in later life, an invagination of one portion of the gut into a lower portion more readily takes place. This is seen in the *post-mortem* invaginations so often found: the act of dying seems to stimulate the peristalsis of the bowels, and it is no uncommon thing to find on the *post-mortem* table many invaginations in the ileum an inch or two in length. In some cases an accident, such as falling out of bed, or some rapid movement up and down in the parent's or nurse's arms, or the administration of a strong purgative, has preceded symptoms of an intussusception, and it is possible that a sudden movement might cause a toneless piece of gut to become invaginated. It must also not be forgotten that the infant's intestines, especially the cæcum and colon, are more movable than those of an adult, having a wider mesentery, and consequently one piece of bowel is more easily dragged into another portion.

Fig. 21.—Ileo-cæcal intussusception. *a*, Ileum (the Intussusceptum); *b*, cut edge of window in colon made to show the middle layer; *c*, colon (the Intussuscipiens).

The exciting cause of intussusception is occasionally found to be a polypus, more often an inflammatory thickening of the cæcum, or some hardened nodule of fæcal matter which adheres to the wall of the gut, and sets up local peristalsis. We have met with a case, related below, in which a local tuberculous peritonitis causing thickening of the bowel was the

immediate cause of the invagination. Sometimes tuberculous caseating glands are found in the mesentery, which has been dragged into an intussusception. This occurs in children of over eighteen months or two years of age, rather than in infants. It is quite probable that such a gland pressing into the wall of the gut may be the starting-point of the invagination.

With regard to the frequency of intussusceptions at different ages, it has been stated by Pilz that, out of 293 cases, 153 were in their first year, and of these 98 were from four to six months of age. According to Leichenstern, out of 122 cases, 73 were under a year old and 49 from one to five years of age. It is certainly the common experience that the majority of cases occur in infants under a year, and that from four to six months of age is a very common time. Pitts records 115 cases, of which 81 were under a year old.

In at least three-fourths of the cases in infants the invagination is ileo-cæcal, in the minority of cases it is ileum into ileum or colon into colon. In the ileo-cæcal variety the ileum enters the cæcum, not through the ileo-cæcal valve, but the cæcal valves are pushed before it, so that the valves themselves occupy the lowest part, and as it travels downwards, more and more of the ileum enters, dragging its mesentery along with it and forming the inner tube, while the middle layer is formed by the inverted cæcum and colon, the colon also forming the outer layer. The layers of an intussusception therefore consist of (1) an outer layer of intestine into which the invagination takes place, the peritoneal coat being external and the mucous membrane internal; (2) a middle layer continuous with the outer layer at its upper end but turned inside out so that the mucous membrane is external and the peritoneum internal; (3) an internal layer formed by the intestine entering the outer layer with its mesentery and vessels, and this becoming nipped as it travels downwards forms the obstruction. In consequence of the mesentery becoming dragged in, the included intestine does not lie in the centre of the containing gut, but is more or less tilted to one side. As a result of the invagination, the inner and middle layers become congested and œdematous and of a dark-red colour; blood is extravasated from the congested mucous membrane and is passed per rectum. In some cases, lymph is thrown out by the serous surfaces and a local or general peritonitis takes place. In a few cases, more particularly in the ileum into ileum variety, sloughing may take place and the invaginated bowel be separated and passed per rectum, while fæces may be extravasated or recovery take place by a process of cicatrisation. The extent to which life is threatened depends very largely upon the tightness with which the bowel is nipped and the circulation of blood obstructed, and this appears to vary to a considerable extent, so that death may ensue in a few hours with the symptoms of collapse, or, especially in older children where the bowel is only partially obstructed and the circulation of blood through it but slightly interfered with, the course may be chronic, going on for weeks or even months.

Symptoms.—An infant of a few months who may very probably have suffered for a few days from symptoms of bowel irritation, suddenly begins to kick and scream as if in violent pain which nothing appears to relieve. It soon begins to vomit continuously, and strain as if it wanted to pass a stool, but nothing escapes but a little blood and mucus. In the intervals between the attacks of vomiting and colic, the infant may be tolerably quiet, but it is

usually restless and moaning as if in pain. On examination of the abdomen with the warm hand it is usually found more or less soft and flaccid, and on careful palpation in the course of the transverse colon, an inch or so above the umbilicus and towards the left hypochondriac region, an elongated tumour may be felt, which is movable, and, as a rule, not acutely tender. There may be also a feeling of want of resistance in the right lumbar region from the absence of the cæcum and ascending colon. In very fat infants it may be impossible to detect such a tumour. We must not, however, forget that if an early examination be made no tumour may be felt, inasmuch as the invaginated portion of ileum may only have passed two or three inches into the cæcum and lie too deeply to be felt. If it travels as far as the splenic flexure of the colon, it is tolerably certain to be felt. In some cases, as in one related below, no tumour was felt after forty-eight hours. The rectum should be next carefully explored with the finger, and the presence of a tumour there, which is pressed down when the child strains, while the withdrawn finger is covered with blood, would establish the diagnosis. The position of the tumour necessarily varies according to the length of the included gut; but inasmuch as the colon is nearest the abdominal wall where it crosses the upper part of the umbilical region, if this part is involved, as it usually is, the tumour will be most readily felt here. The temperature is mostly normal or subnormal, unless there is peritonitis, when it may be raised a degree or two. The tumour is usually not acutely tender, but if the case be an acute one, or, in other words, if the included gut be tightly jammed and its vessels strangulated, the child may scream on its being pressed. If the case continues unrelieved, the vomiting, straining, and distress continue, the child wears an anxious, pinched expression, with sunken eyes, and dies with the symptoms of collapse. The period at which death takes place varies; in infants it may be within twenty-four hours, more often from the third to the fifth day.

While the above description applies to the majority of cases, it must be borne in mind that the symptoms are at times far less well marked, so that the presence of an intussusception may be overlooked; there may be perhaps vomiting, colicky pains, and mucoid stools, the infant dying in convulsions. On the other hand, it is possible that an invagination may occur, and fortunately right itself before it becomes tightly impacted.

We have already remarked that an intussusception is by far more common in infants under six months or a year than it is in older children, and when it occurs in the latter, the symptoms in the early stages especially may be ill defined and consequently the diagnosis is difficult. There will be vomiting and severe colic with constipation, and in many cases no tumour can be felt, and there may be an entire absence of mucus or blood per rectum. In other cases the course is more subacute or chronic, there being no actual strangulation of bowel, at first at least, and the obstruction to the passage of fæces is not complete. In some of these cases there is some tuberculous lesion, either old or recent, present in the abdomen, which has in some way or other contributed to the commencement of the invagination. (See CHRONIC OBSTRUCTION OF BOWELS.)

The ileum into ileum variety is very uncommon in our experience in children. The symptoms produced will resemble those of a strangulated

hernia with fæcal vomiting and severe colic, and there may be, but not necessarily, mucus and blood passed by stool.

The following case illustrates some of the difficulties of diagnosis, inasmuch as no blood or mucus was passed by the bowel and no tumour could be felt.

Intussusception, Gangrene, Peritonitis.—A girl of 2 years (seen with Dr. A. Hopkinson) was knocked over by a perambulator, falling somewhat heavily on her side. Four days afterwards, during which period her bowels had acted normally, she was seized with acute vomiting and colic. She cried out from time to time, placing her hand on her abdomen, saying, 'Pain, mother, pain.' An enema was given without result. On the second day of the illness the vomiting and pain continued, the temperature was 99·6°, the tongue was clean, the abdomen was not distended or tender. On the third day some chloroform was given, and a careful examination made of the abdomen, but no tumour could be detected. Fourth day. The abdomen was distended and tympanitic with some dulness in the left groin; the pulse rapid and feeble, the eyes sunken; the vomiting, especially after food or fluid, continued, and also the paroxysms of pain. Death occurred on the fifth day. No stools or flatus were passed during the illness, no blood or mucus, and no tumour was felt. *Post-mortem.* Early stage of a general peritonitis, most marked on the right side. The large bowel was empty except the cæcum, the latter forming a tumour nearly three inches in length, the ileum having become impacted into it for about that distance. No amount of force sufficed to reduce it. On incision of the cæcum, the included ileum was found to be gangrenous. The appendix was long but otherwise normal. The mesentery contained some tuberculous glands. (We are much indebted to Dr. A. Hopkinson for his notes of the case.)

The diagnosis in this case was exceedingly difficult. The girl had eaten some indigestible food a day or two before, more or less of which had returned in her vomit, and it was at first naturally assumed that the improper food was the cause of the sickness and colic. Apparently the lower two or three inches of the ileum passed through the ileo-cæcal valves and quickly became tightly jammed.

In the following case there was an old tuberculous peritonitis and caseous mesenteric glands; the latter were found dragged into the invagination.

Intussusception: Partial Obstruction.—Kathleen P., aged 5 years, was admitted into the Children's Hospital, September 27, 1895. The girl had enjoyed good health up to three months before admission, but latterly had been getting thinner, and at times suffered from abdominal pains and vomiting. It was, however, only during the last three weeks that she had been attended by a doctor, the abdominal pain being very severe, the vomiting persisting and the stools being sometimes simply loose, at other times consisting of pure blood or blood and mucus. The vomit was never fæcal, but was sour-smelling and greenish in colour. The attacks of abdominal pain had been exceedingly severe, so that she rolled about in bed in agony. When admitted she was in a semi-collapsed state, but in much pain, twisting and writhing about in bed. The abdomen was somewhat distended: the coils of the intestines could be distinctly seen through the abdominal walls. The abdomen was slightly tender to the touch, and an elongated tumour could be felt in the left iliac fossa. This tumour was movable and could be rolled about under the fingers, and could be traced upwards to the edge of the ribs, where it was gradually lost. The finger in the rectum detected a soft cylindrical mass, high up with a definite 'os,' into which the finger could be introduced. There was blood and mucus present in the rectum. It was abundantly clear that the only treatment was to open the abdomen, and if possible reduce the invagination. Accordingly the abdomen was opened in the left linea semilunaris, and the intussusception readily exposed. It was quite irreducible, so a longitudinal incision was made in the intussuscipiens and the intussusceptum excised; the ends were united by an Allingham's bone bobbin and Lembert's sutures, but the child died in a few hours. It

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would have been better in this case to have strictly followed Barker's method, since after excision of the inner portion the ends separated and some fæcal contamination occurred. (See figs. 22 and 23.)

Morbid Anatomy.—On making a *post mortem* examination, care must be taken to distinguish between an intussusception which has taken place during life and given rise to the symptoms noted, and an intussusception which is *post mortem* and caused by the irregular yet vigorous peristalsis of the bowels which may take place during the act of dying or after death.

Fig. 22.—Intussusception removed by operation. The invagination was ileo-cæcal. (From a drawing by Dr. W. E. Fothergill.)

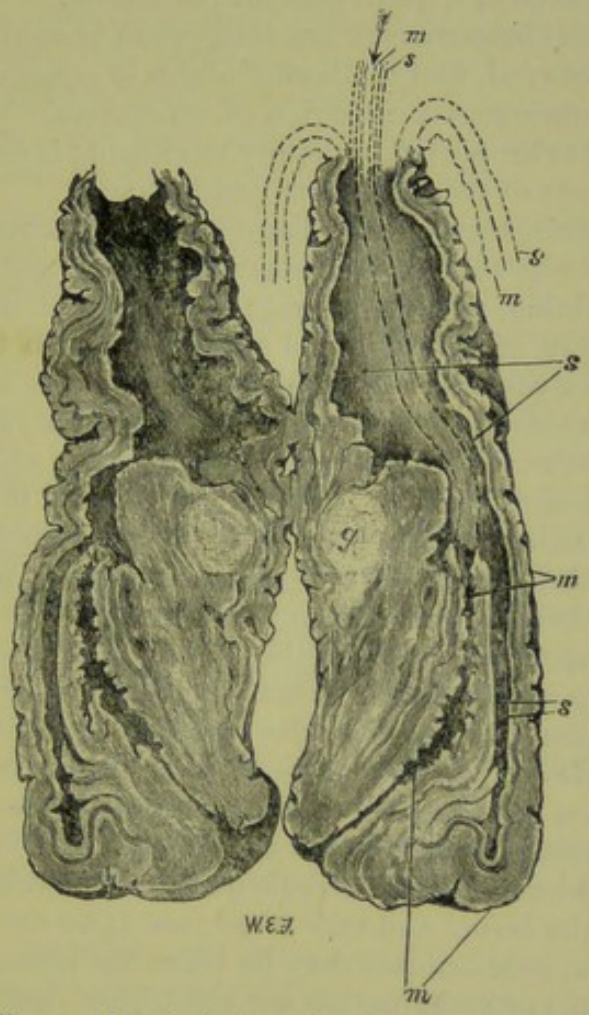

Fig. 23.—Longitudinal section of intussusception, fig. 22. The dotted lines show continuation of layers of intestine; the inner being small intestine, the outer the encasing colon; *m m m*, mucous membrane of intestine; *s s s*, peritoneal coat; *g*, caseous mesenteric gland dragged in. (From a drawing by Dr. W. E. Fothergill.)

In the latter case the invagination involves the ileum, or at any rate the small gut, and there are often several of them. They are rarely more than an inch or two in length, are readily pulled out by gentle traction, and while a ring of congestion may be seen near the seat of constriction, or where the gut has been doubled on itself, there is no œdema or marked congestion or effused lymph. A *post-mortem* invagination does not completely occlude the passage of the gut. In the examination in a case of the ileo-cæcal variety which has become strangulated, an elongated mass, dark red in colour, is seen lying in the course of the transverse colon continuous with it

at its lower end, while the ileum with its mesentery is seen to enter at its upper end; the ascending colon and cæcum will have disappeared. In most cases the contained gut cannot be withdrawn without tearing, as it has become rotten from gangrene. Its passage will, in an acute case, be completely occluded, partly on account of the œdematous and congested two inner layers, partly by reason of the tilting on one side of the inner gut through the dragging in of its mesentery. Lymph may be found effused between the two peritoneal surfaces, gluing them together, and there may be evidence of a more general peritonitis.

In chronic cases less congestion is seen, the bowel probably is not entirely obstructed, and the bowel above is generally hypertrophied and its mucous membrane in a condition of ulceration. We have already noted that sometimes chronic inflammatory thickening is found in the cæcum, and tuberculous lesions of the peritoneum and glands.

Diagnosis.—The diagnosis in an acute case in an infant is not likely to give rise to difficulty, inasmuch as the sudden attack of vomiting, with pain, straining, and the passage of blood and mucus from the bowel, and the discovery of an elongated tumour through the abdominal wall or per rectum, make the case tolerably clear. We may be more in doubt if with the above symptoms no tumour can be felt; but we must bear in mind that a short ileo-cæcal invagination may be present and lie too deeply in the right lumbar region to be felt. But the question of the presence of an intussusception sometimes arises in infants who are suffering from symptoms of obstruction to the bowels of an uncertain origin, possibly with a certain amount of thickening or resistance in the right iliac fossa, which may be due to the impaction of fæces in the cæcum or to an invagination. In all such cases, as long as any doubt exists purgatives should be avoided, and small doses of opium given to allay the pain and straining. Purgatives have been shown by D'Arcy Power to have a peculiarly fatal effect in intussusception even when operation has been subsequently resorted to. If there is pain on deep pressure, it is better to avoid enemata, trusting rather to narcotics. In older children the error may be made of mistaking an ileo-colitis for an invagination of the bowel and *vice versâ* (see ILEO-COLITIS), or obstruction of the bowels from other causes may be taken for intussusception. Multiple and complex forms of invagination are sometimes found; thus Golding Bird has recorded a case in which an ordinary intussusception downwards was enveloped in a second retrograde invagination, and another in which an upward invagination took place into a persistent Meckel's diverticulum. Watson Cheyne, 'Annals of Surgery,' Dec. 1904, records a case of intussusception of Meckel's diverticulum associated with others and with a stricture. Successful resection was done. References are given to other recorded cases. Appendicular intussusception is alluded to later.

Treatment.—The treatment which is to be adopted must necessarily vary according to the acuteness of the case and the time the symptoms have lasted, for if the bowel has passed into a gangrenous condition it is obvious that only harm can be done by treatment which might have been of the greatest service in an earlier stage. The questions to ask oneself before commencing treatment are, what is the state of the invagination? is the gut tightly jammed? is it gangrenous? Unfortunately these questions are very

difficult to answer, inasmuch as in some cases the inner layer of bowel becomes tightly impacted from the first, and no amount of force applied by distending the bowel per rectum will replace it ; while in other cases success has attended inflation of the lower bowel with air several days or even a week after the onset of the symptoms. Thus in a child[1] aged 7 months, under the care of Dr. J. S. Bury, injections of oil and afterwards of air were employed fourteen hours from the commencement, but failed to reduce the invagination, the infant dying twelve hours later, within twenty-six hours of the onset ; at the *post-mortem* 'reduction was quite impossible without tearing the gut' ; there was some lymph effused locally. In this case, by the end of twenty-four hours, the bowel was tightly strangulated, and neither by injections nor abdominal section could reduction have been effected. Such a case is no doubt exceptional, and it would probably have ended fatally under any circumstances unless mechanical replacement could have been undertaken, or laparotomy performed within a very short time of the seizure. By the time the invaginated portion of the bowel has travelled along the colon as far as the rectum, the collapse produced, especially in a small infant, is very great, and the difficulties in the way of replacement are necessarily much greater than if only a few inches of bowel are involved. But cases appear to differ very much in the amount of œdema and congestion taking place in the nipped bowel, and consequently in the difficulty of replacement. While some cases, such as the one just referred to, are acute and irreducible almost from the first, others are reported in which the intussusception was reducible some days after the onset of symptoms ; in one case, reported by Dr. W. B. Cheadle,[2] in a boy aged 5½ years, the invagination was successfully reduced by massage and the injection of air on the seventh day from the onset. In another case, reported by F. H. Elliott,[3] in an infant of 8 months, attempts at intervals to reduce the invagination were at first only partially successful, but finally succeeded.

As soon, then, as the existence of acute intussusception has been ascertained, it becomes necessary to decide what method of treatment should be adopted.

Recoveries after spontaneous reduction and after sloughing have been recorded, but they are so rare that waiting for a natural cure means practically abandoning the child to almost certain death. Even if recovery by sloughing takes place, the risk of subsequent stricture has to be considered. It is then clear that some attempt at reduction should be made, and we have the following plans at our disposal for this purpose. (1) Inversion of the child, combined with external taxis or succussion. The child is held up by the legs with the head downwards, and an attempt made to draw the contents of the abdomen to the upper part of the abdominal cavity by kneading and stroking with the hands through the abdominal wall, or by sudden shaking movements of the child an attempt is made to dislodge the intussusception. It is clear that this plan can only be expected to succeed when the intussusception is small in extent and recent in formation. Chloroform is required during the manipulations.

[1] *Medical Times*, Feb. 19, 1881. [2] *Lancet*, Oct. 23, 1886.
[3] *Ibid.* Jan. 8, 1887.

(2) Distension of the bowel with fluid or air in the hope of pushing back the invagination.[1] If fluid injections are employed an enema tube fitted with an anal shield should be passed into the rectum, and warm water or oil allowed to flow into the bowel from a vessel raised above the level of the patient's body. The amount thus injected must vary with the age of the child and the position of the intussusception ; from one to two pints is about the usual quantity, and a fall of not more than three feet is required.

Inflation by air is best managed by passing the nozzle of an ordinary pair of bellows, fitted with the pipe, into the rectum, and blowing air in till the tumour is felt to give way, or it is not safe to distend any further. In both these methods the abdomen should be carefully watched, and a hand kept on the intussusception tumour to feel for any change in its size or position.

The following cases illustrate the success of these methods of treatment :

Intussusception : Injection of Air : Recovery.—A fine healthy infant, 6 months old, was suddenly seized, on the evening of January 2, with griping pains and tenesmus. It had been brought up on the breast, with a bottle or two a day of cow's milk. The mother was menstruating for the first time, and the infant was cutting two lower teeth. His mother gave him an enema with a small ball syringe, which brought away a large curdy stool. During the night he was very restless, vomiting frequently, and straining constantly, and at 7 A.M. passed a bloody stool with mucus sufficient to saturate an ordinary napkin. We saw him, with Dr. E. H. Smith, of Knutsford, next morning, January 3, fifteen hours after the seizure. His face was placid, not drawn or distressed ; there was no fever ; the abdomen was flaccid and not distended, and could be easily palpated in every part. On deep pressure an elongated tumour was felt ; the left end was most distinct, and was situated in the left lumbar region, just below the ribs and near the tip of the spleen ; it could be traced from left to right across the abdomen for two or three inches, its outline being gradually lost. It was movable and not tender. No tumour could be felt in the right lumbar region or per rectum, but the finger, on being withdrawn, was covered with blood. We at once decided to reduce the invagination, which we believed to exist, by distending the colon by water pressure. The attempt proved a failure, as the water returned by the side of the catheter into the rectum without distending the colon to any great extent. We next tried the inflation of air, by means of an ordinary Higginson's syringe, the bone nozzle being inserted into the rectum ; the pelvis was raised, and the tumour gently kneaded, while air was forced into the bowel by squeezing the ball of the syringe. After four or five squeezes the tension in the colon was felt to be considerable, then followed a gurgling noise, and the tumour disappeared. We continued to pump more air in, in the hope that we might effect the complete reduction of the invagination. The infant seemed relieved, and went to sleep for some hours ; but towards evening the straining returned, and he spent a restless night. There was no vomiting ; he passed per rectum some flatus, blood-stained mucus, and a little curd. We saw him again next day, January 4. There was some distress noticeable now on his face ; he had colicky pains at times ; there was no tumour to be felt. A minim of tr. opii was given, and the infant was placed in a warm bath for ten minutes. The colon was slowly distended with warm water by means of a Higginson's syringe, the infant being in an inverted position ; no immediate effect appeared to be produced. Three hours later another minim of tr. opii was given. An hour later, after another warm bath, he passed a copious yellow liquid stool. From this time he continued to improve, though for a few days he was griped at times and passed small quantities of blood and mucus in his stools. Small doses of opium were given for a few days.

Intussusception : Injection of Water : Recovery.—A healthy infant of 5 months, who was nursed at the breast for three months, and latterly fed on milk and water, was seized,

1 *Vide* Mortimer, *Lancet*, May 23, 1891, p. 1144, for an account of experiments upon distension.

in the evening of February 7, with vomiting and abdominal pain. He had been constipated for some time previously, and, for a day or two, more restless than usual. During the night he passed some blood per rectum. He continued much in the same state during February 8 and 9. We saw him with Dr. Massiah, of Didsbury, on the evening of the 9th. There was no distress visible on his face, but he was pale and weaker than usual. The abdomen was semi-distended and flaccid; no tumour could be felt, though we were able to press deeply into the abdomen. He strained at times; and the finger, introduced into the rectum, returned covered with dark decomposing blood. A minim of tr. opii was given, and he was put into a warm bath; chloroform was given, and warm water injected per rectum by means of a Higginson's syringe. There was much straining and resistance at first, but this was gradually overcome. It was evident, on percussion, that the water reached the ascending colon and cæcum. Having distended the bowel three times with the water, we resolved to wait and see the effect. After the last injection he vomited some stercoraceous fluid. Four hours afterwards he passed a liquid stool and made a good recovery.

These plans are open to the objections—first, that there is distinct danger of over-distension and rupture of the bowel, as shown by the experiments of Bryant and others; secondly, that they can only succeed where no adhesions have formed between the adjacent peritoneal surfaces; and thirdly, that, even if reduction does apparently take place, it may be incomplete or invagination may recur. They are, of course, necessarily inapplicable to cases above a competent ileo-cæcal valve. A case of our own well illustrates this last fact.

Intussusception: Abdominal Section: Death.—Harold T., aged 7 months, was admitted into the Children's Hospital, May 30, 1887, with symptoms of acute intussusception of three days' duration. The invagination could be felt externally in the left iliac region, and internally per rectum. Under chloroform inflation was employed without success; ten ounces of water were then injected through an india-rubber tube three feet long, with the result of causing disappearance of the tumour and increase of resistance previously deficient in the right iliac area. He slept quietly for some hours, and then began to scream again, and the intussusception reappeared. Injection was again apparently successful, and the child spent a quiet night. The next afternoon the symptoms reappeared, but were once more relieved by injection. The next day the general condition was worse, and, as it was clear that no complete reduction had taken place, abdominal section was performed, the intussusception found and reduced; the bowel was inflamed but not gangrenous, there were no adhesions, and the invagination was ileo-cæcal. The child sank and died an hour later.

(3) Abdominal section may be performed and the obstruction relieved by more direct means. The section is best made in the median line below the umbilicus, the bladder having been previously emptied. As soon as the abdomen is opened, the intussusception should be drawn to the surface and carefully examined. If the bowel is in good condition a careful attempt at reduction should be made by squeezing the tumour and pressing out the 'intussusceptum,' rather than by directly pulling out the invaginated gut. If this can be done and the bowel is not too much injured for recovery, it should be left to itself and the wound closed.

Intussusception: Abdominal Section.—In a case which we saw with Dr. Cox, of Eccles, his patient, a child of 8 weeks old, had symptoms of twelve hours' duration. With the help of Drs. J. J. and F. Cox and Hutton, an attempt was made to reduce the invagination by injection; this partially succeeded, but a nodule could still be felt in the right hypochondrium. We therefore opened the abdomen and drew up this nodule, which consisted of the cæcum with the small intestine entering it. At this point there had been

evidently a previous local inflammation, since the parts were much thickened and indurated, and the adjacent glands were enlarged. The intussusception had been reduced, and nothing more appeared necessary. The abdomen was closed, and the child got quite well. It, however, unfortunately died of pneumonia three or four weeks later.

If the bowel, however, is too much injured to have a reasonable chance of recovery or if the intussusception is irreducible, one of three courses must be followed—either the bowel must be opened above the tumour and an artificial anus made, the invagination being left to itself, or the intussusception must be resected and the two ends of the gut stitched together, or finally, after resection, the two ends may be brought out of the wound and fixed to its edges, an artificial anus being made. The plan of leaving the intussusception alone has no advantages, inasmuch as the injured bowel will almost certainly act as an irritant and set up peritonitis. The plan of resection and suturing together the ends of the bowel, if successful, gives, of course, the most perfect result ; but it is open to the objection that it is long and tedious, and the child is likely to die of exhaustion, and, further, there is danger of leakage even after the most careful suturing. If this plan is adopted, it is probably wise to use Barker's plan of resection of the intussusceptum from within the gut, or one of the many other modes of uniting the ends of the bowel may be employed. Of these, that by Murphy's button is probably the quickest method ; but in the absence of any of the special appliances, simple direct suture by Lembert's method may be employed. The least dangerous course, if the child is very feeble, is to resect the tumour and fix both ends of the gut to the abdominal wound. Subsequently, i.e. after several weeks, should the child recover, an attempt may be made to restore the natural channel and close the artificial anus by the usual method. The ends of the bowel may be dissected away from the edges of the wound and united to one another by sutures or other method. This, though a less showy plan and one requiring more prolonged treatment, is safer at the time than the other method of immediate union after resection, though in a case where the child appeared well able to bear the more severe operation, immediate union is the proper course. The utmost care in all cases must be taken to prevent the escape of the intestinal contents into the peritoneal cavity ; this is managed by emptying the segment of gut dealt with before opening it, and keeping it empty by pressure of an assistant's fingers or a clamp, such as a pair of forceps shielded with soft rubber and fixed very lightly on the bowel, so as not to bruise it. All blood &c. must be carefully cleaned out of the peritoneum. Rapidity of operation and the avoidance of shock are important factors in success.

Though we have discussed the other methods of treatment, we are distinctly of opinion that they are only justified in the rare instances where an operation is impossible. It is probably true to say that the mortality of intussusception is directly proportionate to the delay in reduction, and the only certain means of reduction is by abdominal section. The fact that a few cases, such as those mentioned, have recovered by other treatment, does not justify the waste of valuable time, during which congestion is increasing, adhesions forming, and exhaustion coming on.

The cases we give illustrate the fact that spontaneous reduction may occur, that reduction may be effected by injection, that death may follow an

apparently successful operation, and that even after two days reduction may be easy; but the fact remains that routine operation is the proper course. For further details, we must refer to the general text-books or to Sir F. Treves's work on Intestinal Obstruction, or to Mr. D'Arcy Power's Hunterian Lectures, 1897, and the discussion at the British Medical Association's Meeting, 1901, and papers by Mr. Clubbe of Sydney.

Ileo-cæcal Intussusception: Operation: Recovery.—A child of 6 months of age was seen in January 1902. Its bowels had been 'disordered' for two or three days, and castor oil had been given. At 7 P.M. the day before operation there was a sudden onset of abdominal pain with passage of blood and mucus. This, together with vomiting, continued up to the time of the visit. On palpation early in the morning of the day following the attack, Drs. Jones and Melland felt a mass in the abdomen. Nothing could be felt per rectum; the abdomen was not distended. The temperature was 100°; the child, though well nourished, was becoming exhausted. Arrangements were made for operation at once, and a few hours after the swelling, which was below and to the right of the umbilicus, was found, the abdomen was opened and the intussusception was reduced by 'expression.' The cæcum was thick and infiltrated, and the appendix congested. Recovery was uneventful.

In another instance a child 3 months old had pain and passage of blood for a few hours, and a swelling was felt in the splenic region. At the operation an ileo-cæcal intussusception five inches long was found, which was reduced with some difficulty, and a rent in the peritoneal coat of the colon of 1½ inch long was made in reduction; there was extravasated blood in the wall of the small bowel. The peritoneal rent was sutured, and recovery without trouble followed.

In another case there was a delay of two days, during which there was passage of blood and brown vomit. Injection of water had been tried without effect, and the abdomen was distended. Operation was performed, and the intussusception, which lay deeply at the back of the abdomen and could not be felt even under chloroform, was readily reduced, but the child died the next day.

Intussusception and Spontaneous Reduction: Exploration: Recovery.—A child 5½ years old was seen in May 1904. It had been carefully watched by Dr. Anderson, of Chapel-en-le-Frith. There was a history of abdominal pain and diarrhœa a week before, which improved after two days, but again returned. There was then tenesmus with passage of mucus and blood; there was no distension and no vomiting. A sausage-shaped tumour was felt in the left iliac area, and after injection was found to have moved to the hepatic region. On examination with Dr. Anderson, we found the child looking well; the abdomen was retracted, there was resistance in the hepatic region, and emptiness in the iliac fossa. No abnormal condition was felt per rectum. The abdomen was opened, and some thickening of the cæcum and adjacent ileum with swelling of mesenteric glands was found, and it was believed that an intussusception had existed and been partly reduced by the injection, while the remainder had spontaneously returned. The child was very ill for 24 hours, but after a turpentine enema she improved and got quite well.

In case of an irreducible or gangrenous intussusception high up in the small intestine, resection and immediate reunion is of course necessary to avoid death from inanition.

In the unusual cases where there is much distension, it may be necessary to drain the bowel, either closing the incision at once, or putting in a Paul's tube for a time, as may seem advisable. Even after successful reduction recovery is by no means certain, death occurring from shock or exhaustion or toxæmia from absorption from the injured gut. Warmth, opium, stimulation, and judicious feeding, and in some cases saline transfusion, seem to be the most important measures.

Chronic intussusception is exceedingly rare in children, except, perhaps, as one form of so-called prolapse of the rectum, which is really intussus-

ception of the upper into the lower part of the bowel. A chronic invagination may, however, occur elsewhere ; its duration may be weeks or months ; Treves records a case of a year's standing and a doubtful one of many years' duration. We have had a child under the joint care of our colleague Dr. Hutton and ourselves in which a chronic intussusception of the ileo-cæcal variety existed for a year, and which ultimately died of fæcal extravasation from gangrene found at the time of abdominal section. The whole tumour was soft and pulpy, there was intermittent constipation, no vomiting, tenesmus, or bleeding, much distension with visible peristalsis at times, at others a flaccid abdomen ; no definite tumour was to be felt in the rectum or abdomen, and, in fact, the symptoms in this case, as in most of those on record, were very uncertain, and not at all characteristic of intussusception. Resection was the only thing that could have relieved this case, and if the symptoms were at all urgent we should recommend it in another case, reduction of the invagination being quite impossible. The bowel in these cases sometimes sloughs away as in the acute form. In the simple rectal form the prolapse is usually reducible, and it so can be cured by rest, avoidance of straining, and, if necessary, the use of the cautery as in other cases. It is of the utmost importance that the motions should be passed in the recumbent position, and should be kept soft by doses of cod-liver oil or by olive-oil enemata. (*Vide* RECTAL PROLAPSE.) We some years ago (1895) saw with Dr. Cox a child in whom there were symptoms suggestive of intussusception, though there was no bleeding or tenesmus. There was obstruction, with a palpable oval tumour lying on the right side of the umbilicus, and closely simulating an intussusception. We, however, came to the conclusion that the case was one of tuberculous mesenteric glands, which by pressure or traction caused the obstruction, and on opening the abdomen this view proved correct : the tumour was a large mass of glands caseating and breaking down, and other enlarged glands were found. The manipulation relieved the obstruction, but the child was too ill to bear removal of the glands, and died a few days later.

We have recorded in conjunction with Dr. Knowles Renshaw[1] a case of intussusception of the vermiform appendix into the cæcum treated by removal of part of the appendix. Reduction was only partially effected even after opening the cæcum and pushing out the intussusception from within. The lumen of the bowel was not, however, seriously obstructed, and the child completely recovered. Other cases of this condition have been put on record by Chaffey, Pitts, and others.[2] Since there is no obstruction in these cases the symptoms are not acute. The occurrence of an intussusception through a persistent Meckel's diverticulum has been already mentioned. Eve thinks inversion sometimes begins at the caput cæci.

Chronic Obstruction of the Bowels.—Reference has already been made to the constipation of infants and older children, due to an atonic condition of the colon or a chronic intestinal catarrh ; but other causes of inactive bowels exist which are attended with serious inconvenience, and even fatal results. Occasionally fibrous bands due to old, perhaps fœtal or tuberculous peritonitis, tie together the coils of intestine, more

[1] *Brit. Med. Jour.* June 1897.

[2] Vide *Treatment*, November 25, 1897.

especially the lower part of the ileum, and consequently check or interfere with the peristaltic action of the bowels. It appears also that occasionally the sigmoid meso-colon and meso-rectum are shorter than usual, fixing the lower bowel, and perhaps more or less forming a kink at its natural curves, where hardened fæces may lodge and a temporary obstruction take place. A fatal case, which seems to have been due to this cause, is recorded by Dr. Eustace Smith, the patient being a boy of 8 years who died shortly after coming into hospital. Whatever may be the cause, cases not infrequently come under observation where the child has suffered from constipation all its life, large accumulations of fæces taking place in the colon, which have to be removed by enemata, and where the bowels, if left to themselves, only act once or twice a week. It must not be forgotten also that a chronic intussusception may exist for many months, and give rise to the symptoms of chronic obstruction. A careful examination of the abdomen should be practised in order to ascertain the presence of a tumour, and to determine if possible its nature, whether due to collections of hardened fæces, matting of the omentum and intestines, as in chronic peritonitis, or to the presence of an invaginated bowel. An examination of the rectum should always be made. The possibility of obstruction being due to pressure of an abscess or growth in the pelvis, or to the presence of a foreign body in the bowel, must also be borne in mind.

Congenital Hypertrophic Dilatation of the Colon.—This is a curious and rare condition in which the whole or part of the large bowel is enormously dilated and its walls greatly thickened and hypertrophied. The mucous membrane is often extensively ulcerated, and the appearances and history are those of a chronic obstruction to the escape of bowel contents situated at or close above the anus. However, in these cases no obstruction or cause for the dilatation has as yet been found. The condition seems to begin during the first few months or first two years of life, though similar symptoms arise sometimes in later years. There is fæcal accumulation, usually fluid, and emptying at intervals. More or less mechanical disturbance of respiratory and other functions, and a rickety condition of the skeleton, have been noted as accompanying the disease.[1]

The difficulty of unloading the bowel gradually becomes greater ; medicines and enemata lose their effect. Failure of health with chronic poisoning appear, and at the end, perhaps after five or six years, the child dies with signs of toxic absorption.

In two of these cases which, by the kindness of Dr. Wilkinson, we have been able to see, the distension was at times enormous. In one we did inguinal colotomy, and found the intestine full of frothy fluid. The child died shortly after the operation. In one instance Sir F. Treves removed the colon with a good result.

Beyond the relief by purgatives, &c., above mentioned, no medical treatment is of much avail ; massage, electricity, strychnine, are of no, or only temporary, avail. Colotomy in our hands, as in those of others, gives no good result. Excision of the large intestine with anastomosis is apparently the only means of dealing with the trouble which has so far had any success.

[1] Stewart and Hand, *Archives of Pædiatrics*, March 1900.

A certain amount of stricture of various parts of the gut, and spasmodic contraction of the anus, have been found by S. Fenwick,[1] but it is not yet established that these are sufficient explanations. Various secondary pressure effects upon the kidneys, liver, heart, &c., by the enormously dilated colon are met with. A similar condition occasionally occurs in later life.

It is possible that before resorting to such a serious measure as colectomy it would be worth while to forcibly dilate the anus and keep it patulous, and drain the rectum by use of a large tube worn continuously.

[1] *Brit. Med. Jour.* January 9, 1900.

CHAPTER VIII

DISEASES OF THE DIGESTIVE SYSTEM—(*continued*)

Tuberculous Ulceration of Bowel and Mesenteric Disease

IN the majority of cases of children dying of tuberculous disease, tuberculous ulcers are present in the intestines, and the mesenteric glands are enlarged and 'cheesy' on section. This association of ulceration of the intestines with cheesy mesenteric glands is so much the rule that it is impossible to separate the two clinically, and it must also be remembered that anatomically the solitary glands and Peyer's patches are lymphatic structures. The frequency with which these lesions complicate phthisis or general tuberculosis is shown by the fact that in 103 consecutive *post-mortems* made at the Manchester Children's Hospital, on children of all ages dying of tuberculosis, in 62 there was tuberculous ulceration of the intestines, in 71 cheesy mesenteric glands, in 55 both ulcers and cheesy glands existed together, in 7 tuberculous ulcers without cheesy glands, in 16 cheesy glands without ulcers. (See also TUBERCULOSIS, Chapter XIII.) These numbers, as far as the frequency of tuberculous ulceration is concerned, do not overstate the fact, as it is far more likely that the presence of ulcers in the intestines, especially if they are small, should be overlooked, than their frequency overrated. These statistics also show the frequent association of ulceration of the intestines and disease of the mesenteric glands, though this association is not constant, and one may be found occasionally without the other. Ulceration may exist without the mesenteric glands joining in the process, but there is a strong probability, amounting almost to certainty, that if extensive ulceration be present the glands will be found to be affected. On the other hand, it is certain that ulceration is not the necessary precursor of mesenteric disease; for just as a chronic catarrh of the nasal mucous membrane may in an unhealthy subject set up glandular enlargement and abscess, so a catarrh of the intestine, if long continued, is exceedingly apt to give rise to mesenteric disease. Although mesenteric disease is so commonly found in children dying with a widespread distribution of tubercle, it is by no means so common to find tuberculous disease beginning with symptoms of tabes mesenterica as is commonly believed, for in practice it is constantly found that infants and children who have habitually distended abdomens, with more or less wasting, are put down as suffering from 'consumption of bowels.' In the greater number of these cases there is no mesenteric disease, but a chronic and obstinate catarrh of the intestines which is perfectly remediable. Besides the very frequent

association of ulceration and mesenteric disease, chronic tuberculous peritonitis is a frequent complication.

Infants and children of all ages suffer from tuberculosis of the intestines and glands, but it is perhaps less common before the age of one year than afterwards. The common cause of marasmus in infants is a gastro-intestinal atrophy rather than tuberculous disease, such infants succumbing before a tuberculous process is set up, though in some cases cheesy glands may be found. It has just been noted that in at least 70 per cent. of cases dying of tuberculosis, disease of the mesenteric glands was present, and in rather more than 55 per cent. tuberculous ulceration was associated with it; it is of some interest and importance to inquire in how many of these cases was the tuberculosis of the intestines and glands primary, and the tuberculous lesions elsewhere secondary; and in how many instances the tuberculous disease begins with abdominal symptoms. (See TUBERCULOSIS.)

Of the 103 fatal cases of tuberculosis referred to above, in 13, or about 12 per cent., the early symptoms were referable to the abdomen; in a few of the cases, symptoms of lung mischief were absent during life, and the lungs were found free from tubercle, or only slightly affected; in the majority of cases the physical signs and symptoms pointed during life to lung complications, which supervened sooner or later, and at the *post-mortem* more or less extensive pulmonary lesions were found, though in some instances these only appeared during the last few weeks or months of life. Tuberculous ulcers are most frequently found in the ileum, and in the large bowel, especially in the cæcum. In chronic cases they may be very extensive, with much matting together of different coils of intestine, and of the omentum by peritonitis. The walls of the cæcum are often much thickened. The ulcers, if recent, are sharply punched out; if chronic, their edges are thickened and irregular, mostly running across the gut. The mesenteric glands when affected are enlarged and cheesy; sometimes a few, at other times nearly all the glands seem to have undergone cheesy changes; occasionally suppuration takes place. The ulcers may cicatrise, and by puckering the gut give rise to some obstruction to the passage of the intestinal contents, especially in the large bowel or at the cæcum.

Symptoms.—If a child of over 2 years of age suffers from a chronic looseness of the bowels, with wasting and hectic, there is a strong probability that it suffers from abdominal tuberculosis. This probability passes more or less into a certainty if it comes of a tuberculous stock and presents the usual tuberculous aspect, such as marked pallor, long curved eyelashes, and excessive growth of fine downy hair upon the skin. The abdomen is usually more or less distended with gas, the superficial veins are enlarged, there may be tenderness on deep pressure, and perhaps some thickening may be felt over the cæcum, or some matting of the omentum. The symptoms are often varied according as ulceration of the bowels, mesenteric disease, or chronic peritonitis is extensively present. In most cases of tuberculous ulceration there is troublesome diarrhœa, though it must be borne in mind that this diarrhœa in many cases completely stops for a while, or, indeed, may be absent from first to last. There is no special feature about the diarrhœa of tuberculous disease; there is a general tendency to looseness, and colic may come on after errors in diet, or directly after food is taken, or may appear to

be the result of cold. The stools are mostly liquid and brown or yellow with an excessive quantity of mucus and perhaps streaks of blood, but too much stress must not be laid upon the character of the stools. The tongue is usually clean and red, with enlarged and congested fungiform papillæ. It is of course necessary to examine the lungs carefully in all such cases, as any confirmatory evidence of tuberculosis there would be of great importance from a diagnostic point of view. The course of such cases is often chronic, and they often greatly improve for a while, probably on account of the intestinal catarrh which is present undergoing improvement, or the ulcers may slowly cicatrise and heal. On the other hand, there is a constant risk of a tuberculous meningitis supervening, or some acute lung trouble carrying them off. Sooner or later, however, the diarrhœa, wasting, and hectic reappear, the child becomes more and more pallid, the abdomen more distended, the feet swollen, and the face puffy. The diarrhœa at the last is often constant, and the desire to go to stool, only a little mucus or liquid fæces passing, is very distressing and not easily relieved. The emaciation at the last is often extreme. When symptoms of abdominal tuberculosis follow on those of chronic tuberculosis of the lungs, the diagnosis is not difficult, and a more rapid course may be predicted. When the tuberculosis of the intestines is primary and uncomplicated with other trouble, the course may be very chronic, extending over several years, improvement taking place from time to time.

In rare cases severe hæmorrhages may occur from tuberculous ulceration of the intestines. This takes place, as would naturally be expected, in the acute rather than in the chronic cases, as in the late cases thickening and cicatrisation take place. We have known fatal hæmorrhage from the bowel to take place from a tuberculous ulcer of the ileum.

In the following case there was severe hæmatemesis, and some dark blood was also passed by stool. The case was puzzling, as at the time the vomiting of blood took place there was nothing in the lungs or abdomen to suggest tuberculosis.

Acute Tuberculosis: Ulcers in the Jejunum: Severe Hæmatemesis.—William T., aged 10 years. He was, it was stated, always a strong boy till a fortnight before his admission, when he complained that he was lame in his right leg; both knees were painful and swollen. Admitted June 18. He was a well-nourished boy; all the organs were normal; his appetite was bad; there was no diarrhœa. The right knee was swollen; there was a suspicion of early hip disease on the right side. The evening temperature reached 102°; the temperature continued raised a degree or two for a few days, and then became normal. He complained for the next week or two of great pain in his knee. On July 11, after having had a good dinner, he suddenly vomited a quantity of bright blood with large clots, and quickly became blanched; twice during the day he again vomited dark blood. There was some tenderness and resistance on the left side of the abdomen, just below the ribs. He remained fairly well till July 18, when he again vomited some half-pint of blood and mucus; there were large quantities of dark blood in his stools. July 28.—He has wasted much in the last few weeks; there is no cough or diarrhœa. From this date till his death the temperature was hectic, varying from 100° to 103°; râles were heard in his lungs, especially at the apices, and it was evident he was suffering from acute tuberculosis. He gradually became extremely emaciated; there were no more hæmorrhages. He never suffered from any diarrhœa. Death occurred September 27. At the *post-mortem*, both lungs were found studded with clusters of tubercles, becoming caseous at the right apex; the mediastinal glands were caseous. The stomach was healthy; the mesenteric glands were

swollen, but not caseous; there were some large, recent, sharply cut tuberculous ulcers in the middle of the jejunum, and numerous others in the ileum and large bowel. Miliary tubercles on the spleen and liver. Early tuberculous hip disease.

In those cases where the mesenteric glands are chiefly affected the symptoms are still less definite, though this, as has been pointed out, is not often the case, as varying degrees of tuberculous ulceration of the intestines and chronic cicatrising peritonitis are apt to be present. The symptoms are usually those of chronic intestinal catarrh, perhaps without marked diarrhœa, with wasting and hectic. It must be remembered that a distended abdomen which is chronically in this condition, with some wasting and an evening exacerbation of temperature, does not necessarily mean mesenteric disease, any more than the signs of a chronic pneumonia are necessarily to be interpreted as the signs of tubercle; we only infer in both cases that tuberculosis exists if we get confirmatory evidence elsewhere. A history of tubercle in the family, the steady progress of the disease, wasting, great pallor and hectic, would help the diagnosis. The supposed large glands should be carefully felt for, taking care not to mistake fæces in the large bowel or indurations of the mesentery or cæcum for enlarged glands. The fingers should be laid on the abdomen below the umbilicus and pushed well in, and gently moved about; the mesenteric glands lie deeply, can rarely be distinctly felt, they are movable, and of size varying from hazel nuts to walnuts. If the abdomen is distended with gas, even large groups of glands may exist, and yet not be felt. An early diagnosis is rarely possible by discovery of enlarged glands; it is only towards the close that they can usually be felt, when the tonus of the abdominal muscles is diminished and the intestines more or less collapsed. Rectal examination will sometimes reveal the presence of enlarged glands not felt otherwise.

Diagnosis.—A child with a temperature raised a few degrees at night, with a distended abdomen, chronic diarrhœa which resists treatment, and has produced wasting and marked pallor, is probably the subject of tuberculous ulceration of the intestines. If, at the same time, local indurations can be felt in the region of the cæcum or in other places, or if there are signs of tuberculous disease in the lungs, the diagnosis becomes still more probable. Moreover, the diarrhœa probably persists in spite of liquid diet, rest in bed, and astringents, and is only temporarily kept in check by opium. Mesenteric disease is much more frequently diagnosed than discovered *post mortem*. A progressive wasting due to chronic intestinal catarrh or gastro-intestinal atrophy is frequently attributed to caseous degeneration of the mesenteric glands, and a fatal termination is looked upon as inevitable. It is well, however, to bear in mind that mesenteric disease is uncommon before eighteen months or two years of age, and, moreover, great wasting may be due to intestinal catarrh without mesenteric disease. It is but seldom that enlarged glands can be felt; the diagnosis mainly depends upon the signs of tubercle elsewhere in the body and upon the family history. If there has been much diarrhœa with hectic, and symptoms of chronic peritonitis, followed by extreme wasting, there is good reason to suspect mesenteric disease.

Treatment.—The treatment of tuberculous ulceration and mesenteric disease is the treatment of tuberculosis in general. Fresh air and careful

dieting are all-important. The special treatment consists in keeping the diarrhœa in check, while nourishing food easy of assimilation is being supplied to the patient. The class of foods must be selected from those which contain much nutriment in little bulk, such as eggs, fish, meat, fats, milk, rather than foods containing large quantities of starch and sugar. If there is but little diarrhœa, milk may be allowed in moderate quantities, but the amount taken must not be excessive if much looseness of the bowels exists, as too much fluid taken is apt to aggravate the diarrhœa. In all stages of the disease minced underdone meat, whether chicken, beef, or mutton chop, is of great value. The child's portion may be taken from red juicy meat found close to the bone in a large joint of roast beef. It should be finely minced, cut as fine as it is possible to cut it, and gravy poured over it before it is taken. Of this, large quantities will be taken readily by the children, some crumbs of stale bread being given with it ; but even small quantities of starch are apt to disagree and give rise to flatulence. An egg or part of an egg beaten up in milk may be given once or twice a day. The diarrhœa is best kept in check by careful dieting, avoidance of more food than the child can digest, and if excessive, the food for a while must consist almost entirely of pounded underdone meat or meat juice. Small doses of opium combined with mercury and chalk may be given (F. 41, 42.)

In the later stages small enemata of laudanum and starch may be required, but too often the diarrhœa is quite uncontrollable. Opium fomentations are useful. If the diarrhœa is due to the presence of indigestible food, laxatives such as a powder containing rhubarb and soda should be given. Cod-liver oil, either as an emulsion or in combination with other tonics, is useful in all stages except when diarrhœa is excessive. (F. 43, 44.)

Tuberculous Disease of the Appendix is not very uncommon, and its richness in adenoid tissue and resemblance to a tonsil would readily account for this fact. The condition is usually only recognised during an operation for removal of the appendix, but it may be suspected when, in conjunction with recurrent appendicitis, there is evidence of tubercle elsewhere. The presence of tubercles is no argument against removal of the appendix, but rather makes the operation more necessary ; it may, however, make it much more difficult, or even impossible, from the presence of extensive matting, and perhaps of enlarged lymph glands, and it makes the prospect of sound healing more doubtful.

Congenital Obstruction of the Bowels.—It is not an uncommon circumstance for a newly-born infant to suffer from complete obstruction of the bowels ; passing no meconium, though the rectum may be normal, and shortly after being put to the breast it may vomit, first milk, then bile, and finally meconium. In the meantime the abdomen becomes distended, the face pinched, and the infant dies in a few hours, or perhaps lingers for a few days. At the *post-mortem* various obstructive lesions may be found. There may be a stenosis of the duodenum, jejunum, or more frequently the ileum, the gut perhaps being narrowed or even reduced to a mere band of fibroid tissue which runs along the free edge of the mesentery for perhaps several inches, and opens out again into normal bowel lower down ; this cicatrisation of a portion of bowel may have been produced by a

fœtal peritonitis, or it is the result of a mal-development. In the following case it was apparently the latter :

Congenital Occlusion of the Duodenum (Dr. T. B. Grimsdale's case).—The mother was a healthy woman who had had five children previously. The first was still-born ; the four others all suffered from symptoms of obstruction and died on the third day after birth. The sixth child appeared healthy and well nourished at birth, and for the first two days seemed quite well. For the last two days it was a peculiar colour—a sort of orange purple tint. It only vomited once shortly before death ; it was convulsed before death. At the autopsy the stomach and upper part of the duodenum were found distended with fluid ; the duodenum to terminate in a cul-de-sac about two inches from the pylorus. The rest of the intestines were well formed though small ; the bile duct opened into the duodenum below the obstruction.

In the following singular case there was an obstruction of the jejunum, presumably due to a fœtal peritonitis and possibly some chronic inflammatory lesions after birth.

Congenital Obstruction of the Jejunum : Dilated Stomach and Duodenum.—W. M., aged 15 years, seen with Mr. C. R. Graham, of Wigan. His mother gave the following history : He was nursed at the breast for some months, and during this time he was subject to periodical attacks of severe vomiting ; these attacks were much more severe than infants are usually subject to. The vomiting began immediately after birth ; the vomited matters consisted of curd and bile. These attacks of vomiting have occurred at intervals of a week or two all his life. On more than one occasion the attacks have been so severe and long continued that his life was despaired of. He has vomited as much as six or eight pints in one night. He went, on one occasion, a voyage to the Mediterranean, but had to be landed on the first opportunity, as the constant vomiting had so exhausted him that his life was in danger. Sometimes he would suffer from colic and nausea, but did not vomit. Errors of diet, excitement, or worry all seemed to excite an attack. A physical examination showed a dilated stomach ; the abdomen was also more or less distended. The symptoms and physical examination pointed to a dilated stomach, secondary to some congenital obstruction in the upper part of the bowels. The vomiting attacks continued during the next four years, up to the time of his death, when he was nineteen years old. We are indebted for details of his last illness to Dr. Sutcliffe, of Jersey, where he died. He seemed in his usual health on December 6, 1890, and joined in a game of football. The same evening he had one of his usual vomiting attacks, which was more severe than usual, and Dr. Sutcliffe was sent for. When seen on December 8, he was evidently suffering from acute obstruction of the bowels ; the vomiting was continuous, and nothing was passed per rectum. There was intense collapse. Death took place on the fourth day of his illness. *Post-mortem* made by Mr. Graham and ourselves : The body was that of a well-grown but thin youth. On opening the abdomen the small intestines were seen to be intensely congested and of a dark purple colour ; there was some lymph on the surface ; the parietal layer of the peritoneum was much injected. The whole of the small intestines were evidently strangulated, there being a complete volvulus ; the last foot or so of the ileum was wound two or three times round the upper part of the jejunum, the latter being twisted on itself, so that the jejunum, mesentery, and blood-vessels were strangulated ; the cæcum was dragged upwards out of its place. The immediate cause of death was the volvulus, probably the result of severe vomiting. A further examination showed the cause of his vomiting attacks. The stomach and duodenum were immensely dilated and hypertrophied, the duodenum looking like a second stomach ; at the junction of the duodenum with the jejunum, the gut was bound down and surrounded by fibroid adhesions for some six inches, and one spot was contracted so as only to admit the forefinger. The fibroid mattings were presumably the result of some inflammatory lesion taking place before birth.

In another instance we were called to see a patient 26 years of age, with intestinal obstruction. Before seeing him we were told as a re-

markable peculiarity that he had gone on growing until the time of his illness, i.e. his 26th year (ateleiosis). We found a tall, thin, ill-developed, youthful-looking man, dying of intestinal obstruction. On opening the abdomen there was general peritonitis, the intestines were inextricably matted together by old adhesions as well as by recent lymph. Nothing could be done. The testes, though in the scrotum, were very small and undeveloped, and there were practically no signs of puberty. It appears likely that the arrest of development was the result of the old and probably fœtal peritonitis which was ultimately the cause of the obstruction. The abnormal prolongation of the period of growth was probably due to the same lack of development of adult characters. He died at the time of the operation.

In a few cases a twist in the lower end of the ileum has been found. In rare instances, a new growth or hernia has occurred, or a knuckle of bowel has been found tied up by some band or persistent omphalo-mesenteric duct.

Obstruction of the bowels in infants a few weeks or months old may be due to a congenital lesion which has caused a partial obstruction, which is rendered complete by the impaction of hard curdy feculent matters.

In all cases of vomiting with signs of obstruction of the bowels, a careful examination of the anus and rectum should be made.

Imperforate Anus.—The lower segment of the large intestine, including the sigmoid flexure and rectum, is very liable to important malformations.

In the first place there may be mere malposition, the sigmoid flexure descending on the right side or in the middle line instead of on the left ; this would not necessarily give rise to any inconvenience during health, and would be mainly of importance should there be any disease of the bowel in later life.

The more immediately important conditions are the various forms of obstruction of the lower bowel from want of development of some part of it, or the presence of abnormal openings from imperfect differentiation of the digestive and genito-urinary segments of the cloaca.

Several varieties of malformation are found. Clogg (*Lancet*, December 24, 1904), from an examination of the recorded cases, concludes that most of the intestinal malformations in the duodenal portion are dependent upon some anomaly in the development of the liver or pancreas and that single occlusions of the lower part of the small intestine are dependent upon some error associated with Meckel's diverticulum. '"Snaring of intestine by the umbilical ring" and volvulus account for some of the cases and inflammatory conditions have little, if anything, to do with these malformations.' As far as treatment goes the only possible success will be by anastomosis between the upper and lower segments, but as the lower segment is not certainly properly formed the success is more than doubtful, and it does not appear that any such case is on record. The rectum may be well formed, but there may be no anus (*Imperforate anus*). Or the anus may be present and well developed but may have no continuity with the rectum, which itself may be deficient to a varying extent (*Imperforate rectum*). Sometimes there is merely a thin membranous septum between the anus and the gut above, while if the rectum is itself defective there may be a long interval between the anus and any pervious bowel. Again, both anus and gut may be absent. In all these varieties the meconium is, of course, retained. In another class of

malformation the rectum, instead of ending blindly, opens into the urethra or bladder, or much more commonly in the female into the vestibule, not in our experience into the vagina, as is commonly stated. We can only recall a single instance of a true vaginal outlet—this was in a case kindly sent to us by Dr. Cullingworth—usually the vaginal orifice is seen in front of the rectal outlet.

It appears that an opening into the vulva or urinary tract and '*imperforate anus*' are the two forms of maldevelopment most commonly met with.

Occasionally a 'tablike fold of skin' passing from the scrotum to the coccyx obstructs but does not close the anus (Cripps). Edge has recorded a more complete case where the anus was double and the rectum imperforate. We have met with a case where a single anus led up to a double gut above. Rarely there is an unnatural anus in the groin or in communication with the bladder, or, as in a case of Erichsen's, a fistula below the umbilicus; scrotal, penile, and perineal fistulæ have also been met with as well as congenital stricture of the rectum which was not actually imperforate. (*Vide* PROLAPSUS RECTI.) As a less important condition mere tightness of the anus may also occur.

When the anus is present, but there is no communication with the bowel, the malformation is often overlooked at first, and it is thought that the infant is simply constipated; in such cases purgatives are often given and the child's distress much increased. Constant crying, distension of the abdomen with visible intestinal coils, and subsequently vomiting and collapse come on, and unless an examination with the finger is made and the obstruction discovered the child dies exhausted. On examination it will be found that the finger can only be passed a very short distance; if the rectum is developed and there is only a membranous septum, the bulging of the gut as the child strains will be plainly felt, but should the bowel end higher up this sensation may not be distinguishable.

Where the anus is absent and the rectum ends just above it, as according to Cripps it usually does, though in our own experience the common condition is a well-marked proctodæum but no rectum, the bulging will often be readily made out, but if the rectum ends higher up there may be no impulse; in such cases the perineum is narrow and the pelvic outlet smaller than it should be. When there is no anus the rectum is generally nearer the surface than when an anus is developed but the rectum ends blindly.

Where the rectum ends high up in the pelvis, a fibrous cord may be prolonged downwards in the position of the natural bowel. The anatomical developmental explanation of these malformations has been recently revised by Mr. Wood Jones (*Brit. Med. Jour.*, December 17, 1904). We may briefly state it here. *Imperforate anus* is, of course, simply a failure of formation of the proctodæum or involution of the epiblast which normally dips in to meet the gut. In *Imperforate rectum* the deficiency occurs just below the level of the peritoneal reflection, and beyond this the gut is absent or defective, though communication with the prostatic urethra in the male or the genital passage in the female is common.

It appears from Mr. Wood Jones' researches that it is incorrect to describe the separation of the intestinal and genito-urinary passages as due to a growth of septa. It is rather that at a certain stage the hypoblastic canal

becomes, as the backward growth of the embryo proceeds, U-shaped, and a dilatation forms at the apex of the curve, so that by this dilatation a chamber, the 'cloaca,' is formed, into which open dorsally the hind gut and ventrally the allantois. Normally this 'post-allantoic' gut should grow backwards to meet the ingrowing proctodæum ; its failure to do so produces *imperforate rectum*. The rapid backward growth of the gut behind the cloacal opening, together with perhaps some lateral infolding of the walls, closes the communication between the gut and the cloaca, and the site of this closed orifice corresponds with the reflection of the recto-vesical pouch of peritoneum. Hence it is at this level that the bowel should be looked for in operations for imperforate rectum.

Should the opening of the gut into the cloaca persist, it constitutes the orifice of communication of the bowel with the prostatic urethra of the male or the genital canal of the female, as the case may be.

The cloaca of the embryo becomes the urethra. The Mullerian ducts open originally into the cloaca just in front of the hind gut orifice, i.e. into the prostatic urethra in the male, but in the female the communication with the cloaca becomes lost and the vagina is not formed by partitioning off an already existing cavity, but by hollowing out a new channel somewhat as the post-allantoic gut hollows its way towards the proctodæum. Where this fails to occur absence of the vagina or atresia vaginæ results, and according to the extent of failure will be the level of the opening of the gut in the genital passage in cases of imperforate rectum.

It appears that the urethra is at one stage occluded and again reformed by a hollowing-out process as are the vagina and rectum (*vide* later).

When the rectum ends in the urethra there is a passage of fluid fæces and flatus by the urethra, together with absence of the natural orifice. Subsequently, if the child survives, there is much trouble from obstruction of the urethra by fæcal matter and from irritation set up by the decomposed urine. Kelsey[1] points out that if the opening is into the bladder the meconium is mixed with the urine, while if it is urethral the bowel contents may escape independently of the urine. When the rectal outlet is within the vestibule the bowels may be sufficiently relieved for the deformity to escape notice, and there may be no impairment of health ; indeed, the presence of such malformation may remain unknown until adult life. In many cases, however, though the opening is sufficient for the escape of the fluid or soft fæces of childhood, it is not large enough to allow the passage of solid motions, and obstruction arises later on. There is no incontinence of fæces in these patients, the internal sphincter preventing involuntary escape.

As in so many other congenital malformations, a large number of children the subject of these deformities do not survive birth. Where, however, a living child is found to have no outlet at all for its intestinal contents, immediate treatment is of course necessary, although it is said that patients have grown up and relieved the bowels by periodical vomiting of fæces. As soon then as the deformity is recognised, a decision must be come to as to what is the best mode of relief.

Treatment.—When a thin septum alone closes the gut a simple crucial incision, using a speculum if necessary, and subsequent dilatation with a

[1] *Arch. of Pædiatrics.*

bougie or the finger, is all that is required. The child, if it survives, may in no way suffer afterwards, though we have seen a case of a girl of 10 or 12 years old who had been operated on in infancy and had not got perfect control over the bowels.

Where the separation between the rectum and the surface is greater, bulging of the distended gut should be carefully felt for and an incision made just in front of the coccyx and carried down to the bowel, which should then be freely opened and brought down and stitched to the skin, unless there is so great tension that the stitches are not likely to hold, in which case the opening should be packed with gauze to keep it patent, or a large drainage tube inserted.

If no bulging can be felt, an attempt to reach the bowel should still be made by a similar incision, and the dissection should be carefully carried upwards, keeping well back in the hollow of the sacrum and feeling from time to time for the bowel. As it is most important that the child should strain, chloroform should only be given during the first steps of the operation, and fortunately this is the most painful part of it. With a similar object it has been advised to delay operation until the bowels are distended; this is not, however, a wise course. If the gut is found, it should be treated as in other cases, or, if it cannot readily be brought down, it must be left but kept patent in a similar way, or a tube may be kept in through which fæces can pass. Amussat and Verneuil resected the coccyx and lower part of the sacrum in order to bring the gut to the surface, an anticipation of modern methods of rectal resection (Kraske, &c.).

Should it be impossible to reach the bowel from below by dissection, which may be carried to a depth of an inch and a half, in no case must any blind puncturing with a trocar in hopes of finding the gut be employed; by such means there is much more likelihood of puncturing the peritoneum, especially as it usually descends lower than in normal anatomy. Either Littre's operation of opening the bowel in the groin or Amussat's (Callisen's) lumbar operation must be performed, or an abdominal section to assist the approach through the peritoneum would be a good step. Apart from this, there is some uncertainty in all these cases as to the course of the bowel, and as in a certain proportion the colon lies in the middle line or to the right side, it is wiser on the whole to do Littre's operation. The danger of opening the peritoneum is not so unequal in the two plans as might be thought, since there is often a mesentery in these cases, and the anus is much more conveniently placed for self-management in after life; there is little choice in the matter of danger between the two. Littre's operation then should be selected. The operation consists in making a vertical or oblique incision about two inches in length in the left groin above and a little external to the middle of Poupart's ligament; a vertical incision is probably the best, since, if the sigmoid flexure does cross to the right, a slight upward prolongation of the incision will enable the surgeon to reach it. The abdominal wall having been cut through and the peritoneum opened, the distended bowel will present at the opening and should be picked up with forceps, and treated as in the ordinary colotomy operation.[1]

[1] For a description of the operation we must refer to the general text-books.

If the child can bear the delay in opening the bowel, the operation should be done in two stages as in gastrostomy ; to avoid leakage Cripps suggests the use of a coarse thread in stitching the gut to the edge of the wound ; the use of a round sewing needle answers better.

Edmund Owen has six times performed Littre's operation, twice successfully ; three of his cases died from the operation being too late, peritonitis existing at the time. In three or four of the instances in which we have done inguinal colotomy the result was perfectly satisfactory ; the children got quite well for a time, but it is probably rare for such patients to survive childhood. It has been suggested that after opening the sigmoid flexure in the groin, a probe should be passed downwards and an anus made in the natural position with the guidance of the probe. Owen's two successful cases of Littre's operation died after the performance of the second operation, but Byrd and Kronlein have been successful.[1]

Curling's statistics and opinion are much in favour of the inguinal operation ; Cripps' figures are inconclusive.[2] Huguier's operation of opening the gut in the right groin on the ground of the more frequent position of the colon on the right side than the left is not supported by Giraldes' statistics, quoted by Holmes, where in 431 autopsies the colon was in its normal position in 396 instances ; in eighty of these Littre's operation had been performed, and in every case the sigmoid flexure was on the left side. Atkin, of Sheffield, records a case in which the small intestine was opened by the inguinal operation, the whole colon being rudimentary ;[3] and our colleague, Mr. Whitehead, tells us he operated in the left loin on one occasion and found at the *post-mortem* that the cæcum had been opened.[4]

We have opened a coil of large intestine by right inguinal colotomy in an adult, and found that it was the sigmoid flexure and not the ascending colon that had been secured.

Cripps' table gives the following results :

Of 16 cases of	inguinal colotomy	. . . .	11 died
„ 3 „	lumbar „	. . . .	2 „
„ 17 „	puncture „	. . . .	14 „
„ 8 „	resection of the coccyx	. . .	5 „
„ 39 „	perineal incision .	. . . .	14 „
„ 14 „	operation for vaginal (i.e. vulvar) anus.		1 „
„ 3	miscellaneous cases .	. . . .	3 „

Bodenhamer records eight recoveries out of twenty-five Littre's operations.

The deaths are mainly due to peritonitis, or failure of relief.

Where there is a fistulous opening between the rectum and the bladder or urethra, Littre's operation should be performed, unless the gut can be reached from the perineum, when possibly the communication with the urinary tract may close spontaneously. When the unnatural anus opens in the vulva, in the cases we have seen it has usually been by an orifice in the side of the distended rectum and not by a terminal opening ; that is, the rectum has

[1] *Vide* Kelsey, *Arch. of Pædiatrics*, February 1885 ; also Goëde, *vide* Cripps.
[2] *Vide* also Erckelen, *Arch. f. Klin. Chir.*, Langenbeck, 1879.
[3] *Lancet*, January 31, 1884.
[4] Pillore advised opening the cæcum.

been pouched and projected below the vulvar aperture. This pouch is developmentally the post-anal gut. In such conditions a bent probe should be passed through the orifice into the gut and made to press against the perineum just in front of the coccyx. An incision is then made upon the probe, the rectum freely opened and treated in the usual way. Great care must be taken to keep the new aperture patent, otherwise it is prone to contract and the fæces continue to pass both ways. In some cases it is said that the vulvar orifice will contract and close of itself (Holmes). In our own cases we have not found this to occur, and in one of them we pared the edges of the vestibular opening and sutured them ; no union, however, resulted, and we afterwards laid open the perineum, dissected away the gut from the vestibular wall, stitched it carefully to the skin, and then sewed up the perineum, with a successful result ; the patient was about 6 years old. In another instance we performed the same operation in a child of 9 months, but it died some weeks later of inanition. We have had a third successful case in which power of retention seems well preserved. Dieffenbach appears to have been the first to adopt this plan, which, however, is often called Rizzoli's operation. It is, we think, well to wait until the child is two or three years old before doing the second operation.

One of the difficulties we have met with in these cases is that of keeping the bowels regular even when there is quite a free opening ; this we believe to be due to imperfect muscular action, though the muscular coat of the bowel is hypertrophied in some of these cases. Enemata, castor-oil emulsion, and occasional more active purges are required under these circumstances. Sometimes when the case is one of vulvar anus a collection of hard fæces is found in the intestine above at the time of operation ; this requires removal, as the child is often unable to void it even when a good-sized aperture has been made.

Deformities of the Umbilicus.—In some cases of extroversion of the bladder there is no trace of an umbilicus to be seen in after life, the scar being lost in the malformed abdominal wall. In other cases the umbilicus is abnormally large—that is, a considerable part of the abdominal wall is formed by the structures of the cord, and sloughs away when the cord shrivels up, so that an actual deficiency of the abdominal wall results. In two cases of this condition we have seen that were operated upon, one by Sir H. Howse and one by ourselves, a portion of the liver protruded through the opening and was covered only by the sloughing tissue. In our own case we dissected away the dead part and closed the abdominal openings by sutures, but without success ; in a third case, under our care, the part was simply protected from irritation and left, but this child also soon died.[1] The frequent presence of the liver in the hernia has given rise to the name of Hepatomphalos, but the stomach and other viscera are often included in the protrusion.

At the third month of intra-uterine life there is still a coil of intestine lying in the umbilical cord outside the abdominal cavity ; should this condi-

[1] Underwood records a case of recovery in which the treatment consisted in poulticing, and Tanner and others have had successful cases. In a case of Brodie's, *Path. Soc. Trans.* vol. xv., besides the hepatomphalos, there was diaphragmatic hernia with deficiency of the pericardium, and a coil of bowel lay in contact with the heart.

tion persist, a true congenital umbilical hernia is found. The importance of this fact is that in ligaturing the cord the gut might be included in the ligature and strangulated, a mishap that has actually occurred. In slighter cases there is only a small protrusion standing out from the abdominal wall much like the end of a glove finger ; the bowel is reducible and the treatment is that of an ordinary umbilical hernia. In other instances, owing to persistence of the vitello-intestinal duct, Meckel's diverticulum remains open, and passing up to the umbilicus may open there, giving rise to fæcal fistula, as in cases of our own where a ligature round the protrusion, followed by the application of strapping to draw together the sides of the orifice, procured closure of the fistula.[1] Edmund Owen advises emptying the bowel by free purging and subsequent administration of opium, thus giving time for the fistula to close ; he applies a dry pad over the fistula and leaves it undisturbed. Success has followed this treatment, but it appears to be applicable to older children rather than to infants. A plastic operation on the usual lines for the cure of fæcal fistula would be the proper treatment in a troublesome case. *For patent urachus &c. vide* SURGERY OF THE URINARY ORGANS, *vide also* DISEASES OF THE NAVEL.

Congenital hiatus of the abdominal wall may occur in other parts besides the umbilicus from simple failure of closure of the ventral laminæ. In some cases the recti fail to meet one another in the middle line, and ventral hernia may result with great weakness of the abdominal wall.

Well-arranged pads applied by means of a belt must be employed to prevent protrusion, or in some cases it would be justifiable to cut down upon and stitch together the margins of the aperture, an operation not of a very serious nature, and not of course necessitating any injury to the peritoneum.

Umbilical Hernia.—Umbilical hernia in children may be congenital or acquired ; in the congenital form it is sometimes due to persistence of the fœtal condition where a coil of bowel lies outside the abdomen ; in other cases, as already pointed out, it is the result of failure of closure of the ventral laminæ.

The acquired form usually appears within the first few months of life ; in this case the rupture protrudes not through the centre of the scar, which is occupied by the fibrous remains of the vessels, but usually above it or even through an independent opening in the linea alba. Astley, however, believes that the protrusion is generally through the ring. Both forms of hernia are readily reducible and usually consist of small intestine ; the amount of protrusion varies from a mere convexity of the navel to a prominent glove-finger-like outgrowth.

The treatment consists in applying a flat pad of wood or poroplastic felt about the size of a penny and two or three times as thick ; this pad should be covered with flannel and fixed over the umbilicus by a broad band of strapping encircling the body or by a soft webbing belt ; we prefer the former as more efficient and less likely to slip, though it is not so comfortable as the belt. If the pad is worn constantly for from one to three months according to the age of the child, the hernia is usually 'radically cured.' In cases which obstinately resist treatment the orifice should be cut down upon

[1] Vide p. 33, 'UMBILICAL POLYPUS.'

and sutured transversely or vertically. A case of irreducible umbilical hernia containing omentum was successfully operated on by Roocroft in a girl of 14 years;[1] but it is clear that most cases of umbilical hernia in children are cured, since the condition is hardly ever seen in young adults. We have had occasion to close by operation a median ventral hernia in a child. The result was successful.

Inguinal Hernia.—Inguinal hernia is met with in childhood in the following varieties:

1. The funicular process of peritoneum remains widely open and in free communication with the cavity both of the peritoneum and tunica vaginalis: a hernia descending into this cavity is a true *congenital* hernia, or hernia of the tunica vaginalis (Teale).

2. The tunica vaginalis may be shut off from the funicular process at the upper part of the testicle; a hernia coming down into the patent process is called a *funicular* hernia, or hernia into the funicular process.

3. When the same condition as in (2) exists, but the hernia, instead of descending along the canal of the funicular process, pushes down a separate pouch of peritoneum behind the process, the hernia is called infantile. The name 'encysted' is given to cases where the funicular process is obliterated at the internal ring or just above the testicle, and the septum is pushed down and invaginated into the lower part of the process. In the former case, in cutting down upon the bowel from the front three layers of peritoneum, viz. two funicular and one sac proper, will be found in front of the gut; in the second case two layers will overlie the bowel.

4. An ordinary acquired hernia may be met with. Hernia may, of course, be complete or incomplete—that is, it may descend into the scrotum or only distend the canal or bulge at the internal ring.

The first and second forms are much the commonest, and it is usually impossible to be certain which is present unless the parts are exposed by operation. Where the testicle is completely wrapped round by the hernia it is probably *congenital*; where the testicle remains a distinct boss upon the surface of the hernia it may be *funicular*, though it is not by any means always so. We believe the funicular variety is the more common. Infantile or encysted hernia can only be recognised by operation, but it may be suspected if, after reduction of a hernia, an unusual amount of thickening along the cord remains, or if there is a hydrocele of the cord or an infantile hydrocele in conjunction with a reducible hernia. Fortunately, an exact diagnosis of these conditions from one another is not of much importance.

Hernia may develop at any age; it is sometimes noticed immediately after birth; in other instances it comes down later when, from failure of health, or bronchitis, or whooping cough, the muscular walls of the abdomen become relaxed, and are in addition overstrained by coughing, violent crying, straining in defæcation, micturition, &c. So common is it for straining in micturition to bring down a hernia, that it is quite certain that phimosis is a most fertile cause of rupture.[2] The presence of a calculus or worms acts in the same way. Hernia very commonly accompanies ectopia vesicæ.

[1] *Lancet*, August 2, 1884.

[2] An important fact first pointed out by Mr. J. A. Kempe, though its influence in the production of hernia is disputed.

As is well known, inguinal hernia is sometimes met with in female children, though not nearly so commonly as in boys. Of 112 unselected cases of hernia seen in our out-patient department, there were—

In males .	57	right inguinal,	12	left inguinal,	16	double, and	9	umbilical.
In females	4	„	5	„	no	„	9 (? 10)	„

Mr. Leader Williams told us that in his experience in the Maternity Department of St. Mary's Hospital, Manchester, umbilical hernia was by far the commonest variety, and this is no doubt true of the first few weeks in life.

Right inguinal hernia is much commoner than left, as the processus vaginalis closes later on the right side.

Most commonly an inguinal rupture in a child contains small intestine with or without omentum, perhaps most commonly without. Other parts of the intestinal canal are, however, not rarely found. We have many times during operation found the cæcum and vermiform appendix in a hernia, and not rarely the appendix can be very distinctly felt through the coverings without an operation.[1] The ovaries in girls and the bladder in either sex are sometimes protruded.

Generally a rupture is easily reducible, but often it is necessary to make the child lie down before it readily goes back ; it then often does so spontaneously. Violent crying will sometimes make it quite impossible safely to reduce a hernia, and the child must be quieted or anæsthetised before reduction.

It must be remembered that, though as a rule herniæ are opaque, a tightly distended rupture consisting only of bowel, and that full of flatus, in a thin-skinned child will be distinctly translucent ; this fact was, we believe, first pointed out by Sir H. Howse, and we have several times seen it.

Various abnormal conditions may complicate hernia ; thus the testis may be entirely retained or have imperfectly descended on the same side. A vaginal hydrocele or hydrocele of the cord may coexist with a hernia, or fluid as in a congenital hydrocele may distend the sac of a congenital hernia. The rupture, of course, may be single or double, and sometimes of a different species on the two sides. We have seen a 'funicular' and a 'congenital' hernia on opposite sides in the same child. Children the subject of hernia are undoubtedly often affected with intestinal disturbance, which appears to be sometimes at least due to the hernia. It has, however, been suggested by Lane that the hernia is due to the intestinal trouble, and it is undoubtedly true that marasmic children with chronic indigestion and irregular and often constipated bowels not uncommonly have herniæ which are not readily cured till the nutrition is improved.

Ruptures in children are occasionally irreducible ; when this is due simply to straining, as already pointed out, the difficulty is easily got over ; in other cases the hernia may be obstructed by its contents as in adults ; again, adhesions to the sac or to the testicle or matting together of bowel to bowel, or bowel to omentum, may prevent reduction. In one of our cases a large hernia was made irreducible by the presence of tuberculous mesenteric glands which had evidently enlarged after their descent, and it was only

[1] *Vide* papers in the *Brit. Med. Jour.* vol. i. 1887, by Sir F. Treves, and also by one of the present writers.

after removal of some of these and enlargement of the rings that the rupture could be reduced; the child recovered, but evidence of tuberculosis, of course, remained.

It is somewhat rare for a hernia to become strangulated in childhood. We have, however, met with several such cases; they differ in no respect from the similar condition in the adult, but considering the extreme tenderness of the tissues in children immediate operation is the wisest course in preference to treatment by ice, or more than gentle and momentary taxis; we have known a child die of the injury done to a coil of intestine which was reduced before the child was seen by us, and could only have been strangulated for a few hours. The youngest cases with which we are acquainted were about three weeks old. The sac always requires opening, since the neck itself forms the constricting part. Sometimes in an hour-glass sac the constriction may be in the scrotum.

The *treatment* of hernia in children resolves itself into three questions—first, the removal of all causes tending to produce rupture, such as cough, phimosis, &c.; secondly, treatment by apparatus; and lastly, operations.

Ruptures in children sometimes get well of themselves without treatment, or simply by keeping the child lying down and avoiding disturbance of its temper and bowels. In other instances circumcision will prevent further descent of hernia by removing the cause of straining.

Failing these means, the wisest plan is at once to provide a well-fitting truss, a matter which should be seen to by the surgeon himself, and not left to an instrument-maker. The truss must be worn night and day without any intermission, never being removed on any account for washing or any other purpose except to put another on; this is necessary, because the truss is in children used to cure rupture, and not merely to palliate it as in adults. When it is absolutely necessary to change a truss, the new one must be got ready, the finger slipped beneath the old one to keep pressure upon the canal and then the truss changed, the child being kept on its back and soothed to prevent crying. During the treatment the skin must be carefully watched and kept dry and unirritated by the free use of boric acid powder; this can be dusted beneath the truss without removing it. A little judicious packing with absorbent wool will serve to take pressure off any tender part. Almost any hernia during the first year of life that can be kept up without once coming down for three months will be permanently cured; after the first year a longer time is required.

The ordinary flat-pad trusses do very well if the parents can afford to frequently renew them, but they get stiff and hard, and the springs soon rust and rot with the frequent soakage of urine, so that they have to be frequently changed, and a duplicate should always be at hand in case of sudden giving way. One descent of hernia undoes all the preceding treatment; this is the cardinal rule to impress upon the mother or nurse. The inflatable and the glycerine pad rubber trusses we have found useful and satisfactory when carefully managed, and they are not affected by urine nearly so rapidly as the common truss, but they require careful inspection from the first, as they are often imperfectly made, and flaws or tears are soon fatal to them. The hard rubber truss is sometimes spoken well of; we have not tried it. Celluloid or gum trusses are good. If from bad management a sore is produced by truss

pressure, careful padding will often avoid the necessity of leaving off the truss ; but with proper attention and care that the truss spring is not too strong, it seldom occurs.

Hydrocele and orchitis we have more than once seen as the result of wearing a truss ; in such cases we may be sure that the spring is too strong, and a different truss must be applied. Spica bandages, wool trusses, &c. are inefficient substitutes for a good truss. The pad of the truss should be flat and not convex, and peaked trusses are never required : the object is to prevent the hernia from entering the canal, not merely to cover up the rupture.

When a fair trial has been given to trusses, different ones being, if necessary, employed, and all sources of irritation have been removed and still the rupture cannot be kept up, an operation for its permanent cure should be performed. Much has been written of late on the etiology and treatment of the hernia of children. It is maintained that inguinal hernia is always due to the existence of a patent funicular process, i.e. a pre-existing sac, and it is recommended that in all cases an operation should be performed for the radical cure of a hernia as soon as it is discovered. It is further asserted that in true congenital hernia it is never, or only exceptionally, necessary to do more than tie up the peritoneal sac, i.e. that sutures through the wall of the canal are not required. On the other hand, special operations are sometimes recommended. We are quite prepared to admit that it is a great saving of trouble to all concerned to operate on all cases of hernia in children and we agree that the risk is small and the results good. But there is some risk in all operations, the perfect result is not certain and the operation is not necessary to obtain a cure in all cases. It is a matter for fair consideration by parents and surgeon, and the advantages of each method should be weighed in each individual case.

We have no doubt that failing cure by a truss in six months an operation is called for.

Of all the various plans, the one we think simplest and as good as any consists in making a free incision over the canal and upper part of the scrotum, cutting down to the sac, reducing the hernia, closing the neck of the sac and passing silk sutures through the walls of the canal. To do this the sac must be opened and the finger passed into the abdomen to make sure that the canal is empty. The sac is then cleared all round and separated from the cord at the upper part, pulled well down, tied as high up as possible and divided. The needle, which must be in a handle, is passed through one side of the canal, and guided by the finger is brought out at the ring ; it is threaded with silk and withdrawn, then unthreaded and passed through the other side, then threaded with the other end of the same silk and again withdrawn ; two or three sutures are passed in this way till it is felt that there are enough to close the canal ; the threads are then tied. If the hernia is a congenital one or of the congenital funicular variety, as it so often is, it is not necessary to remove the whole sac nor to close it below with the idea of making a tunica vaginalis. It may, after ligature above and division, be left to itself as to the lower part. Where the sac is very thin and difficult to separate from the cord one edge of the sac close up to the neck may be picked up and threaded upon the needle, and successive portions of the surface of the sac pinched up and transfixed (like threading them upon a

skewer) until the other edge is reached ; the needle is then threaded with catgut or silk and withdrawn, leaving the ligature, which when tied puckers up the sac into closely applied folds which soon adhere, and the sac is thoroughly obliterated ; by this means all trouble and disturbance in separating the sac from the cord is avoided, and the closure is quite firm and complete. The wound should be closed, and will heal by primary union. The silk requires careful preparation ; if not thoroughly sterilised, a troublesome sinus is likely to form, and the suture finally comes away. We prefer to select the particular mode of operation most suited to the case, rather than to confine ourselves to any one method exclusively. There is sometimes a good deal of swelling after the operation, but this gradually subsides and should be looked upon as a good sign of firm consolidation. For the methods of managing complications of the operation we must refer to the ordinary text-books, for undescended testis to the chapter on that subject. An omental sac may be met with : we have seen a very perfect instance. The management of such cases and of adhesions differs in no way in the child from that of similar conditions in the adult. After operations in young children we prefer to cover the wound with a couple of layers of gauze sealed down with celloidin. This well supports the edges, is impervious to soakage with urine and leaves the wound open to inspection. It is, we think, in all ways to be preferred to a large cumbrous dressing. Some operators fix the child in a sort of double splint to prevent movement and disturbance—the plan seems a good one, but we have not found it necessary to do more than fix the child with draw sheets and sandbags.

In the case of very young children it may be better to take them up and nurse them from the first if they cannot be pacified, otherwise it is preferable to keep the child lying down for at least a fortnight. It is better not to allow a truss to be worn after the operation unless there is some special reason for it.

The operation is not free from risk and not always successful ; we have had one death from peritonitis coming on some time after the operation, and have had to operate more than once in several cases. In the fatal case the canal was perfectly closed and the peritoneal surface almost undimpled. The cause of failure is chiefly a thin and flaccid condition of the abdominal muscles, which cannot be made to form a firm barrier.

Femoral hernia in children is very rare, we have never seen a case ; one recorded by Sabourin in a premature female infant was readily cured by a truss. E. Owen saw one in a boy of 10 years out of 748 cases of femoral hernia.[1] Diaphragmatic hernia is occasionally met with.

Prolapsus Recti.—Slight degrees of prolapse of the rectum are common in children and are often only transitory, occurring perhaps once or twice and not again ; the more severe forms are much rarer.

Prolapse of the rectum consists in protrusion of more or less of the rectal wall through the anus. The slight and most common form is simply a pushing out of a ring of mucous membrane, which is readily reducible and often only comes down when the child strains. In other cases the whole of the rectal coats from mucous membrane to peritoneum may be protruded.

The first variety of prolapse is usually about half an inch long and appears as a red mucous ring with radiating folds diverging from the central orifice

[1] *Lancet*, June 6, 1884.

the mucous and cutaneous surfaces shade off into one another at the margin of the protrusion. The second form is larger, reaching from one to two inches in length, and is often conical in shape, its base being at the anus ; the folds are not radial but annular, running round the prolapsed part ; the orifice is central, and on passing the finger into it, it is evident that the whole thickness of the bowel and not merely mucous membrane, is involved in the prolapse. Sometimes this form of protrusion reaches much larger dimensions, even six inches in length, and in such cases necessarily a large pouch of peritoneum is carried down, and this is more extensive on the anterior than the posterior aspect of the bowel. In one case that we examined *post mortem* there was a definite diverticular pouch with a sharp lunated edge projecting from the recto-vesical hollow down the anterior wall of the rectum ; it seemed to us probable that the presence of a coil of bowel in this pouch would have much to do with keeping down the prolapse.[1] Not only small intestine but the ovaries even may be found in this peritoneal pouch, which then becomes the sac of a rectal hernia ; the characteristic gurgling or the presence of a solid body felt on manipulating the wall of the protrusion may give a clue to the extent of the disease. Rectal hernia sometimes comes down behind the bowel, or may even protrude through a gap in the muscular coats (Kelsey). This variety of prolapse is sometimes curved as a result of traction by the mesocolic fold of peritoneum or the attachment of the rectum to the vagina (Van Buren). In it also the mucous and cutaneous surfaces shade off into one another, though the transverse folds of mucous membrane on the surface of the prolapse may somewhat obscure the line of junction.

A so-called third form of prolapsus recti, where the upper part of the rectum or the sigmoid flexure is invaginated into the bowel below and protrudes from the anus, is recognised by its size and by the presence of a sulcus between the prolapse and the anal margin. This condition, however, is more naturally considered as an intussusception than as a prolapse.

The mucous surface of the protruded gut may be nearly natural, but more often is excoriated and coated over with a thick slimy mucus ; it sometimes becomes congested and may even slough from irritation or constriction by the sphincter, though in most cases the anus is so lax and patulous that the existence of a sphincter at all is hardly felt by a finger passed within the opening. Bleeding to small amounts often occurs, and there is much mucous discharge.

The motions come away freely, but the irritation and discharge weaken the child, and he loses flesh and health. In most cases the prolapse is reducible with more or less difficulty, but often it returns immediately pressure is taken off ; in others it remains up until the child strains from any cause and then redescends ; in others again the protrusion after a time becomes irreducible from matting together of the parts and from congestion.

Where a rectal hernia exists it is subject to all the conditions of an ordinary inguinal hernia, i.e. it may be reducible or strangulated, &c.[2] Occasionally the prolapse sloughs and fæcal fistula results, or the wall may burst in attempts at reduction.

[1] The specimen from this case is in the Owens College Museum ; this definite pouching so far as we know, undescribed hitherto.

[2] *Vide* Kelsey, in an elaborate paper in *Archives of Pædiatrics*, 1885.

The causes of prolapsus recti are many, though it is obvious that there must be some weakness of the sphincter and levator ani or relaxation of the rectal walls in these cases, or prolapse would be much more frequent than it is. Any condition that produces violent and constant straining may bring on prolapse in a child predisposed to it. The child is generally miserable and weakly when seen, but this is no doubt partly the result of the irritation. Phimosis, contracted meatus urinarius, stone in the bladder, cystitis, constipation, diarrhœa, worms, polypus recti, violent coughing, &c. all may cause prolapse. Boeckel believes stricture of the rectum to be a cause, and in one case we found a tight annular stricture of the rectum about one inch from the anus ; this only admitted the tip of the index finger in a child of about three years old ; the stricture apparently formed the apex of the prolapse, and may possibly have been the result rather than a cause of the protrusion.

The *diagnosis* of prolapsus recti is easy where the protrusion is large ; the only doubtful point is what extent of rectal wall is included in it. It small it can only be mistaken for piles or polypus ; the former are exceedingly rare in children and never form a complete ring, the latter is of course a single isolated, usually pedunculated swelling ; a mistake can only occur from lack of examination. Kelsey lays it down that any prolapse over 2½ inches in length contains peritoneum, while the presence of a sulcus serves to distinguish between the second form and the rectal intussusception. The direction of the folds and the size distinguish between the first and second varieties.

The *treatment* of prolapse consists first in removing the cause of straining, next the child should be kept rigidly lying down in bed ; the protrusion must be reduced each time it comes down, and if it constantly recurs an attempt should be made to keep it up by a pad and T-bandage, or by strapping the buttocks together with a broad piece of plaster. The bowels should be kept easily open so as to avoid straining, and it is sometimes useful to support the sides of the anus during defæcation by pressure or by drawing the skin tightly to one side ; as advised by Van Buren, the motions should be passed into a napkin without the child being allowed to sit up.

Enemata of cold water or astringents, tannin, quassia (2–4 oz. of the infusion), oak bark, sulphate of iron, &c., will do good in many cases, and it is only the more severe forms that are not cured by bed and the means above described ; indeed, simple confinement to bed cures the majority of these children. Should the prolapse be irreducible, an anæsthetic should be given ; if this fails and there are no urgent symptoms, a warm fomentation and putting the child, if old enough, upon his hands and knees with the pelvis raised, will sometimes succeed.

If sloughing occurs the prolapse may be protected from irritation, and dusted over with boric or salicylic acid, and kept clean. The sloughing will very likely cure the prolapse, but it may be at the expense of causing a stricture, and this, if it is at the apex of a long prolapse, will be high up in the rectum when the protrusion is reduced.

Failing milder measures, the actual cautery may be employed, four or five narrow lines being drawn in the long axis of the gut from skin margin to near the apex.

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Paquelin's cautery is the most useful instrument, and is better than nitric acid or nitrate of silver. Only the mucous membrane of the prolapse should be burnt through, while at the skin margin the cautery should lay bare the sphincter; sufficient irritation must be produced to procure adhesions between the mucous and muscular coats. Bryant advises the application of nitrate of silver over the whole surface. After the application the bowel should be reduced and a pad applied. Another useful plan is to excise wedge-shaped strips from the margins of the anus, including a little of the mucous membrane, the base of the wedge being at the anus; the edges of the wounds are then brought together, and the resulting contraction supports the bowel. We have found this successful in a very severe case. In severe and irreducible cases the prolapse has been clamped and removed, but this should only be done as a last resource and with the full knowledge that in a large prolapse the peritoneum will probably be opened and the utmost care must be taken to reduce any rectal hernia that may exist. If the peritoneum is wounded it must be carefully closed with catgut sutures. This operation is rarely justifiable; we have once done it but unsuccessfully; it is not to be confounded with the method of treating prolapse by removal of strips of mucous membrane in the long axis of the gut by means of the clamp, a method sometimes employed.[1]

The bowels should be open two days after operation, as delay makes the first action very painful.

A very successful and safe method which has been extensively employed by our friend Mr. Burgess is that of injection of paraffin into the submucous tissue. The injection should be made under an anæsthetic, and two or three tiers of paraffin masses should be arranged to act as shelves one above the other at intervals around the lumen of the gut. The paraffin should have a melting-point of about 110° F. This method is much less dangerous than removal, and though it requires some experience and care in manipulation, is probably the best means to employ in severe cases.

Fistula in Ano is an uncommon condition in children, though we have several times met with it. As in adults, it is apt to be associated with tuberculosis. As pointed out by Mr. Holmes, most of the fistulæ are blind external ones; this is also our experience. There is nothing peculiar in either the pathology or treatment, which is the same in children as in adults. The abscess is sometimes due to foreign bodies impacted in the rectal wall.

We have, however, introduced the plan of dividing the sphincter ani subcutaneously close to its attachment to the tip of the coccyx, and then scraping out the fistula. This is a less severe way of dealing with fistulæ than the ordinary plan, and is probably sufficient for all cases likely to be met with in children.

An ischio-rectal abscess may discharge per vaginam, as in a case under our care at the Children's Hospital in 1896.

Piles in children are usually described as unknown, or almost so, and their occurrence is no doubt very rare; we have, however, seen two cases of

[1] Dr. Cullingworth related at the Pathological Society of Manchester, December 1887, a successful case of complete excision of a large prolapse in a young lady in which the peritoneum was opened.

external piles, and Ogston, jun., has recorded a case in a child 3 days old. In another instance a child was brought to us for bleeding from the bowel, and on examination a condition indistinguishable from that of well-developed internal and external piles was found ; this had been giving trouble since the child was about a year and a half old, but the affection was probably congenital. Light was thrown upon the case by the presence of a large partially degenerated nævus on the buttock, quite distinct, and at a distance from the anus, and probably the case was really one of nævus of the anus. The disease was readily cured by applying ligatures just as for piles. There was no nævoid tissue higher up, though this is occasionally met with. Ligature or the actual cautery is the best treatment. Howard Marsh and Barker have recorded instances : in one the patient, an adult, ultimately died of hæmorrhage.

Condylomata frequently occur in children about the anus or its neighbourhood as flat, sessile, pink or pinkish-white elevations, or sometimes as large irregular masses. They are usually a manifestation of congenital syphilis, but sometimes, we believe, simply the result of dirt and irritation, and some of them are tuberculous. When syphilitic the local treatment is, of course, subordinate to the general measures, but dusting over with calomel or the application of black wash usually speedily cures them. Sometimes, especially if non-syphilitic, they are more obstinate, and may require to be scraped away or treated with the actual cautery, nitrate of silver or chromic acid.

Polypus of the Rectum is one of the diseases which, though not absolutely peculiar to children, are by far most commonly found in them. Most cases of rectal bleeding in children, apart from that due to mere tenesmus and diarrhœa, are due to polypus ; hence careful search should be made for a tumour in all cases where unaltered blood escapes from the bowel.

Rectal polypi are usually pedunculated rounded bodies about the size of a hazel nut ; they are composed of myxo-fibromatous or soft fibro-cellular tissue, or in some cases are adenomata ; in the former the surface is smooth, though sometimes superficially ulcerated or excoriated, and the pedicle is often long and thin, though the growth in its early stages may be sessile. Adenomata are granular or warty in appearance. The anterior wall of the rectum about an inch from the anus is the usual seat of these growths ; sometimes, however, they are attached higher up in the bowel, and may be even beyond reach of the finger.

Polypi, besides the loss of blood, give rise to irritation and tenesmus, together with mucous discharge from the gut, and frequently to prolapse. The growth itself is often protruded from the anus during straining, and is sometimes mistaken for prolapse or piles ; examination, however, readily enables a diagnosis to be made, as the polypus is quite separate from the general mucous surface. The pedunculated form is best treated by simple twisting off, or a ligature may be applied to the pedicle, which is then snipped through with scissors ; to do this conveniently the child should be anæsthetised, and the rectum well dilated and a speculum used ; often during an examination the pedicle is torn through and the polypus comes away without further trouble, and occasionally the mass is detached during defæcation and passes with the motion. The sessile form may be ligatured or snipped off and its base cauterised. Recurrence of the growth is improbable.

We have met with rectal polypus in two members of one family, and Cripps relates similar cases.

Occasionally the whole mucous surface of the lower bowel is the seat of warty adenomatous growths, as in a remarkable case recorded by our colleague Mr. Whitehead. Dermoid cysts have also been found. We have had occasion to remove a suppurating dermoid cyst from the ischio-rectal fossa of an adult. Before operation it was thought to be a simple abscess.

Small superficial ulcers and fissures about the anus are common in dirty and in syphilitic children, but they are more common at a little distance from the orifice than actually at the anus. They give rise to pruritus, but seldom to the severe symptoms seen in adults; sometimes there is reflex irritation of the urinary organs, frequent micturition, &c. In the non-syphilitic cases, cleanliness, the destruction of worms or other irritants, and the application of nitrate of silver are usually sufficient. Menthol has been recommended for the pruritus. Tuberculous ulcers may be met with. Ischio-rectal abscess is not very uncommon, and should be opened early; it is probably better to divide the external sphincter at the time to avoid the risk of tedious healing or the formation of a fistula.

Rectal ulcers are due to either follicular inflammation, in which the rectum is involved in common with the rest of the lower gut, or to rectal catarrh, tuberculosis or the presence of a polypus. The symptoms are seldom marked, and the condition is consequently not often seen; *vide also* PROLAPSE and DYSENTERY.

Removal of irritation and improvement of the general condition of the intestinal mucous membrane are the only treatment required.

CHAPTER IX

DISEASES OF THE DIGESTIVE SYSTEM—(*continued*)

Malformations and Deformities of the Digestive System.

Hare-lip.—The upper lip is developed from the fronto-nasal process and the maxillary processes which in the normal course of development fuse in front of the mandibular fissure. Should this fusion fail to take place on

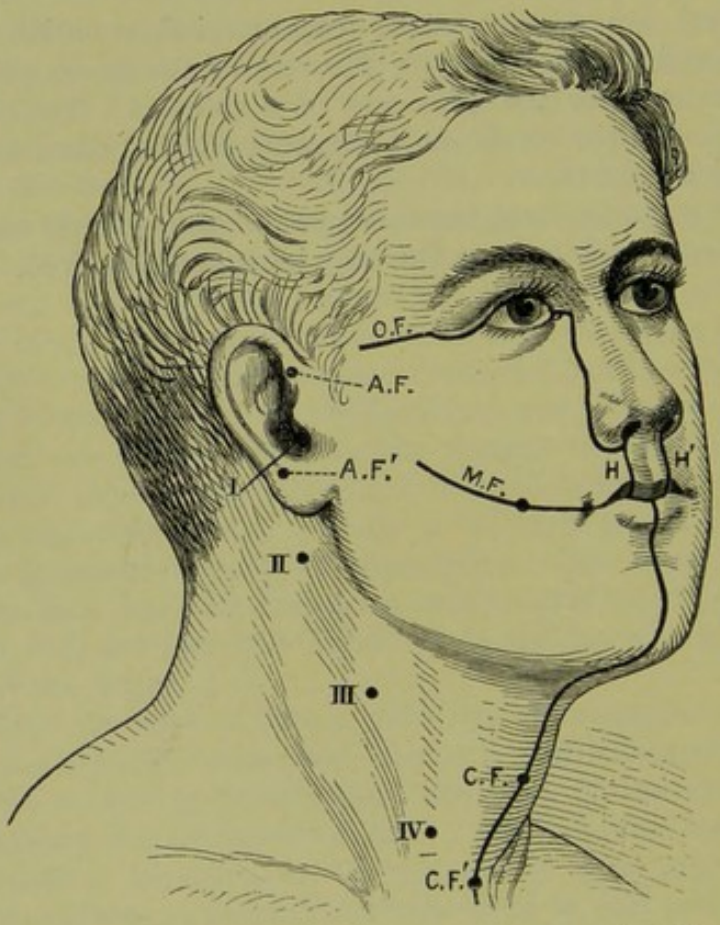

Fig. 24.—Shows the lines of union of the face, and indicates the origin of the chief malformations. AF, AF', situations of congenital auricular fistulæ. I., II., III., IV., indicate the external orifices of *branchial* fistulæ. I. is the external auditory meatus; OF, the orbital fissure; MF, the mandibular fissure; HH', the lines of lateral hare-lip; CF, CF', mark the situations of congenital *cervical* fistulæ. (From Bland Sutton, *Lancet*, Feb. 1, 1888.)

either or both sides, a single or double hare-lip respectively results. If the inward growth of the palatine processes which should take place to separate the nasal and buccal cavities fails, cleft palate occurs.

The præmaxillæ are formed from the globular processes forming the angles of the fronto-nasal or nasal process; hence should the lateral process not fuse with the globular, a cleft between the præmaxilla and the maxilla will result on that side, while, if there is suppression of the two globular processes or failure to fuse in the middle line to form the philtrum, median hare-lip follows; this, though exceedingly rare in man, is met with more or less constantly in some mammals in which the globular processes fail to unite with one another.[1] Mr. C. Roberts has lately shown us a child where the suppression of the meso-nasal process was so complete that there was no columna or vomer, or indeed nasal septum at all.

As to the actual causes of such arrest of development much controversy exists. It is commonly asserted that frights and shocks of various kinds, as well as strong *maternal impressions* of other sorts occurring about the time of the development of these parts, may determine the arrest of growth which results in such malformations. Although many instances have been brought forward to show a causal relation between the two facts, it is not clearly established that anything more than a coincidence really exists.

Fig. 25.—A Simple Case of Double incomplete Hare-lip. This is much rarer than the complete variety.

It is, however, certain that in many cases there is an *hereditary tendency* to such defects, and it is also certain that they are often associated with other congenital malformations. It is asserted that the hereditary tendency is commonly transmitted on the father's side.

Various degrees of hare-lip are found; Mr. Lucas believes that congenital absence of an upper lateral incisor is sometimes the forerunner of hare-lip and cleft palate in a later generation; in some instances there is merely a deficiency of the muscular fibres of the orbicularis, so that although the lip is not actually fissured there is a furrow from the absence of muscle. Thus there is also thinning of the lip which at the affected part consists only of skin and mucous membrane, often somewhat imperfect in structure, together with an intervening layer of connective tissue.

In other cases there is a shallow notch in the prolabium or at the anterior nasal orifice, the parts being otherwise well formed. Between these conditions and the most severe forms of hare-lip all degrees of deformity may exist (figs. 25 and 26).

As the superficial structures are developed more or less independently of the bony framework of the face, hare-lip may occur without any cleft of the palate, and without any separation of the præmaxilla from the maxilla. Most

[1] *Vide* Bland Sutton, *Lancet*, February 18, 1888.

commonly, however, if the hare-lip is complete, i.e. if it extends into the nostril on one or both sides, there is also deformity of the bones, either non-union of the præmaxilla or single or double cleft palate. Thus there may be a mere notch in the line of the gum, a cleft through the alveolar margin on one side, a cleft running backwards, on one side of the nasal septum through the hard and soft palates, or a double cleft isolating the præmaxilla from the maxillæ and leaving it protruding from the end of the nasal septum while the two halves of the hard and soft palate are completely separated and the nasal septum is seen in the middle line as a prominent ridge not attached to either side of the palate—complete or double-cleft palate ; the septum is often seen to taper off and end as a ridge upon the upper wall of the pharynx. It is usually said that cleft palate is always single, but the term may well be limited to those cases where the septum is attached to one palate process only. In other instances the failure of union may occur only in the soft palate, more often in the soft with just the posterior edge of the hard palate, or in slighter degrees of the deformity still the uvula alone may be bifid, or the palate perforated. Most rare of all is cleft of the hard without cleft of the soft palate. We have once or twice seen this condition, which is apt to be mistaken for a congenital syphilitic or other lesion. In some recorded cases the uvula has been absent.

Fig. 26.—Severe Double Hare-lip. Showing the projecting præmaxilla.

Two other conditions associated with hare-lip and cleft palate respectively are of extreme importance as regards successful operation ; the one is the flat, wide, distorted ala of the nose found in complete hare-lip ; the other is the pitch of the palate arch, which may be either wide and flat or very high and narrow ; the latter condition is said to be often associated with mental deficiency.

Sometimes the præmaxilla carries the four incisor teeth, and these are therefore implanted in the projecting mass in cases of complete double hare-lip. In some instances, however, one incisor tooth is attached to the maxilla, most commonly the outer tooth is suppressed altogether, its sac having apparently been lost in the cleft.

Rotation of Præmaxilla.—Very frequently there is some rotation of the præmaxilla upon a vertical axis, especially in unilateral cleft ; in such cases the teeth are also rotated and may be so directed that the outer border, or in some instances the cutting edge, looks directly forwards. This position of the teeth requires to be remedied after their complete eruption. As, however, hare-lip is now usually operated upon before the teeth are cut, their exact position is in such cases of little importance at the time.

Feeble Vitality.—The deformity of simple hare-lip unaccompanied by malformation of the palate, is important almost solely on account of the disfigurement, though it must be borne in mind that many of these children have other deformities or are weakly, and, though without any actual malformation, do not seem to have sufficient vitality to make it possible to rear them.

When, however, the failure of the union affects the palate as well as the lip, other ill results follow ; the child is unable to suck from inability to produce a vacuum in the mouth ; its nasal passages and pharynx are exposed to the air and become affected with chronic catarrh, its tongue is dry and the air entering its lungs is imperfectly warmed. Even when fed with a spoon the food often regurgitates through the nose. Hence to the already weakly condition of the child are added the dangers of insufficient nutrition and catarrh of the respiratory tract. It is not, therefore, to be wondered at that only a small proportion of children so affected survive ; should they do so, they are subject to the further drawback of imperfect and indistinct speech. It is alleged that many of these children die from starvation, which might be prevented by operation ; we do not think this is true ; we believe they would die in any case from simple lack of vitality.

In those cases where the child is unable to suck, it should be fed in an upright posture, when the milk is less likely to regurgitate though the nose, or one of the special obturator teats devised by Mr. Mason and others employed ; probably the best of these is Oakley Coles' rubber teat.

The *treatment* of hare-lip is necessarily purely operative ; several important questions have, however, to be considered in each individual case. First, it is clearly of no use to operate on an infant that is incapable of living from the presence of some other deformity incompatible with life, nor in cases where the general health of the child is feeble and it is losing weight, since union of the wound would not take place. No operation then should be done unless the child is in perfect health ; and the time of actually cutting a tooth should be avoided.

Age for operation.—Next comes the question of the best age for operation. On the one hand it must be borne in mind that there is a certain amount of risk attending the necessary loss of blood and the shock in a very young infant, and on the other hand that, if the deformity is severe, the effect of closing the cleft in the lip as regards moulding the subjacent parts into their natural shape will be greater the younger the child and the softer the tissues. As has been well shown by the late Dr. Rawdon, of Liverpool, and others, a most remarkable modelling process in the outline of the upper jaw takes place after closure of a hare-lip, and more than this, the width of the cleft in a divided palate is much reduced after a time by uniting the lip.

Increased facility in feeding and the removal of hideous deformity are other reasons for early interference, while experience shows that early operation is not attended with a specially high rate of mortality. Many infants die shortly after the operation for hare-lip, but in most of these death is due to malnutrition, not to the operation.

The common practice now is to operate at any time after the first three weeks of life or even earlier in the less severe cases, and a month or two later in the more serious deformities, double hare-lip being dealt with later still ; operations are, however, often successfully done within the first few days of

life. Our own preference is not to operate before a month in single hare-lip, nor before six months in severe deformity.

In view of the recommendations made of late years to operate at much earlier ages in both hare-lip and cleft palate, and to change the order of operation, we have asked our colleagues at the Children's Hospital, Messrs. Montgomery and Ray, and our old friend Mr. Murray, of Liverpool, all surgeons of large experience in this subject, to give us their views on both questions.

As regards hare-lip, Mr. Ray says, 'I prefer to operate in no case under one month old, incomplete single hare-lip at one month, complete single hare-lip at two months, double hare-lip at the 4th–6th month.'

Mr. Ray's opinion therefore coincides with our own. Mr. Montgomery holds the same views.

Operation.—It is, in our opinion, much better in all cases to give chloroform for the operation. The coronary arteries should then be controlled by bulldog forceps or finger pressure, and the lip very freely detached from the maxilla, the dissection being carried far outwards along the jaw, upwards nearly to the lower margin of the orbit, and inwards and upwards so as to freely detach the alæ nasi from the subjacent bone.

The extent of the separation will, of course, depend upon the severity of the case; but, as a rule, failure is more often due to insufficient separation than to any other single cause.

The bleeding during this part of the operation is often free, but is easily controlled by pressure, and stops immediately after the stitches are put in; for this reason we sometimes pare the edges of the cleft before freeing the lip, though if the paring is done last it is easier to adjust the edges exactly. It is very important to slice away the sides of the cleft freely, and not merely to scrape them or to take away a thin shaving; too little is much more often taken away than too much.

In adjusting the edges of the wound, the chief points to attend to are that the prolabial margin on one side exactly corresponds with that on the other; secondly, that the highest suture is well within the nostril, so as to prevent a gap at the upper margin, and to remedy the tendency to flattening of the nostril; thirdly, to insert a suture on the inner and under (mucous) surface of the lip; this more than anything else prevents the appearance of an unsightly notch at the lower end of the line of union. The main sutures should be made to include the whole thickness of the lip except the mucous membrane; the intermediate ones may be only superficial.

Silver-wire sutures, usually about three in number, with intervening horse-hair stitches, will be found very successful, and are, we think, on the whole, the best.

Hare-lip pins are hardly ever necessary, and should not be used if it is possible to avoid it. We have not used them for years. If the lip is freely separated from the upper jaw, there will be no tension. We used sometimes to put pins in temporarily to keep the parts in apposition while the rest of the stitches were being inserted, and then remove them at the end of the operation. If the pins are left in, it should be for not longer than forty-eight hours; the rest of the stitches may be taken out a day or so later, according to the amount of irritation set up and the condition of the child. Where the power

of repair is feeble, the sutures should be left in longer. Some surgeons prefer silk or gut sutures. The first stitch, if pins are not used, should be put in opposite the prolabial margin ; this answers the double purpose of controlling the coronary arteries and of fixing the level of adjustment of the two sides. If forceps have been used for controlling the bleeding, they should be removed just before putting in the stitches.

Some surgeons apply a strip of strapping over the lip after the operation, or use a Hainsby's truss ; neither is necessary. We prefer to dust the wound over with boric powder and leave it exposed. The strapping is objectionable in that it tends to collect blood and mucous discharge from the nostril, and so to irritate the wound. It is, however, sometimes wise to put plaster on for forty-eight hours after removing the sutures until the union is quite firm, and it is a good plan to lay a narrow strip of lint over the line of union beneath the plaster.

If the child has not been weaned before the operation, it should be allowed to suck as soon as it recovers from the chloroform ; in such case care must be taken to prevent injury to the mother's breast from the wire sutures. In most cases, however, the child has been bottle or spoon fed.

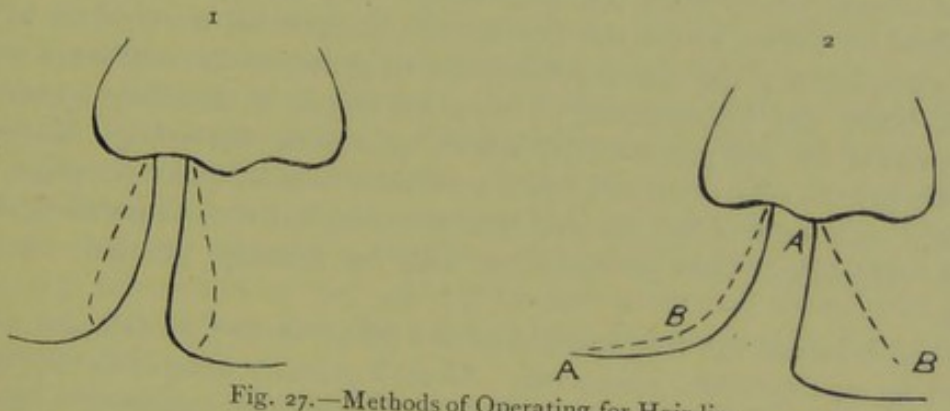

Fig. 27.—Methods of Operating for Hair-lip.

In any case the hands must be carefully secured by bandaging them to the chest with a flannel bandage or by some similar means, and watch kept that no injury is done to the lip.

The principal *methods of operating* for single hare-lip are as follow : each case must be managed according to its special needs, no one method answering in all cases :

1. The edges of the fissure are simply pared by a straight incision and brought together. This, though answering well in some cases, is apt to leave a notch at the prolabial margin unless there is abundance of material to work with. By making the line of incision slightly curved, with the concavity towards the cleft, the notching may often be avoided (fig. 27, 1).

2. The single-flap method shown in fig. 27, 2 is one of the best (Owen's operation). A fits to A. B to B.

The more complicated operations of Giraldès and Collis are seldom employed, but it is occasionally very useful to carry the incision round the ala of the nose in severe cases ; by this means the depth of the lip can be greatly increased ; this plan was, we believe, first employed by Dr. Rawdon, of Liverpool. Many other methods are described.

In double hare-lip two special difficulties have to be met, the management of the prælabium and of the præmaxilla. The prælabium may be—

1. Pared at its sides and free extremity so as to make a semicircular or tongue-shaped flap which is fitted between the upper parts of the two lateral flaps, these having been previously pared.

2. If long enough, the prælabium may be brought down to make the central part of the lip, being pared only at its sides, and the lateral flaps are then fitted to it instead of to each other.

3. The central flap may be removed altogether, and the two sides brought together throughout their whole length.

4. The prælabium, having been dissected away from the præmaxilla, may be doubled upon its base and turned up to form a columna for the nose. The first and second of these plans are the most generally useful.

The præmaxilla in some cases may be pushed gradually backwards by constant pressure with a pad before the hare-lip is operated on, or it may be forcibly pushed back at once; this is open to the objection pointed out by F. Mason, that the wedging back of the præmaxilla may tend to keep open the cleft in the palate. Removal of a wedge-shaped piece from the septum nasi or of lateral pieces from the præmaxilla is a plan sometimes adopted. The method we prefer where the præmaxilla cannot be covered is to shell out the bone, leaving the muco-periosteum to preserve the outline of the lip, and then bring the lip together;[1] this, we think, is certainly better than entire removal of the præmaxilla, which produces flattening of the lip. Where the præmaxilla is turned upon a vertical axis so that one edge looks forwards, it may be forcibly rotated into position, but if the lip can be united over the projection the prominence will, as already pointed out, soon diminish.

Any notch left at the free margin of the lip or at the nostril can usually be closed by a subsequent operation. Should primary union fail throughout, an attempt should be made at once to procure secondary adhesion by either putting in fresh sutures, or, if the tissues are too soft and inflamed to hold them, by applying strapping to bring the sides together. If the child's health is good, this will probably succeed; failure is, however, often due to malnutrition; in such cases union cannot be expected to occur, and a second attempt should be put off until the health is improved. It is wiser not to operate too soon a second time; many cases that look unsatisfactory after operation improve much in time. Our former house surgeon and old friend Mr. Murray, of Liverpool, while bringing a flap across very much as in Owen's method, uses a button suture to bring up the ala nasi and avoid the flattening of the nostril, which is sometimes difficult to obviate.

The particular mode of operating must be selected for each individual case, looking especially to the size of the central portion of the lip in double hare-lip and to the inequality of the two sides in the single deformity.

Cleft Palate.—The varieties of cleft palate have already been mentioned. The severer forms are commonly associated with double hare-lip—indeed, it is said to be very rare for double hare-lip to occur without cleft palate, and no doubt this is true in the complete forms of hare-lip.

[1] This method was introduced by Sir W. Fergusson.

Here a brief account of the modes of treating the deformity can alone be given.

There is no doubt that a great change of opinion has taken place with many surgeons as to the time and order of operations for cleft palate, and the tendency is to recommend operation on the palate before doing that on the lip. It is said to be wise to close the palate 'between the age of two weeks and three months' (Owen).

Owen, following Brophy, has been led to think that the risk of shock has been exaggerated, that the greater adaptability of the tissues gives such advantages, and that results as regards localisation are so much better that the operation should generally be done within three months of birth. He, however, gives no statistics of results, and only describes a single case.

Brophy's plan is described as consisting in forcibly pressing together the maxillæ after paring the edges of the cleft, and if this is impracticable, the maxillæ are divided horizontally till the palate processes can be brought together. They are held in position by thick wire sutures passed through the base above the alveolar processes and fixed by lead plates. These wires are left in for three or four weeks. The edges of the cleft are, of course, sutured in the ordinary way.

We have no experience of this method. Before these very early and severe operations are recommended further information is required as to the condition of the patient at the time, the result as regards union of the palate and especially as regards the lips and condition of the child a year or more later. There are various objections to this method, but it is a subject on which detailed information may or may not show that we have been unduly cautious. In our experience very few of these children are seen either of those who have or have not undergone operation still living after six years of age, and we believe that the number who survive in any case to adolescence is very small.

Our colleagues Messrs. Montgomery and Ray tell us that they are inclined to favour operation on the palate before that on the lip, and to do it in the first few months of life *provided the child is strong and healthy*. It seems doubtful whether Brophy's plan greatly assists the approximation of the posterior part of the hard palate.

Mr. Montgomery would operate in easy cases at six months; in severe cases at from twelve to eighteen months.

Mr. Ray would operate on cleft of the soft palate alone at six months, and says, 'In any such case I think operation may be safely and successfully undertaken at the age of twelve months.'

Mr. Murray advises:

1. In slight cases operation at about one year; in severe cases at about two years old.

2. As a rule to operate upon the lip before the palate.

3. His experience of Brophy's operation is limited (January 1905) to two cases, incomplete on account of failure to obtain satisfactory approximation. He is, however, inclined to give it a further trial.

4. He advises operation on the hard palate only if the operation is done during infancy, on the ground that late operation on the soft palate gives a more mobile structure.

The actual results at Pendlebury and Liverpool justify us in advising caution in operating in cases of cleft palate at an early age, and, as already stated, the question is to be considered as still *sub judice.*

In earlier operations the risk both of failure of the operation and of the child's life is much greater. We have operated earlier than the time we have advocated in slight cases, but are not inclined to attempt closure of a severe case of cleft of both hard and soft palate earlier than eighteen months to two years at soonest. We are inclined to say that operation for cleft palate in cases where both hard and soft palates are involved is done quite soon enough if performed at the end of the second or in the third year. No doubt a cleft of the soft palate alone may be closed at almost any time, but we do not think it is wise to divide the operation into two stages. As in all plastic operations, care must be taken that the child is in good health. The other general rules to be observed are : the edges of the cleft must be freely pared, all tension must be carefully avoided, the muco-periosteum must be thoroughly loosened at the junction of the hard and soft palates in cases of cleft of the velum alone, no hard food must be given till union is complete, and if the operation is only partially successful or fails altogether, another attempt should be made at the end of three months.

Staphyloraphy, or the operation for closure of a cleft of the soft palate, consists in freely paring the edges of the cleft throughout, then a sufficient number of sutures are passed, and next the attachment of the soft palate to the hard is carefully loosened, and, finally, the palate muscles having been divided to relieve tension, the sutures are tightened up. The exact mode of operating that we prefer is as follows. The child is anæsthetised, a pillow is placed beneath the shoulders, and the head allowed to fall right back so that the roof of the pharynx is almost horizontal ; in this position light enters the mouth well, and the blood and saliva collect in a pool in the pharynx instead of irritating the larynx. A gag is then inserted, the whole of the cleft carefully pared, and then from four to seven wire sutures are put in in the following way : a slightly curved needle in a handle is passed through the edge on one side into the cleft, it is then threaded with wire and withdrawn, the wire is disengaged, the needle passed similarly through the other side and threaded with the end already passed ; this is then drawn through the second side by removing the needle, bringing the wire across the gap with the two ends projecting on the oral surface.[1] For the uvula we often use horsehair sutures. When all the sutures are passed an incision is made through the muco-periosteum of the hard palate down to the bone on each side of the front of the cleft and well away from it ; the muco-periosteum is then carefully detached from the bone all round the anterior extremity of the cleft so that the soft parts are quite free and loose. Next, holding all the sutures together in the left hand, the palate knife is carried backwards and outwards from the incision already made until the levator and tensor palati are freely divided and the velum is quite lax. Sometimes it is well to divide the palato-glossus and pharyngeus by snipping through the pillars of the fauces. If there is no tension, it is a good plan to make the relaxation

[1] For knowledge of this most simple plan we are indebted to our colleague, Mr. Hardie. Reverdin's needle would also do.

incisions after twisting up the wires. A minute or two is then given up to firm pressure with a sponge upon the palate, so that all bleeding may be stopped. Finally, the wires are twisted up: we usually begin with the middle wires, as they bear tension best. The ends are then cut short, the cleft inspected to see that the lips are accurately adjusted, and that there is no tension, and the gag is then removed. We often free the muco-periosteum from the bone before passing the sutures.

Various modifications of the operation are of course well known, and will be found described in the general text-books.

During the operation it is important to avoid the use of sponges as long as possible, since mopping out the pharynx much increases the amount of secretion poured out.

The after treatment.—The hands must be carefully secured to avoid injury to the palate, and no solid food should be given for a week. Many surgeons give nothing by mouth at all for forty-eight hours, and feed the patient by enemata. Others allow milk from the first, and sops after two or three days; others, again, allow soft solids from the first; probably it is better to restrict the diet to milk for two or three days and then allow soup and sops till the end of the week; after this the ordinary diet may be gradually resumed, avoiding of course any hard or irritating material. The stitches we usually leave to take care of themselves, and nothing more is seen of them; the child probably spits them out. If, however, they are setting up irritation, or if after a few weeks they have not come away, they should be removed. Any little granulating point or small perforation left at the anterior extremity of the cleft will usually heal up of itself; if it does not do so, the application of nitrate of silver will sometimes succeed, or in other cases a second little operation may be required.

Only one mode of performing the operation of *Uranoplasty*, or closure of a cleft of the hard palate, will be described here; in our experience it is much more successful than the other plans, and if it fails there is less difficulty in a second operation than after the so-called osteoplastic method.

Operation by *muco-periosteal flaps* consists in paring the edges of the cleft throughout; then an incision is made midway between the alveolar margin of the palate and the cleft for its whole length down to the bone. There is an advantage in making the lateral incision for raising the muco-periosteum quite close down to the alveolus, in that by so doing the palatine vessels are retained in the flap. In any case the incision must be either external to or internal to the line of the vessels to avoid the risk of longitudinal splitting of the arteries, which would probably cause troublesome bleeding. The bridge of muco-periosteum between the incision and the cleft is then stripped off the bone with a blunt raspatory completely into the cleft throughout its whole length; this must be done most thoroughly, so that there is no tension upon the flaps, which, however, must not be bruised more than can possibly be helped. The sutures are then passed as in the operation upon the soft palate and twisted up.

In case of operation upon the soft palate alone we prefer the plan of paring the edges first, then passing the sutures, and then dividing the muscles before twisting the sutures; while in uranoplasty the edges are first pared, then the flaps raised, and lastly the sutures are passed and twisted up.

The *shape of the palate arch*, already alluded to, is of importance ; the higher and narrower the arch the easier in most cases is the closure of the cleft, since there is proportionately more tissue to draw across the gap.

In some children the cleft is so wide, that is, the failure of growth of the palate processes is so marked, that it is impossible to close the opening by the ordinary plastic operation ; in such cases Davies-Colley's or the flap method may be tried, or an *obturator* may be fitted to the gap. Operation is, however, nearly always practicable.

In some instances the deficiency may be lessened by operation, even though complete closure is impossible ; a smaller obturator is then sufficient.

Obturators are liable to increase the size of the opening by pressure unless carefully managed.

The results of the operation are, in successful cases, that the power of swallowing is improved, the food no longer tending to pass into the nasal fossæ, and the tendency to pharyngeal catarrh is lessened. The voice is not improved by the operation itself, but closure of the cleft renders it possible by subsequent training greatly to improve speech : and if sufficient care is taken it may be rendered practically perfect ; this no training can do while the cleft remains.

Mr. Mason's plan of completely dividing the soft palate backwards is devised to remedy the rigidity of the velum, sometimes resulting after operation, which interferes with speech and deglutition.

A high-pitched roof to the mouth sometimes produces exactly the same effect upon speech as a cleft palate ; this has been treated by Mr. Warrington Haward by loosening the muco-periosteum and excising a strip ; the edges of the wound are then brought together so as to lower the pitch of the arch. Much improvement followed in his case.

Other Malformations.—The rarer forms of congenital malformation of the lips require little more than mention here.

A median fissure of the upper lip is of extreme rarity, but does occur ; it results from complete suppression of the lower part of the præfrontal process,[1] or lack of development of the median portion. Mr. Reginald Smith, of Warrington, informs us that he met with such a case in the summer of 1898. (*Vide supra*, p. 177.)

Cleft of the lower lip has occasionally been met with, as well as a peculiar mammillary projection on each side of the middle line. In one instance the cleft ran downward from the angle of the mouth. Murray is quoted by Mason as having seen a case where congenital sacculi existed in the lower lip in four members of one family. A similar case is recorded by Sympson in the 'Brit. Med. Jour.' December 9, 1882. We have also seen more than one of these cases. Mr. Woollcombe, of Plymouth, in recording two of these cases in the 'Lancet' (February 11, 1905), emphasises the association of these papillary projections with double hare-lip, and points out that the processes fit into the clefts in the upper lip when the mouth is closed, and may possibly be the result of overgrowth from lack of pressure.

Macrostoma, or congenital enlargement of the mouth, is usually unilateral, occurs most commonly in females, and is not hereditary ; it may be

[1] For a discussion on this subject, see Mr. Bland Sutton's admirable lectures, *Lancet*, February 18, 1888, and *Tumours, Innocent and Malignant*, 1893.

associated with branchial fistulæ and supernumerary auricles, together with hare-lip, as in a case of our own. In Guersant's case, figured by Mason in 'Surgery of the Face,' the deformity was bilateral and clearly due to failure of union of the superior maxillary with the fronto-nasal and external nasal processes, i.e. persistence of the lachrymal fissure.[1] In the more usual form it is a persistence merely of the great buccal aperture from incomplete fusion of the superior and inferior maxillary plates, i.e. of the maxillary process of the pterygo-palatine arch and the lower part of the mandibular arch from which Meckel's cartilage and the lower jaw arise. The condition is easily remedied by paring and uniting the edges of the fissure to the required extent.

Fig. 28.—Macrostoma on the left side, with a faint scar-like mark leading up towards a depression at the base of a well-marked supernumerary auricle. (Mr. Southam's case, see p. 191.)

Macrocheilia, or enlargement of the lips, is occasionally met with as a congenital condition due to lymphatic overgrowth or enlarged mucous glands (*cf.* also NÆVUS). When the deformity is sufficiently serious to require treatment, a part of the lip may be removed either by taking out a wedge-shaped piece of the whole thickness of the lip or by splitting the lip and removing a part of its thickness and afterwards stitching together the edges of the mucous membrane.

The more common acquired macrocheilia or 'thick lip' is usually due to a chronic lymphangitis which is frequently seen in tuberculous children. Repeated attacks of acute or subacute inflammation of the lymphatic vessels leave a permanent thickening of the lip behind—a condition analogous to elephantiasis.

Microstoma, or congenitally small mouth, is occasionally seen, and even complete closure—*atresia.* This is treated by enlarging the opening to the necessary extent, stitching together the mucous and cutaneous borders, and at the corners bringing a flap of mucous membrane across the angle to the skin. Similar operations may be performed in cases of cicatricial contraction after ulceration, burns, &c.

In very rare cases the tongue is congenitally absent.

A common deformity, though not nearly so common as it is popularly supposed to be, is **Tongue-tie** or congenital shortness of the frænum. Where this really exists the tip of the tongue is so tied down to the floor of the mouth and inner surface of the jaw that it cannot be protruded, and sucking is materially interfered with : slighter degrees of the deformity often exist, while in rare cases the tongue is so bound down to the floor of the mouth as to be practically immobile (anchyloglossus). Tongue-tie is easily recognised

[1] *Vide* also figs. in Forster's *Missbildungen des Menschen.*

by pushing up the tip with the finger in the child's mouth; its treatment consists in snipping through the edge of the frænum with a pair of blunt-pointed scissors and then tearing the rest with the finger nail while the tongue is pushed upwards. The division should be made near the jaw, and should not be too free, or possibly the ranine vessels might be injured, or even it is said 'tongue-swallowing' occur, from loosening of the tongue muscles in the child's subsequent efforts at sucking. A more probable danger is the occurrence of cellulitis.

Sometimes the tongue is malformed, cleft in the middle line, or even trilobed,[1] or the muscles of one side may be deficient,[2] e.g. as sometimes in facial hemiatrophy.

Sublingual cysts may develop in the median line between the genio-hyo-glossi as a result of persistence of the lingual duct which runs from the foramen cæcum towards the isthmus of the thyroid; the cavity of these cysts is lined with epithelium and contains fatty material[3] (*vide* p. 192).

Macroglossia is the term applied to a congenital affection of the tongue in which the normal lymph spaces are greatly enlarged and there is also an overgrowth of the connective tissue of the part; there is, in fact, congenital lymphangiectasis. The result of this is great enlargement of the tongue, which may be kept protruded from the mouth to varying degrees, and by its bulk and unwieldiness interferes with sucking and breathing. We have also met with slighter degrees of the same condition affecting only the sublingual tissue and resembling ranula. Associated commonly with macroglossia is hygroma or one form of 'hydrocele of the neck.' This is simply a similar condition of the lymphatics of the floor of the mouth and upper part of the neck. It appears as a soft, doughy swelling in the submaxillary region, and may reach a large size, occupying the greater part of the sides and front of the neck (*vide* chapters on TUMOUR GROWTH and also NÆVUS).

In severe cases these conditions rarely admit of successful treatment, the children are generally marasmic and often otherwise malformed. Removal of part of the tongue with scissors or excision of a wedge from it with subsequent closure of the gap may be attempted. Galvano-puncture, electrolysis, setons, and injections are all worth thinking of, and pressure and astringents are said to have done good in some instances. Our friend Mr. Howlett, of Hull, has recorded a most successful case of the treatment of macroglossia by electrolysis. The case was a very severe one, but repeated applications, twenty-six in all, completely cured it (*vide* 'Quarterly Medical Journal,' October 1896). It must be remembered that hygroma sometimes spontaneously disappears.

Slighter degrees of the deformity are occasionally met with in older patients: in them the condition has a less obvious connexion with the lymphatics, and appears to be sometimes mere overgrowth of the mucous and connective tissues.

Ranula is the result of occlusion of a mucous duct and the formation of a retention cyst, rarely it is due to obstruction of a sublingual salivary duct. It appears as a bluish-grey translucent swelling beneath the tongue; it

[1] Barling, *Brit. Med. Jour.* December 5, 1885.
[2] Cholet in Billard's *Maladies de l'Enfance.*
[3] Bland Sutton, *Brit. Med. Jour.* February 27, 1886.

is soft, fluctuant, and painless, but produces deformity from pressure of the tongue upwards and the floor of the mouth downwards, and, if large, interferes with speech and deglutition. The swelling contains a clear glairy fluid like white of egg. Ranula may be treated by excision of a part of the cyst wall or by passage of a seton through it ; both methods are frequently successful, but sometimes fail ; if they do the greater part of the cyst wall should be clipped away with scissors and the surface remaining be well scraped or rubbed over with solid nitrate of silver. Relapse is believed to be sometimes due to the cyst being multilocular. Rarer forms of ranula are said to be due to enlargement of a bursa beneath the mucous membrane (bursa of Fleischmann), or of the one between the genio-hyo-glossi muscles—these may contain melon-seed bodies. Ranulæ connected with the submaxillary duct have often been described, but their existence is more than doubtful ; the duct can always be made out lying on the surface of the cyst. Congenital dermoid cysts in connection with the branchial clefts are sometimes met with in the floor of the mouth : they may attain a large size or remain stationary for years ; they contain the usual sebaceous matter, hair, &c.

A form of cyst arising in connection with the lingual duct which runs from the foramen cæcum towards the hyoid bone has already been mentioned. It is due to persistence of the pharyngeal diverticulum from which the thyroid gland is developed, the thyro-glossal duct. *Vide* 'Median Fistulæ of Neck,' p. 192. The dermoid and bursal cysts are to be treated by excision or by free incision, with scraping and subsequent drainage ; in some cases the cyst requires dissecting out through an incision below the jaw.

We have met with a salivary calculus in a child.

Other Affections of the Tongue.—Papilloma and condyloma of the tongue are not rarely seen, as well as nævi and mucous retention cysts. Papillomata may be snipped off, condylomata require of course specific treatment, mucous cysts should be treated like ranula.

Nævus of the tongue is not rare (*vide* chapter on NÆVUS) ; puncture with the actual cautery is usually the best treatment, but excision of part of the tongue may be required.

Mason has described congenital pendulous fibro-cellular tumours of the tongue.

Hypertrophy and Atrophy of the Face.—In some cases one side of the face is congenitally hypertrophied, and continues to grow more rapidly than the other side. Nothing can be done for this deformity unless, perhaps, ligature of the external carotid were tried.

Congenital Atrophy, or rather *arrest of development* of the face, is also occasionally seen ; most often it is the result of either some cerebral deficiency or of some unilateral lesion, such, for instance, as torticollis ; it may occur as an acquired deformity resulting from injury.

Congenital **Atresia** of the mouth has been already mentioned, but in some cases the obstruction is not at the lips, but at the level of the pillars of the fauces, and is clearly due to non-absorption of the septum marking off the buccal involution from the pharynx. If this rare condition is met with, probably free incision and dilatation would relieve the obstruction.

Actual absence of the mouth with deficient development of the facial

bones, and instances of apertures below the natural position or on the cheek, have been met with. (*Vide* Billard, *op. cit.*)

Ballard has recorded a case of deformity of the jaws produced by thumb-sucking, the upper jaw being drawn forwards, and the lower depressed so that the face is 'overhung.'[1]

Branchial Fistulæ.—Small orifices large enough to permit the passage of a fine probe for distances varying from a quarter of an inch to two or three inches are sometimes met with in the neck on one side of the middle line. They may occur in the immediate neighbourhood of the external ear or lower down in the neck; the most common position is said to be just above the sterno-clavicular joint. The fine channel continuous with these openings usually runs upwards and towards the middle line. A little watery mucous discharge is often secreted from glands lining the interior of the passage, and occasionally there is a distinct communication with the pharynx. These fistulæ, which are often hereditary, may be single, or there may be two or three of them, and they may be symmetrical. Fragments of cartilage[2] may be found in their neighbourhood, and it is possible that pharyngeal diverticula may result from patency of the internal orifice.

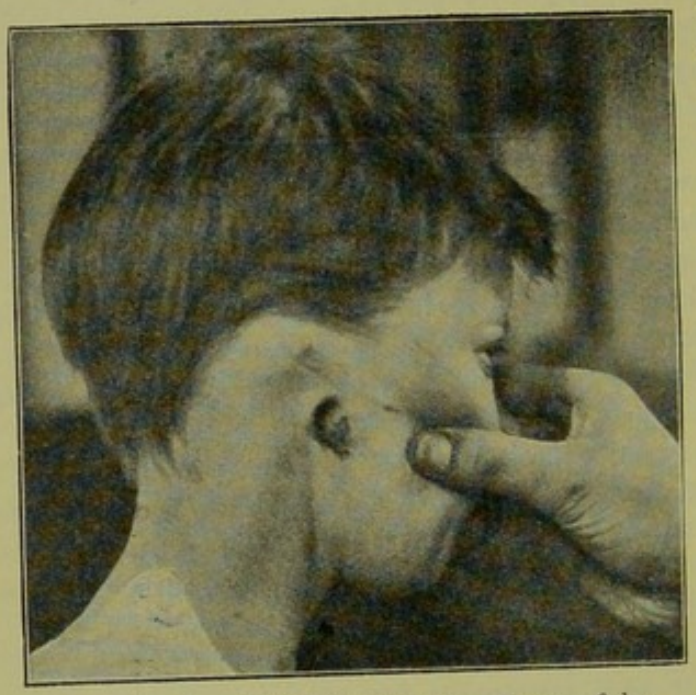

Fig. 29.—Branchial fistula in a girl. Traces of the pinna are seen above the fistula.

The presence of these fistulæ is due to imperfect obliteration of the branchial clefts of embryonic life.

The most remarkable instance we have seen is that figured. The pinna was deficient, and the aperture below allowed ready passage to a finger into the pharynx. The aperture was closed by a plastic operation.

While the cervical branchial fistulæ are rare, it is quite common to see children in whom there is a small pendulous body, like a molluscous growth, upon the cheek just in front of the external ear. Sometimes there is more than one of these, and very often at the base of the little body is a minute orifice leading a short distance inwards. On three occasions we have met with an abscess, in connection with aural fistula. The condition closely resembled a local tuberculosis and was somewhat difficult to treat. We have most often seen these **'supernumerary auricles,'** as they are called, unassociated with any other deformity; but in one instance the child, which had several of these auricles, had also macrostoma, double hare-lip, and cleft

[1] *Path. Soc. Trans.* vol. xv.

[2] Treves records a case in which a rod of cartilage existed, but no fistula (*Path. Soc.* November 1, 1887). We have seen a similar case.

palate, and a small pendulous body exactly like one of the auricles upon the tip of the nose. Our friend Mr. Southam has recorded a somewhat similar case (fig. 28), and Mr. J. H. Morgan another. Cervical 'auricles' are also met with (*vide* fig. 30).

The cervical branchial fistulæ represent the clefts between the hyoid and thyrohyoid arches, or between the thyrohyoid and subhyoid, or again between the subhyoid arch and the upper boundary of the chest, while the presence of aural fistula occurring, as it sometimes does, in the helix or elsewhere, is due to persistence of one or more of the fissures between the 'tubercles' of which the pinna is built up,[1] the supernumerary auricles themselves representing displaced or ununited 'tubercles.'

The common 'supernumerary auricles, which may or may not have a little pit at their base,' are most frequently due to persistence of the fœtal con-

Fig. 30.—Supernumerary auricle in the neck.

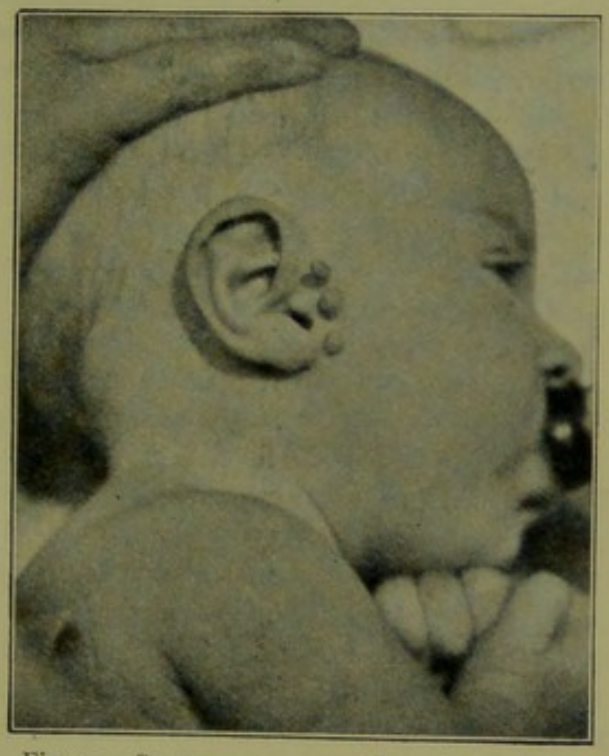

Fig. 31.—Supernumerary auricles in front of ear.

dition of the tragus or of the anterior part of the helix. The little pit sometimes seen at the base of the auricle represents the cleft between the prominences (*vide* His in 'Quain's Anatomy'). The presence of these auricles is often associated with other malformations, and sometimes with mental deficiency.

The auricles, sometimes at least, contain cartilage, and the association of enchondroma of the parotid occurring in later life with disturbance of the development of these parts has been pointed out by Mr. Jacobson,[2] though the pathology of parotid tumours is still doubtful.

In rare instances an orifice is met with in the median line of the neck.

[1] *Vide* Mr. Bland Sutton's Lectures, *Brit. Med. Jour.* February 19, 1887, and *Lancet*, February 1888, and his book on *Tumours*, 1893; also Sir J. Paget (*Med.-Chir. Trans.* 1878), from whose writings much of our information on the subject is taken.

[2] Vide *Guy's Reports*.

Of this we have seen four cases, two of our own and two in the practice of our colleagues; in one there was a seam in the skin closely resembling the scar of a tracheotomy wound, and in the centre of this, just above the sternum, was a small opening; in the second case there was a discharging fistula over the lower part of the thyroid cartilage. These median apertures may be explained by failure of the branchial arches to close in the middle line, or possibly by a deficient closure of the 'sinus cervicalis.' It is, however, most probable that such a fistula, the 'thyro-glossal duct' or 'canal of His,' is, in the words of Dr. C. F. Marshall, who kindly sent us his paper on the subject, 'a remnant of the middle thyroid rudiment of His. It is not difficult to imagine,' he says, 'that this may gradually become dilated at its lower end into a sac by the secretion of mucus from the wall of the canal, and that this sac ultimately causes the skin to give way by its pressure till a sinus is formed.' Dr. Marshall, in his interesting paper, points out that these fistulæ are not present at birth, but appear later, a strong point in support of his view, which is now generally accepted.[1]

H. E. Durham in the 'Med.-Chir. Trans.' 1894, points out that the proof of a fistula being derived from the thyro-glossal duct depends upon—

1. A median position.
2. A ciliated epithelial lining.
3. Permeability through the foramen cæcum.
4. Paired lumina resulting from the original bifurcation.
5. The presence of thyroid gland follicles.
6. A connection with the thyroid gland below.

The first two points are the most important.

As these branchial fistulæ give rise to very little inconvenience it is usually best to leave them alone, especially as they are intractable to treatment from the difficulty of thoroughly destroying their secreting surface. The passage of a hot wire down them, or passing a probe in and then dissecting round it, or the use of the galvanic cautery, is the plan usually advised. In the second of our median fistulæ, in which there was a 'pinching' pain in the part, we with some trouble succeeded in obliterating it for a time by several applications of nitrate of silver fused upon a wire and passed well up the track; subsequently, however, fresh secretion occurred, and even excision failed to cure the condition entirely; however, complete excision of the whole fistula is the only at all certain method of cure, and this may involve a somewhat troublesome dissection.

In a recent paper in 'Brit. Med. Jour.' October 1, 1904, Dr. Edington, of Glasgow, describes cases of thyro-glossal cysts in various positions, and points out the very close attachment the duct has to the hyoid, a fact which makes complete removal by excision much more troublesome, and may necessitate resection of part of the bone. The cystic dilatation of the duct may occur at any point between the foramen cæcum of the tongue and the thyroid, and if suppuration occurs it may travel still lower down the neck.

Edington also records a good example of a ranula associated with the sublingual gland or an outlying portion of it. It is possible that some of

1 *Vide* Sir J. Paget, op. cit.; also Tillaux and others, *Le Progrès Médic.* February 21, 1885; Dr. C. F. Marshall, *Jour. of Anat. and Phys.* vol. xxvi.; also *St. Thomas's Hospital Reports*, 1890, and *Brit. Med. Jour.* May 1890.

the sublingual cysts may arise in the 'apical glands' in the submucous tissue under the tip of the tongue, but we have not come across an instance.

Edington shows that if the upper part of the thyro-glossal duct ('ductus lingualis') is dilated (suprahyoid cyst) the epithelium may be stratified and squamous, not ciliated as in cysts lower down.

Supernumerary auricles should be simply snipped off. They consist of a small rod of yellow elastic cartilage covered with integument, and are supplied with a small artery.

Instead of fistulæ, congenital dermoid cysts may be found marking the sites of the various fissures &c. of the embryo (*vide* chapter on TUMOUR GROWTH). Clutton has described a case of congenital papilloma in the line of the branchial fissures; and cases of primary carcinoma in the neck, probably taking origin in relics of the branchial clefts, have been recorded.

In some of these patients the lower jaw is imperfectly developed.

Any part of the digestive tract may be the seat of congenital malformation in addition to those already described. Congenital strictures[1] and pouchings[2] of the œsophagus and tracheal fistula[3] are all met with, and in certain cases may have some surgical importance; they cannot, however, be discussed here. We have recorded a case of pouching of the œsophagus which was probably congenital and inherited, inasmuch as mother and son both apparently had it. Mr. Butlin has also recorded cases. Other malformations of the digestive tract are treated of elsewhere (Chapters VI. and VIII.).

[1] Charlewood Turner mentions seven cases in Ziemssen. Vide *Path. Soc. Trans.* 1885.

[2] Sir Morell Mackenzie states that congenital pouching is extremely rare.

[3] May be combined with œsophageal deficiency usually at the middle third of the gullet. The fistula is a persistence of the embryonic condition (Sir M. Mackenzie).

CHAPTER X

DISEASES OF THE LIVER

In examining the liver of an infant or young child, it must be borne in mind that this organ is proportionately larger in the child than in the adult ; it consequently occupies a greater space in the abdominal cavity, and thus to the inexperienced it may appear to be enlarged, when in reality it is only of normal size. The fact pointed out by Sahli must not be forgotten, namely, that the angle made by the lower ribs with the tip of the sternum is wider in children than adults, so that more of the liver is left uncovered in the former than in the latter.

The upper limit, as determined by percussion, reaches to the fifth space at the right edge of the sternum, to the upper border of the sixth rib in the nipple line, the seventh in the axillary, and the ninth posteriorly, though the deep dulness reaches somewhat higher. While the edge of the right lobe does not in an adult extend below the costal arch in the recumbent position, in a child it always does. The size of the liver can be as readily estimated in a child as in an adult by percussion ; the lower edge can, however, be much more readily felt in a child than in an adult by placing the warm hand on the abdomen and gently pressing backwards and upwards. In most cases it can be easily determined if the edge is round, sharp, irregular, or flabby as in acute yellow atrophy.

The liver is not often smaller than normal during childhood ; it is so only in the rare instances of the occurrence of acute yellow atrophy or cirrhosis, and even in these cases it is frequently enlarged on account of being engorged with blood.

The best instance of its enlargement from mechanical causes is afforded by the congestion which so frequently attends heart disease, where, in consequence of regurgitation through the mitral valves, there is an obstruction to the onward flow of the blood. It is enlarged also in mediastino-pericarditis for a similar reason. There appears also often to be a temporary enlargement and a sluggish circulation in many cases of chronic intestinal catarrh, where there is said to be a functional derangement of the liver, accompanied by loss of appetite and pasty constipated stools deficient in bile and an excess of pigment and perhaps uric acid in the urine. The liver is frequently enlarged from the presence of excess of fat ; more rarely it is amyloid, or the seat of new growths or of abscess.

The weight of the liver at birth is about 4½ oz. or 4·2 per cent. of the body weight (Birch-Hirschfeld). At a year old 11 oz. or 3·4 per cent. of the body

weight (Holt). In the adult the weight of the liver is 2·5 per cent. of the body weight (Frerichs).

Jaundice

The common form of jaundice occurring in newly-born infants has already been discussed ; the rarer form in which jaundice is due to lesion of the bile ducts may be here referred to.

Congenital Stricture or Obliteration of the Bile Ducts.—In these curious cases an obliteration of the common hepatic ducts appears to take place, which leads to a secondary or biliary cirrhosis of the liver if the infant survive for a few months. The child may die from hæmorrhage from the navel or gastro-intestinal canal during the first few days of life. Such cases, though not common, are by no means rare. Among the more recently recorded cases are those of Wickham Legg, Glaister and John Thomson ; we have seen several cases in which autopsies were made.

Symptoms.—The infant is jaundiced from birth, the yellow colour being intense, affecting the skin, conjunctivæ, mucous membrane, and urine ; the stools are pale and completely devoid of bile. The infant frequently suffers from hæmorrhages, the stools then being black and the skin covered with ecchymoses. In one of our cases the motions were stated by the mother to be black immediately after birth. The liver may be enlarged. Such children may live for a few months ; two of our cases lived to be 4½ months old. The following case illustrates some of these points.

Congenital Absence of Hepatic Ducts. Biliary Cirrhosis.—John H., aged 6 weeks, was brought to the out-patient department on October 4, 1883, with the following history : Mother states he was an eight-months child, born after a tedious labour. About a week after birth it was noticed he was jaundiced (midwife states he was yellow when born) ; his urine was dark and stained the linen ; the stools were loose and pale grey in colour ; he did not 'snuffle,' and there never was any rash. On examination, when 6 weeks old, he was deeply jaundiced ; fairly well nourished ; the edge of the liver was felt immediately below the ribs. October 8.—Much the same ; diarrhœa troublesome, pale white milky stools. October 25.—The liver is enlarged, the edge being felt nearly on a level with the umbilicus ; it has been increasing in size the past week or two. November 1.—Liver still enlarged ; stools loose, resembling milk ; still intensely jaundiced ; is becoming very thin. December 6.—Liver decidedly less ; diarrhœa not so troublesome ; continues to waste. December 30.—Diarrhœa has been very troublesome ; convulsions. Death when 4 months old. He had not at any time suffered from purpura or hæmorrhages.

Post-mortem.—Body extremely emaciated and deeply jaundiced ; all internal tissues bile-stained. Heart, muscular walls pale yellow ; kidneys ditto. Liver, 7 oz. ; does not appear enlarged ; is of a dirty dark green colour, surface finely granular ; no adhesions or peri-hepatitis or matting of parts in the fissure ; it has a tough feel, and creaks under the knife as it is cut ; the section shows a dark green colour with strands of fibrous tissue, much in excess of the normal state, accompanying the portal vessels ; the strands are best marked near the entrance of the vessels at the fissure, and the larger bile channels are more or less dilated and contain thick green bile. On examining the inferior surface of the liver, the gall bladder is seen distended with a non-biliary mucoid fluid ; its duct can be traced downwards, though smaller than normal, to the ductus choledochus ; the latter joining the duodenum in the normal position is pervious and contains mucus only. No trace of a right or left hepatic duct can be found. The portal vein and hepatic artery are apparently quite normal. Microscopical examination of liver shows excess of fibrous tissue surrounding portal vessels and lobules ; many small biliary ducts are seen choked with inspissated bile.

Diagnosis.—The obstructive jaundice of the newly-born can be readily distinguished from functional jaundice, the only form likely to be confounded with it, by the stools in the former being colourless while the latter contain bile.

Morbid Anatomy.—There is much emaciation, the internal organs are intensely bile-stained, with minute hæmorrhages on their surfaces. The liver is mostly enlarged and of a dirty green colour ; the surface is granular, the granulations varying in size from a millet seed to a hemp seed : it has a tough feel, and on section an excess of fibrous strands is seen accompanying the portal vessels—this is most marked at the great fissure ; the larger biliary channels contain green inspissated bile. On examining the vessels in the transverse fissure, the vein and artery are intact, but the gall bladder is usually small and contains no bile, and the common and hepatic ducts are either shrivelled up and nearly obliterated or greatly diminished in size. Microscopical examination of such livers shows biliary cirrhosis. The etiology of these cases is obscure ; in some cases apparently the ducts are never formed. In one of our cases the mother had suffered from syphilis, but neither of the infants showed any symptoms. It is possible that a catarrh of the bile ducts occurring during fœtal life or a blockage from inspissated bile might lead to a permanent obstruction and obliteration. The cirrhosis follows as a result.

Prognosis.—Such cases are necessarily fatal in a few months, and hardly admit of any treatment.

Obliteration or Stenosis of the Common Bile-duct occurs during childhood apparently as the result of an inflammatory lesion in the lower part of its course ; the head of the pancreas may also be involved. In one of our cases a girl of 5 years became jaundiced for the first time when recovering from whooping cough ; she remained jaundiced till her death seven months after ; death took place from hæmorrhage into the bowels. At the *post-mortem* the lower portion of the common duct was found surrounded by fibrous tissue, and would only admit a probe of one millimetre in diameter. The head of the pancreas was indurated ; the gall bladder was very small and contained mucus only. In a second case, that of a girl 7 years of age, there was jaundice for three years before death. In this case obliteration of the lower portion of the common duct had taken place and a gradual dilatation of the biliary tract above, which formed into an enormous bile containing cyst. This was tapped and drained during life ; death was the result of an attempted operation to connect the cyst with the duodenum.[1]

Catarrhal Jaundice.—Children of all ages are apt to suffer from a temporary jaundice, associated with gastro-intestinal catarrh, attributable to a swollen condition of the mucous membrane of the duodenum and common bile duct.

Symptoms.—After a few days, in which there are symptoms of dyspepsia, the conjunctivæ and skin become yellow, the urine contains much pigment and the stools are pale. A few days later the liver may be felt to be enlarged. There are rarely the nausea, low temperature, and slow pulse so often seen in the catarrhal jaundice of adults. We have, however, seen one

[1] See *Medical Chronicle*, Oct. 1898, and also case of Treves, *Practitioner*, Jan. 1899.

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or two cases in which there were jaundice, delirium, drowsiness, and slight fever, in which we suspected acute yellow atrophy, yet they finally recovered and we were left in doubt as to their nature. As a rule, in the course of a few days or a week all the symptoms disappear.

The diagnosis of catarrhal jaundice does not usually give rise to difficulty when it occurs in children. The possibility of the jaundice being due to acute yellow atrophy must be borne in mind, and any ecchymoses or brain symptoms would be very suggestive of the latter. Jaundice due to cirrhosis, or new growth, or syphilitic disease, could hardly be mistaken, as jaundice under these circumstances would not be an early symptom. It is possible that jaundice may be due to round worms finding their way into the duodenum, and entering the common duct. Catarrhal jaundice is sometimes associated with lobar pneumonia. There is probably an infection both of the lungs and bile-ducts with the pneumococcus.

Treatment.—The treatment of catarrh of the bile ducts should be similar to that of gastric catarrh : the diet consisting of beef tea, bread sops, light puddings, and milk. Sulphate or phosphate of soda may be given with infusion of rhubarb two or three times a day. Carlsbad salts and Friedrichshall water are useful in keeping the bowels open.

Biliary Calculi are at times found in the gall bladder of newly-born infants (J. Thomson). Two cases of obstructive jaundice from biliary calculi blocking the common duct have been reported (Bonisson, Portal). Older children sometimes suffer from biliary colic and jaundice, and calculi have been found in the stools.

Epidemic or Infectious Jaundice.—On one or two occasions we have observed limited outbreaks of jaundice in children, accompanied with vomiting and fever. On one occasion this occurred among visitors, chiefly children, at a seaside resort in August. In some instances jaundice appears to have been a symptom in some influenza epidemics. Kissel and some other authors have described attacks beginning with fever, headache, shivering, vomiting, then jaundice supervening in a few days. The liver is enlarged ; the stools in some cases retained their normal colour. In some cases there appears to be albuminuria. But little is known about these attacks.

Acute Yellow Atrophy of the Liver.—This curious and interesting disease appears to occur at all periods of life, infancy and childhood not excepted. Several Continental writers have described cases occurring in infants a few days old, but whether these were in reality true cases of yellow atrophy may be open to doubt. Undoubtedly infants who are jaundiced shortly after birth die in the course of a few days or weeks with symptoms of acute disease, but, as far as can be judged from the reports, the naked-eye appearances of the liver after death were not those usually found in acute yellow atrophy. In such obscure diseases as those named after Buhl and Winckel, jaundice occurs. While this disease cannot be said to be common at any time of life, it is perhaps rarer in childhood than in early adult or middle life, though it is very probable that cases are not infrequently overlooked, inasmuch as some of the recorded cases were not diagnosed during life. That they are not rare is certain, as Dr. Hyla Greves has collected seventeen cases besides one observed by himself. We have seen

six cases, one of which occurred in a boy of 4 years, another in a girl 3½ years, and we have had the opportunity of examining the liver in a case of Dr. Railton's.

Symptoms.—The disease begins insidiously; the first symptoms are chiefly those of catarrhal jaundice, loss of appetite, and constipation, the stools are mostly pale, but sometimes quite normal, and the urine is bile-stained. The patient usually remains in this condition for a week or two, during which time neither his friends nor medical attendant suspect the serious nature of the disease. The liver at this period is enlarged and in some cases distinctly tender; the edge may have a flabby feel. Then come distinct cerebral symptoms which may not improbably be mistaken for the onset of tubercular meningitis. The child is irritable, vomits repeatedly, rambles at night, is perhaps very delirious or convulsed; the pupils are generally dilated. There are often ecchymoses about the body at the seat of slight injuries, and oozing of blood from the gums and œdema of the feet and face. After a few days the child passes into a condition of coma; there are also probably muscular twitchings, spasms of several groups of muscles as the masseters, and perhaps local paralyses. The urine may contain leucin and tyrosin. In the latter stages the liver diminishes in size, but this is not invariably the case. The following case illustrates some of these points:

Acute Yellow Atrophy of Liver.—Stephen T., aged 4 years. Admitted September 27, 1882. Mother dead. No history of congenital syphilis could be obtained. Father is a labourer in poor circumstances. Child has been much neglected, and often had insufficient food. Four weeks before admission child took very little nourishment; became yellow and was constipated. Fourteen days ago vomiting began, and lately he had been delirious at night and queer in his ways. Present state.—Patient is a well-developed boy; moderate jaundice; there is œdema of both eyelids, back of hands, and dorsum of both feet. He is frequently mumbling to himself, and does not readily understand what is said to him. His tongue is red at the tip and edges and is coated on dorsum; he is very thirsty, but almost constantly vomits his milk immediately after it is taken. Abdomen somewhat distended; edge of liver distinctly felt below costal arch and in epigastrium, and on percussion dulness extends upwards to the fourth space. The tip of the spleen is felt below the tenth rib. Heart's sound normal; no marked physical sign in chest. Urine passed with fæces or in bed; some separated from fæces contained bile pigment; no albumen; no leucin or tyrosin under microscope. Fæces, passed a few hours after admission, were solid and of a dark brown colour. Pupils dilated, but act to light. Pulse, 100, weak; temperature, 99° F. Second day (of admission).—Vomiting continued most of day, but less after peptonised milk was given. Temperature, 96·4°–100·2°. Third day.—Less vomiting; hæmorrhage from mouth, apparently from gums; bowels acted once after calomel, solid brown motion; no urine passed for twenty-four hours. Temperature 96°–101·2°, 97·8°–102·8°. Fourth day.—Child has been delirious, with some muscular twitchings of face and neck. This morning, left facial paralysis noticed not affecting the eye; it is well marked when child cries, but not complete; no paralysis elsewhere; pupils dilated and sluggish; child only semi-conscious; several loose stools passed after calomel, the first light yellow, later pale grey colour; no urine obtained; edge of liver very distinctly felt below costal arch. Pulse, 100, weak; temperature, 102·8°, 104°, 102·6°, 101°. Fifth day.—Much worse; is quite unconscious; head and eyes turned to right; all limbs extended and rigid; spasms of jaws causing constant grinding of teeth; breathing stertorous; no optic neuritis, but veins are full and somewhat tortuous. Pulse, 130, weak; temperature, 101·2°–100.° Died in afternoon.

Post-mortem (twenty-two hours after death).—Body well nourished; skin very yellow; much hypostatic congestion of dependent parts of the back and arms and legs; 'coffee-ground' material oozing from mouth; no rigor mortis; slight œdema; a bruise about

size of a penny is visible on the sub-clavicular region, left side. *Chest*: no fluid, old adhesions left side; *right lung* on section showing numerous small hæmorrhages into substance of lung; both lobes are gorged. *Left lung*: there is a solid portion in upper lobe, reaching anterior surface and corresponding in a position with above-mentioned bruise, involving the whole thickness of the lobe, but not the inner or outer edges. On section this solid portion consists of red hepatisation with a blood clot in centre and at circumference; lower lobe gorged and containing small hæmorrhages. Bronchi contain blood and mucus. *Heart*, 2¼ oz.; left side contracted, containing a few strings of yellow fibrin; walls of heart pale yellow and fatty; no endocarditis; hæmorrhages into sheath of aorta. Abdomen: on opening, a few ounces of bile-stained fluid escaped. Much injection of small vessels of mesentery in the neighbourhood of the liver; one hæmorrhage, size of walnut, in mesentery of descending colon. *Stomach* contained coffee grounds; duodenum also darkish contents; rest of small and large *intestines* contained pale yellow semi-fluid contents. *Spleen*, 3 oz. firm; somewhat enlarged but normal. *Kidneys*, 4½ oz.: cortex pale yellow, and has a glistening appearance from presence of fat; pyramids congested. *Brain*: nothing abnormal at base, but convolutions on upper surface are decidedly flattened; the ventricles are distended with turbid fluid, and the parts around, especially the white portions, are softened and easily wash away under a stream of water; no lesion of pons or softening noted elsewhere; no hæmorrhage. *Liver*, 12½ oz.: it is very limp, and capsule wrinkles on doubling up. Right lobe: upper and lower surfaces are irregular from presence of some portions which are more elevated than others; the more elevated portions are greenish yellow, and the others red. On section, bright orange-yellow and red portions are seen, the lobules are not readily seen in the yellow parts, which are soft. In the red, which are firmer, the lobes can be distinguished, the centres being bright red and the circumference pale. The left lobe contains more of the red parts and the right more yellow. Microscopical examination—Red portions, the intralobular veins are normal, the walls of the interlobular veins contain numerous leucocytes, and the surrounding connective tissue is also infiltrated; the lobules contain no hepatic cells, but hyperplastic stroma, leucocytes, many red corpuscles. The biliary capillaries are very prominent objects, and seem to contain epithelium with nuclei undergoing subdivision. Yellow portion—The lobules are large; central vein normal; hepatic cells swollen; nuclei obscured; fine granular contents and bile pigment. The walls of interlobular veins infiltrated with leucocytes. Biliary capillaries stuffed with epithelium.

Diagnosis.—Malignant jaundice in an early stage cannot be distinguished from catarrhal jaundice; it is only when cerebral symptoms appear, and there are dilated pupils, ecchymoses, or constant vomiting, that the suspicion is raised that there is something more than simple jaundice. At this time the case is liable to be mistaken for meningitis, though the presence of the jaundice and cerebral symptoms should indicate the true nature of the disease. It may possibly be confounded with pyæmia, phosphorus poisoning, or pneumonia with jaundice, but in all these the jaundice would as a rule follow and not precede the other symptoms.

Morbid Anatomy.—Organs bile-stained; hæmorrhages in various organs. Liver small, limp in texture, mostly bile stained, some portions being greenish yellow, others orange-red, often bulging in some parts from shrinking in others. On section, there are usually areas of red or yellow colour in which the lobules are indistinct or entirely indistinguishable.

Treatment.—Unfortunately but little can be said under this head, as such cases have been invariably fatal.

Cirrhosis of the Liver

Cirrhosis of the liver is not a common disease during early life, being much rarer than among adults. Toedten met with it thirteen times out of

880 *post-mortems* made during seven years at the Children's Hospital at Munich. Of the various causes of cirrhosis **alcoholism** necessarily takes the first place. Cases of alcoholic cirrhosis have been reported by various authors, Frerichs, Bamberger, Toedten, Howard, and others. Sir S. Wilks has recorded the case of a girl, aged 8 years, who had taken daily for some time half a pint of gin. **Syphilis** is by far the commonest cause of an interstitial hepatitis occurring in early life, more especially during infancy, the liver being enlarged and the infant jaundiced, but it is doubtful if syphilis gives rise to the typical hobnail, cirrhotic liver. Gummata of the liver may make their appearance about puberty, and cicatrisations are formed which may involve the portal vein and give rise to ascites (see p. 202). There is little evidence to point to the interstitial hepatitis of infancy passing on into the typical hobnail liver seen occasionally in older children. Possibly the slighter forms of it which are not fatal do so. **Tuberculosis**, especially of the peritoneum and abdominal organs, occasionally gives rise to a perihepatitis and also cirrhosis of the liver. It must be said, however, in a goodly number of cases of cirrhosis of the liver during childhood, there is no history of alcoholism or syphilis, nor any evidence of tuberculosis. Such cases have been reported by Mitchell Clarke, W. Edwards, and others. In some of these cases the symptoms of cirrhosis have been preceded by attacks of one of the fevers, as enteric, scarlet fever, whooping cough, and it has been suggested that there is more than a casual connection between the two. However, considering the great frequency of these fevers and the rarity of cirrhosis, great caution is required in drawing any conclusions. In a certain number of cases perihepatitis is found without marked cirrhosis, as in chronic peritonitis, pleurisy, pericarditis and mediastinitis. *Symptoms* and *course*.—The symptoms are mostly those found in the adult. Dyspepsia, slight jaundice, epistaxis, anæmia and marked enlargement of the spleen, and later ascites. Often the evening temperature is raised a degree or two. The course is usually chronic ; the ascitic fluid forming again and again after being tapped ; death being preceded by coma. The commonest cause of ascites during early life is tubercular peritonitis ; the next commonest cause, apart from cardiac and renal disease, is mediastinitis. Ascites with enlarged spleen is usually due to cirrhosis, and would mostly distinguish an ascites due to cirrhosis from chronic tubercular peritonitis or mediastinitis. We have seen several cases in which the diagnosis of 'enlarged spleen' was made and which eventually turned out to be cirrhosis of the liver.

Morbid Anatomy.—The liver may be found either enlarged or atrophied, but usually the former. The surface is hobnailed, and the liver creaks on section. In syphilitic livers there may be gummata, cicatricial depressions and bands of fibrous tissue running irregularly through the liver substance.

Treatment.—The treatment of portal obstruction, the result of a cirrhotic liver, is only palliative, for there is but little reason to hope that even in syphilitic disease there is much chance of modifying in any way the fibrous tissue which is strangulating the portal channels in the liver. Relief must be sought by unloading the portal system by purgatives and diuretics and by removing the ascitic fluid by tapping ; the latter is best performed by means of Southey's trochars. In syphilitic cases the local inunction of mercurial ointment and other specific treatment should be tried.

The following case of cirrhosis of the liver illustrates the above remarks :

Cirrhosis of Liver.—Bertha S., aged 10 years, was admitted to the Children's Hospital, Manchester, November 5, 1894. It was stated that the patient had had measles, whooping cough, enteric and scarlet fever ; the latter when eight years of age, followed by nephritis and dropsy. The child's mother is addicted to alcohol, and has been in a 'Retreat' ; the child herself has never had alcohol given her. Her present illness began with jaundice about fourteen months ago, then the abdomen began to swell. *Present state.*—She is a fairly nourished girl, with slight jaundice, no ascites or anasarca. Gums swollen and spongy, and bleed easily. The edge of the liver cannot be felt, the spleen is much enlarged, the inner border can be felt reaching forward nearly to the umbilicus and down to the iliac crest. No abdominal tenderness. Examination of the blood shows 4,230,000 red corpuscles per cub. cent., normal in size and shape, No excess of leucocytes. Hæmoglobin, 49 per cent. No albumen in the urine. Other organs healthy. Later in the month it became evident there was ascites. There was also some smart epistaxis on one occasion. The ascites became more marked, and on December 4 she was tapped with a Southey's cannula and some nine pints withdrawn. After the tapping the spleen was felt as before, but the edge of the liver was not felt. She was tapped three times in December, thirty pints being withdrawn in all. In January, thirty-six pints were withdrawn. In February, twenty-eight pints. She died on March 23, having been comatose for several days. Throughout her illness, the evening temperature rose to 100° F., but was normal in the morning. No albumen was ever found, nor was there any general œdema. At the *post-mortem* there was no perihepatitis ; the liver was small, weighing 15½ oz. Both surfaces were irregular, showing small hobnail projections. On section the substance was tough, and bands of fibrous tissue were seen running through the section. The spleen was enormously enlarged and solid. Weight 13½ oz. There were one or two small granulations on the mitral valve.

Syphilitic Interstitial Hepatitis.—The liver is frequently found enlarged in infants suffering from hereditary syphilis, more especially during the exanthematous stage, or it may be enlarged in newly-born syphilitic infants. Hochsinger noted enlargement of the liver in 46 out of 148 cases, of which 30 got well and 16 died. In the most marked cases, especially if the infant is poorly nourished, the outline of the enlarged liver may be seen, as well as the edge distinctly felt. The edge is smooth and the liver feels hard. The spleen is also enlarged. Ascites hardly ever occurs and jaundice is rare, though a slight yellowish tint of the conjunctiva is sometimes present. The liver at the *post-mortem* in typical instances is found enlarged, of a tawny or yellowish colour, with smooth surface and a tough and elastic feel. On section the same tawny colour is seen, the acini are indistinct or cannot be distinguished ; there may be numerous whitish points seen, the so-called miliary gummata. Microscopically there is a diffuse infiltration of small cells in the connective tissue between the lobules and surrounding the portal system, and also thickening of the arteries. The small gummata consist of small round cells, connected with the smaller branches of the portal vein or biliary capillaries (Birch-Hirschfeld). Embryonic tissue and excessive amount of connective tissue are usually seen in a later stage.

In less advanced cases there may be no marked enlargement of the liver, or no very characteristic appearances to the naked eye, but microscopically commencing interstitial hepatitis may be found.

The following case may be taken as a typical illustration :

E. B., 10 weeks old, was admitted to hospital January 1899. An older brother suffers from syphilitic brain disease (general paralysis and dementia). The infant was

born healthy, but recently it had suffered from coryza, rash, and enlarged abdomen. On admission he was well nourished, there were marked coryza, somewhat hoarse cry, coppery scaly rash round mouth, remains of an erythema about buttocks, abdomen distended and tympanitic, the veins on surface enlarged, edge of liver felt reaching nearly to umbilicus, spleen much enlarged. The infant died shortly after admission, being slightly jaundiced before death. *Post-mortem.—Brain* healthy, *lungs* slight hypostatic pneumonia with some minute hæmorrhages, *heart* normal, *abdomen* contains about an ounce of yellow cloudy fluid, a few flakes of lymph in fissure of liver and on intestines. *Liver* enlarged, 12¾ oz., yellow tawny colour, surface smooth, firm, tough, and elastic in consistence. Cuts with a creaking noise; on the cut surface, which is of a dirty yellow colour, in places the lobules are indistinguishable; in other places, where the colour is more reddish, their outline is faintly visible. A few whitish pin-head points seen in parts. No strands of connective tissue visible, no large gummata. *Spleen*, 2¼ oz., enlarged, firm, purple-red, flakes of lymph on surface. Microscopically there was infiltration of small cells surrounding the portal capillaries and between the acini of the liver.

In older children gummata and cicatrices are found at times on the surface of the liver; with this there may be more or less cirrhosis, giving rise to portal obstruction and ascites. In one of our cases there were 15 or 16 gummata visible on the surface of a syphilitic liver, the size of small nuts. Others were seen on section. There were also local cicatrices. The patient was a girl 10 years of age. See 'Reports of the Society for the Study of Disease in Children,' vol. iii. p. 26, 1903.

Fatty Liver

The liver becomes enlarged from being infiltrated with fat in several different diseases during infancy and early childhood. It is common to find children who are fat, pale, and rickety, with large livers, the edge of the right lobe reaching nearly into the iliac fossa and the left to the umbilicus. If an opportunity occurs for a *post-mortem* examination, such livers are found to be pale and greasy, the lobules being indistinct, and the cells are seen microscopically to be loaded with fat. Such children are usually anæmic, having large distended abdomens, coated tongues, pasty stools, and suffer from chronic indigestion. Under a careful dietary, small doses of mercurials and salines, such as Carlsbad or Rubinat water, improvement gradually takes place and the liver diminishes in size.

Tuberculosis of the Liver

Although it is exceedingly common to find tubercles in the liver in children dying of general tuberculosis, it is exceedingly rare for these tubercles to have given any indication of their presence during life. Tuberculous disease of the liver generally takes the form either of grey miliary tubercles scattered through the organ and on the surface, or of cheesy nodules, rarely larger than peas or at the most small marbles, which appear to have a special preference for the neighbourhood of the bile ducts. These caseous masses may be found bile-stained on section, and small cysts formed of dilated bile ducts filled with inspissated bile may be found which have been caused by compression of the ducts. Jaundice is rarely produced unless there are enlarged caseous glands in the transverse fissure compressing the common duct.

Actinomycosis of the Liver

Chronic suppuration, due to the 'ray' fungus, occurs at times in the liver, and is practically always fatal. The following case was believed to be tuberculous at the time, though no tuberculous lesions were found on microscopical examination. More recent examination of the sections show inflammatory changes and the presence of the ray fungus.

Hepatic Abscess.—Boy, aged 14 years, father and mother dead; never been out of England; admitted December 21, 1880; recently had pain in right side and cough; an anæmic boy; yellowish conjunctiva; pain and tenderness about hepatic region; dulness in right nipple line to fifth rib, and two inches below ribs. Temperature, 99°–102°. January 13.—Slight albumen in urine; spleen is larger, is tender to the touch and on percussion; fine râles at base of right lung. Temperature, 95°–103°. 20th.—Liver excessively tender, hepatic region bulging; left lobe halfway to umbilicus; dulness at base of right lung to angle of scapula; explored left lobe of liver with syringe, only obtained blood; albumen in urine; is wasted. 21st.—Fluctuation felt in liver; aspiration—this time obtained an ounce or two of thick pus. 26th.—Fluctuation decidedly felt; opened antiseptically, 8 oz. of thick glairy pus, mixed with blood and bile; tube inserted, followed during evening by large discharge of pus. 28th.—Has been very weak, vomiting; left leg very œdematous for a day or two, now dark blue as if becoming gangrenous; sudden death.

Post-mortem.—Body emaciated; pus swelling up from fistulous opening; left leg much swollen; some fluid in pericardium. Heart normal. Right lung adherent to diaphragm by lymph and fibrous tissue; no pneumonia; the diaphragm abnormally raised by the enlarged liver below, and is adherent to it by recent lymph; the liver has been punctured in the left lobe near its junction with the right on its upper and anterior surface. The fistulous opening enters a very irregular cavity containing pus; this cavity contains semi-solid cheesy material and irregular fibrous trabeculæ, which give it a worm-eaten appearance; posteriorly in the right lobe is a cheesy mass, size of an orange, beginning to become worm-eaten, and containing a little pus; a few other irregular cavities joining together: no lardaceous change. Spleen enlarged, lardaceous. Intestines matted together by old adhesions, the mesentery containing cretaceons masses (old peritonitis from suppurating glands); contains cicatrices of old (tubercular) ulcers; no recent ulceration. Mesenteric glands in places cretaceous. Left external iliac vein, *ante-mortem* clot; kidneys congested, not lardaceous; lungs, old scars at apices; pulmonary artery contains *ante-mortem* clot; embolism.

Hepatic Abscess

Children occasionally suffer from multiple abscesses, the result of the absorption of some septic material from the region of the portal vein, or from some abscess in the immediate neighbourhood. Thus in one case under our care multiple abscesses in the liver were evidently secondary to an ulcer in the cæcal appendix caused by a pin which had been swallowed. In a second case there was a large hepatic abscess communicating through the diaphragm with an empyema in the right pleural cavity; and in a case of Dr. Hutton's hepatic abscesses were due to the contiguity of the liver with suppurating retro-peritoneal glands. In some cases which have been recorded abscesses in the liver were secondary to typhoid ulcers, and in others to the irritation of worms which had penetrated into the bile ducts. The symptoms consist in enlargement of the liver, extreme tenderness, and intermittent fever. The prognosis is bad. If pus is found, it should be evacuated antiseptically.

Hydatids

Hydatid cysts in the liver are not uncommon during later childhood, but are decidedly rare before five or six years of age. If the cyst is of any size and situated in either lobe so as to come in contact with the abdominal wall, it will form a smooth rounded swelling continuous with the liver, neither painful nor tender, elastic to the touch, or actually fluctuating. Diagnosis under such circumstances is easy, especially if the tumour is tapped or aspirated, the fluid withdrawn being of low specific gravity, non-albuminous, and containing some of the scolices or pieces of cyst wall. If the cyst occupy the posterior part of the right lobe, it may push the diaphragm upwards and discharge into the lung or pleural cavity; occasionally the cyst suppurates—in this case there are hectic fever, pain, and the symptoms of an abscess.

Treatment.—Aspiration of the contents of the cyst may be sufficient; the latter collapses and the hydatid may be destroyed. The operation may have to be repeated, as the cyst may fill up with serum. If suppuration occurs incision is required, and in all cases it is safer and better to open the abdomen, secure the cyst to the abdominal wall, and drain the cavity without any previous aspiration, even if suppuration has not taken place.

In a case under our care, a girl of 12 years who had a large hydatid of the liver, the cyst was aspirated and the girl left the hospital apparently cured; eighteen months after she was readmitted suffering from what appeared to be an empyema of the right side. It proved to be a suppurating hydatid cyst of the lung; this was drained, and she finally made a good recovery.

Tumours of the Liver

New growths originating in the liver during childhood are among the greatest rarities, though cases of carcinoma, sarcoma, adenoma, and cavernous tumours have been described. An interesting case of lymphadenoma of the liver, the only one which we have met with, was admitted to the Children's Hospital, under Dr. Humphreys (now of Torquay), in 1878.

A boy aged 14 years suffered, for a month before coming under notice, with pain in the right hypochondriac region and wasting; he noticed a swelling in the same region about two weeks before admission. When first admitted he was pale and sallow, but not jaundiced, the liver was enlarged, the edge reaching nearly to the umbilicus; there was a large bossy swelling situated between the right costal arch and the umbilicus; the superficial abdominal veins were enlarged and tortuous. Aspiration of the tumour yielded nothing but blood. He wasted, there was a hectic temperature (98°–102°), and the peritoneum and right pleura became distended with fluid. He died seven weeks after admission, having had symptoms for three months. At the *post-mortem* the abdominal cavity contained much fluid, the right lobe of the liver was much enlarged and contained a hemispherical mass, which on section had the appearance and consistence of brain tissue; there were some hæmorrhages into its substance, and fibrous bands passed through it. It was surrounded by a broad zone of compressed liver tissue. There was a mass of enlarged glands at the fissure. The right pleura was full of fluid. Microscopically the new growth resembled the structure of lymphatic glands. In this case it was not easy to decide *where* the growth commenced, but, as in the analogous case of lymphadenomata of the kidney, there is a strong probability that it began in the lymph glands of the fissure and grew into and compressed the liver substance.

CHAPTER XI

INFANTILE SCURVY

INFANTILE SCURVY is characterised by tenderness of the bones, hæmorrhagic stomatitis, blood effusions, purpura, and a tendency to bleed from various organs.

Dr. W. B. Cheadle was the first to point out that this condition was due to scurvy, and to show the curative effects of orange juice and fresh food; and Dr. T. Barlow has added largely to our knowledge of the subject by his clinical observations and *post-mortem* examinations.

Infants of under six months rarely suffer from scurvy even though fed on improper food, and children of over two years of age are not often affected, probably because it is rare for them to be fed exclusively on a diet from which fresh food is excluded. The commonest time of life is between the ages of six months and two years, especially from the eighth to the tenth month. G. Carpenter has reported a case of scurvy in a boy of $5\frac{1}{2}$ years, who had been on a diet deficient in vegetables.

The cause of infantile scurvy is undoubtedly improper feeding, though other causes may be contributory. An infant has suffered from dyspepsia during the earlier months of its life; it has been unable to digest diluted fresh milk; one of the dried milk foods or condensed milk has been substituted, whereupon the dyspepsia has improved, the infant has apparently flourished, until it was seven or eight months old; then it has begun to suffer with pain and tenderness in its legs, or has shown other signs of commencing scurvy. While perhaps in this country at least tinned or preserved foods of the dried or condensed sort are responsible for more infantile scurvy than any other foods, yet these foods are not alone in producing these symptoms. The continuous use of peptonised or pancreatised foods, whether made with preserved or fresh milk, will undoubtedly produce scurvy; and so also will malted starch or starchy foods though made up with fresh milk. The tendency in the use of these foods is to give too much of the food and too little fresh milk. Milk foods sold in bottles, known as 'humanised,' and which have been over-heated in order to make them keep, are also responsible for a large number of cases of infantile scurvy. Scurvy mostly of a mild type is seen also in infants fed on freshly sterilised milk, milk and barley water, and also on raw milk, though this is not common. Mild scurvy may also be seen at times in infants taking their mothers' milk. It is not uncommon to find, among the poorer classes of a city, infants of ten to fourteen months being nursed exclusively on their mothers' milk, and

very anæmic, with a zone of congestion around those teeth which have been cut, and an ill-defined tenderness about their limbs. Such cases improve at once when given fresh cow's milk and orange juice.

In a considerable proportion of cases the infants who suffer from scurvy have been difficult to feed, and have suffered from various forms of dyspepsia, vomiting, diarrhœa, pain and discomfort in the bowels. In some there is a history of bronchitis which in many cases seems to affect the digestion. In a minority of cases—at least this has been our experience—the infants who develop scurvy have been tolerably well according to their friends' account, but an examination is very likely to show that they are anæmic, and they very often show signs of rickets.

While it is certain that some dietetic error is the chief factor in producing scurvy, there is much about its etiology which is not perfectly plain. It is certain that the worst forms will be found to have had either preserved milk or peptonised food, and moreover they improve at once if given orange juice or fresh milk in sufficient quantities. But, on the other hand, it is certain that in some instances infants of eight or nine months old who have been taking 30 to 40 oz. of milk a day have suffered from scurvy; and we have known infants of the same age given dried milk food for months without developing scurvy, though they have suffered from rickets. Several times we have seen the early symptoms of scurvy arise in infants in hospital who were wasted and feeble, and were taking a weaker food (on account of their weakly digestions) than a healthy infant of the same age would have been doing, and this in spite of the diet including beef tea made with vegetables. In another case, that of a wasted infant of 9 months taking a mixture of cream diluted with milk-sugar water, the limbs became tender and the gums red, but it improved at once when whey was used to dilute the cream, the amount of cream continuing the same.

Scurvy.—Jim C., 1 year old, admitted to hospital January 13, weight 10 lb. 4 oz., had suffered much from diarrhœa and vomiting, was wasted and his subcutaneous tissues were œdematous; he was given a peptonised cream mixture. January 26 he was given 12 oz. of cream mixture made freshly and pasteurised, containing fat 3·75 per cent., proteids 1·75 per cent., and sugar 6 per cent.; also 12 oz. of beef tea made with vegetables. February 2 he had some slight broncho-pneumonia, temperature 98°–103° F. for a few days. February 9 it was noted the gums were hæmorrhagic around some teeth that were being cut. He was given three teaspoonfuls of orange juice daily, his food remaining the same; in four or five days his gums were healthy; his temperature was intermittent for some days after.

In another case, an infant of 9 months, weighing 9 lb. 6 oz. when admitted, was given 25 oz. of cream mixture and beef tea with some potato added; the gums became hæmorrhagic, and the right femur tender and swollen. The hæmorrhage disappeared in a week after orange juice was given and without change of diet.

It would certainly seem that in the majority of cases, at least, infantile scurvy is caused by an insufficient amount or absence of an element which is lacking in preserved foods and present in fresh milk and also in orange juice; that occasionally this element is present in insufficient quantities in fresh cow's milk or in human milk; that absence of fresh air, life in stuffy bedrooms, depressing diseases as bronchitis and diarrhœa, are contributory causes.

It is interesting to note that so acute and experienced an observer as Dr. Nansen looks upon adult scurvy as a disease not due to the absence of a certain element in the food, but rather to the presence of ptomaines in badly preserved milk, salt beef, or other preserved foods. He believes that if the preserved foods taken on a voyage are most carefully sterilised, so that they keep well, if regular exercise and plenty of fresh air are taken by the crew, and no intemperance indulged in, there will be no scurvy, and orange and lime juice are unnecessary. The symptoms of scurvy are undoubtedly very suggestive of ptomaine poisoning, but further light is needed.

Infantile scurvy is undoubtedly most common among the infants of the comfortably circumstanced classes, who are able to afford proprietary foods, but it is by no means uncommon among the infants who attend the out-patient department of the Manchester Children's Hospital ; these are among the poorest in the city, and are fed largely on boiled bread, supplemented perhaps by breast milk. Sweetened condensed milk is also a favourite food among the working-class population.

Symptoms.—One of the earliest and most characteristic symptoms is pain, tenderness, and immobility in one of the lower limbs. With this there is usually some hæmorrhagic swelling round a tooth which has recently been cut or which is about to be cut. The pain and tenderness in one of the lower limbs may be difficult to localise if only slight, but the infant draws up its leg and cries when it is washed or disturbed, as in taking it up and carrying it about. It is perhaps thought to have rheumatism, or early disease of the hip is suspected. If the child has been walking or crawling, it will probably refuse to put its foot to the ground. When the disease is more marked the infant cries or screams as if in acute pain when the limb is handled, and indeed cries if it sees anyone coming near its cot with the intention of disturbing it. The hip, as we have said, may be drawn up and held rigidly, or it may hang down or lie motionless like a limb which is paralysed. In some cases it has happened that a diagnosis of infantile paralysis has been made. Whenever the above symptoms are observed in an infant of eight or nine months or more, scurvy should be suspected and the gums carefully examined. Appropriate dietetic treatment should at once be commenced.

In more marked cases there will be a more or less distinct swelling in connection with some bone, usually the femur or tibia, or one or both legs may be swollen with the skin tense and shiny. Swellings may be noted in connection with the bones of the upper extremity, more especially the humerus, or the ileum, scapula, or skull. Sometimes ossification of the periosteum surrounding a hæmorrhage will take place and form a swelling which may remain for many months. There is usually marked weakness of the muscles of the back, so that the infant no longer attempts to sit up or hold up its head, but lies helpless in its cot and resents with cries any attempt to examine it. It is good enough if not disturbed, but cannot bear to be interfered with in any way. Various hæmorrhages are apt to take place, the commonest being from the kidneys. The urine discolours the napkins of a reddish-brown colour, or a deposit of a red-coloured sediment is noted in the chamber vessel, and if the urine is collected and examined the

reactions for albumen and blood will be found. Occasionally there is albumen and no blood. The urine is not smoky or dark as in nephritis. In some cases the hæmaturia and stomatitis are the only symptoms present, or they may be the earliest symptoms. In one case coming under our notice, a stone in the bladder had been suspected and the infant sounded for stone. In several cases we have seen fever and semipurulent urine subside at once on an anti-scorbutic diet. There may be oozing of blood from various organs, from the bowels, from the nasal mucous membranes, from fissures in the anus or cracks in the lips. An orbital hæmorrhage is not uncommon, especially if the infant has a bad cough at the time and strains itself. When this happens the eye is pressed forwards ; the eyelid is often œdematous, giving the infant a peculiar appearance. In bad cases purple discolorations of the skin from subcutaneous bleedings are common, bruise marks being present round the eyes and in various places about the trunk and limbs. A hæmorrhagic condition may be noted beneath the finger nails near their roots. The gums may be much swollen, may bleed easily and be very foul. Separation of an epiphysis and fractures of the shaft of one of the bones take place in some cases. The former is the more common, especially separation of the lower end of the femur. We have only seen one case of fracture of a shaft, and verified it by *post-mortem* examination. This was the case of a child of fourteen months old, illegitimate and badly cared for ; it had been put out to nurse, and fed on bread and milk, though it was a question how much milk she had really had. Both humeri were fractured near the junction of the upper two thirds with the lower third. The child was very anæmic and rickety, and there was a blood swelling over the femur. At the *post-mortem* it was found that the fractures were oblique and had evidently been done some time before death, presumably by holding the child by its arms and shaking it for crying. The periosteum had been stripped off by the effused blood. The bones were markedly rickety. Chronic diarrhœa, often of the dysenteric type with blood and mucus, is in some cases the result of a long continuance of dried foods. We have seen several such begin to recover at once when the diet was changed. In one case coming under our notice, the infant was comatose, but recovered when fresh milk and orange juice was given.

In the majority of cases, when the disease is well marked the infant is anæmic and shows signs of rickety bones. The tip of the sternum and sides of the chest wall are drawn in during inspiration, the ribs are beaded and the epiphyses of the long bones enlarged. Not infrequently there may be marked signs of rickets in an infant with anæmia, and slight tenderness of bones. In some cases of scurvy the temperature is raised a degree or two, presumably as the result of some periosteal inflammation near the seat of the blood swellings.

The prognosis is good if treatment is commenced before the infant has become too feeble and exhausted. In fatal cases death has sometimes supervened suddenly from cardiac failure or a hæmorrhage on the surface of the brain.

Scurvy is apt to run a chronic course in the absence of treatment directed to the cause, whereas it usually is quickly cured if the diet is changed by giving it fresh food in some form.

The following case illustrates some of the above remarks :

Scurvy.—The patient was an infant (a girl) aged 7 months, of middle-class parents (patient of Dr. Alfred Brown). We were given the following history : Healthy born, mother unable to nurse it ; it was consequently given Allen and Hanbury's No. 1 food, which consists of desiccated milk ; at three months of age it was given their No. 2 food, which consists of desiccated milk and maltose ; at five months of age it was given the No. 3 food, which consists of a malted food, to be made up with fresh milk instead of with water, as are the No. 1 and No. 2 ; but the mother thinking that fresh milk would not suit, made up the No. 3 food with No. 2 food. Thus the infant had had for seven months no fresh food at all, but dried milk and maltose made into an emulsion with water. The mother stated that the infant had thriven well, and was always looked upon as a prize baby, and no doubt her photograph would have formed an excellent testimonial for the food supply. For two or three weeks past she had had a bad cough. Two weeks before our visit, the nurse noticed the left eyeball was very prominent ; this appears to have come on suddenly, and so prominent was it that the nurse said she fully expected 'it would drop out.' This was attributed to a slight blow the infant had had on the eye from a 'teat,' or 'comforter,' tied at the end of a string. The eye has continued prominent ever since. She had had several 'bad faints.' On examination, we found the baby was large, fat, and pale ; there was a temperature of 101° F. She was drowsy, but was readily roused. The left eyeball was very prominent, and while the right eyelid closed naturally, the left ball was in part exposed, as the eyelids when closed would not meet. The eyelids were not puffy, there were no ecchymoses either on the eyeball or elsewhere. The ribs were beaded, but there was no tenderness about the limbs. She had some bronchial catarrh, and a persistent cough. No teeth were cut ; the gums were normal. The nurse stated the urine stained the napkins a brownish colour. She rapidly improved when given fresh milk and orange juice.

Treatment.—In order to prevent scurvy, an infant if not fed at the breast should have fresh milk from healthy cows in quantities sufficient to supply its necessities. If in consequence of indigestion it is necessary to lessen the quantity of food which it takes, care should be taken to bring the quantity again up to the normal as soon as possible. If this cannot be done the infant should be carefully watched for any symptoms of scurvy such as tenderness of the bones or hæmorrhagic stomatitis. There is no necessity to give raw milk ; it must be rare for children taking a full quantity of freshly sterilised or boiled milk to develop scurvy. The risk is far greater in using sterilised milk which has been heated to a high temperature and kept in stock for some months before being used. All dried milk foods or peptonised foods should be used as temporary resorts only, or should not constitute the sole food of the infant, and this is especially dangerous after the infant has passed six months of age. If any symptoms of scurvy appear ½ oz. to 1 oz. of fresh orange juice should be given daily and 30 to 40 oz. daily of fresh milk according to the child's age. If it is necessary to dilute the milk, whey should be used in preference to barley water or starchy fluids. If the child is over a year old and its digestive powers are good, beef tea with vegetables, potato broth, or an egg may be added to its diet. All forms of peptonised or malted foods should be avoided, or excess of starchy foods, also all meat extracts, manufactured meat juices, and all proprietary and patent foods. Fresh air and sunlight are of great service. The most difficult cases are those in which there is chronic indigestion as well as scurvy.

CHAPTER XII

GENERAL DISEASES

Rickets

RICKETS is a disease that usually makes its appearance during the first two or three years of life ; it is characterised by chronic indigestion, deformities of the bones, weakness of the muscles and ligaments, and various peculiar nervous disorders. Dentition is retarded ; there is frequently enlargement of the liver and spleen.

The commonest time for rickets to manifest itself is during the period from the fourth or fifth month to the end of the second year ; in rare cases it has been noted earlier than this. During the first year or two of life, even in health, the digestive system is worked to its utmost capacity, in order that it may be able to supply the system with sufficient nutrient material, not only for the exigencies of daily life, but also for the rapid building up of the tissues which is going on at this time ; an impairment of the digestive powers, a weakening of the digestive ferments, or food of an improper kind, necessarily means indigestion in some form or other. An imperfect digestion means that not only do the elements in the food fail to be converted into normal products, but also toxins or pathological products are formed, which being absorbed into the blood interfere with the building up of the tissues and perhaps give rise to symptoms of disease. In some of the milder forms of rickets, when the ribs are seen to be beaded and the bones of the extremities deformed, without any of the symptoms which mark the severer grades, the child may be fat and apparently healthy, and there may be no evidence of a present or past malnutrition ; but inquiry will generally elicit some past illness or subacute dyspepsia, or a history of improper feeding, or some conditions which have tended to produce a mal-assimilation or imperfect digestion of the food.

While we do not believe that it has been satisfactorily shown that a tendency to rickets is hereditary in the same sense that a tendency to gout is hereditary, yet we are far from denying that hereditary influence plays some part in predisposing to rickets. We believe that if either father or mother, especially the latter, is weakly from any cause, their children will be more likely to suffer from rickets. A woman does much manual labour during her pregnancy, more than her strength will really admit of, or she lives under unhealthy conditions : the infant is weakly, is difficult to rear, and becomes rickety ; we can hardly doubt that the influence of the mother's health has predisposed to rickets, or at least to the digestive troubles which precede rickets. We feel certain that weakly or premature infants may become

rickety, even though the greatest pains and care have been bestowed on their feeding and bringing up. The influence of the mother's health in producing rickets is seen in large families, where the later children born are apt to be rickety. It happens also at times that first-born children are rickety, especially in those cases where the mother is very young.

Does syphilis in the parents predispose to rickets in the infant? Parrot asserted that rickets was the result of the syphilitic poison—that the latter when worn out or weakened produced rickets. Very few, even among his own countrymen, have accepted his views. Among the foundlings of Paris and other large cities where syphilis is a common disease, it may be difficult or impossible to say exactly what influence syphilis exerts in producing rickets; in country districts, where syphilis is uncommon and rickets common, it is clearly seen that there is no connection between the two, or only that the syphilitic poison has a depressing influence on the system and so predisposes to rickets as it appears to do to tuberculosis.

Dietetic Influences.—It has been stated that infants nursed at the breast of a healthy mother rarely become rickety, we may say never suffer from severe rickets: while infants who have been artificially fed from the first, and who have suffered much from dyspeptic ailments, are nearly always affected. It is certain, however, that over-lactation is a cause of rickets. Infants who have been suckled at the breast for over ten months or a year frequently suffer from rickets. Infants who have suffered from diarrhœa, gastric catarrh, bronchitis, pneumonia, and especially those who have had a hard struggle for life, very frequently become rickety. Infants who were premature, and who have been reared with difficulty, are among those who often suffer. Infants badly fed, and those who from ignorance or necessity have been deprived of fresh milk and given large quantities of indigestible food, are exceedingly likely to suffer from rickets. That improper feeding plays an important part in the production of bone lesions has been shown in the rearing of the young lions at the Zoological Gardens, and in the feeding of puppies and other animals on lean meat. These animals developed rickets, but improved at once when given milk and pounded bones.[1] The same thing may be seen again and again among our dispensary patients; a marked improvement in the symptoms following their admission to hospital, where a more suitable diet is given than the one which they have been taking.

Now, while there cannot be a doubt that infants who have been given large quantities of sago, sopped bread, arrowroot, condensed milk of a poor quality, or one or more of the much-advertised patent foods, early develop rickets, yet so also do some infants who have been brought up on fresh milk and water, milk and cream, and peptonised milk. The food may have been theoretically correct as far as quality goes, the child may have been well looked after, and the parents or friends are surprised at being told that it has developed more or less of rickets. But children who thus become rickety though brought up on fresh or sterilised milk have almost certainly suffered a good deal from gastric or intestinal catarrh, and their food has failed to be digested and assimilated. It is no uncommon thing to find a child of eight or nine months, markedly rickety, being fed with far more milk than it can possibly digest, passing curd, pasty stools, and suffering from

[1] See Cheadle, 'Rickets,' Brit. Med. Assoc. Meeting, 1888.

flatulence and colic. A food in which starch or sugar has replaced fat, or which in other ways differs from human milk, will be only too likely to give rise to rickets ; but the food may have contained fat in normal quantities and been otherwise suitable, yet if the child suffers from chronic dyspepsia, and the milk food has undergone excessive lactic or butyric fermentation in the alimentary canal, and consequently failed to nourish, the child is likely to be rickety, and may suffer from laryngismus and convulsions. It seems very probable that some toxins, the result of indigestion, which have been absorbed into the blood, are the immediate causes of some of the symptoms of rickets.

Hygienic and Climatic Influences.—The children of the well-to-do classes suffer less from rickets than those of the poor, and when they are affected it is in a milder degree ; the same may be said of country children as compared with the denizens of the slums of our great cities. Rickets is more common in damp cold climates than in warmer ones. From these facts we gather that bad ventilation, and absence of fresh air and sunlight, are factors in producing rickets. That this influence is exercised through the digestive organs is very probable.

From the above remarks it is clear that we believe there are several factors in the production of rickets. Congenital weakness, feebleness of the digestive powers, improper food, breathing vitiated air, exposure to cold and damp, will together, in some instances perhaps singly, produce rickets. Rickets abounds wherever the lower classes of the population are crowded together in courts and slums, where the mothers, from necessity or choice, are unable to suckle their infants, where fresh cow's milk is dear and of poor quality, and infant life is exposed to the various bad influences which poverty and ignorance are certain to produce. Rickets is a rare disease where the parents are strong and healthy, when the mother is able to nurse her infant while taking care of her own health and diet, and is able to devote her whole time to the care and nurture of her offspring.

Chemical Theories.—The older authors attributed rickets to the absence, or diminished quantities, of lime salts in the food, but very little observation was sufficient to disprove this. Others (Seeman) have supposed a deficiency of hydrochloric acid in the gastric juice, and that consequently the lime salts, instead of entering the blood, passed through the alimentary canal. Some have thought there was a deficiency of phosphoric acid or phosphates in the food, and that its absence from the blood prevented the formation of bone. The 'acid theory' has also had supporters, who supposed there was an excess of lactic acid in the blood, which had been formed from the decomposition of milk in the stomach—the presence of the lactic acid dissolving the lime salts of the bones and carrying them out of the body in the urine. We confess to being completely sceptical concerning all these hypotheses, and much doubt if they explain anything as to the pathogenesis of rickets. We are inclined to believe that the phenomena seen in rickets, such, for instance, as the sweating, convulsions, and bone changes, are caused by the presence in the blood of toxins absorbed from the alimentary canal. In other words, that rickets is due to the products of indigestion which are absorbed.

Symptoms and Course.—The premonitory or early symptoms of rickets may be absent, or so intermingled with those of dyspepsia that it may be im-

possible to differentiate them. In the slighter grades of rickets the first and perhaps the only signs of the affection are slightly beaded ribs and enlarged epiphyses at the lower ends of the radius and ulna. In the more severe forms of the disease the early symptoms are slight fever, the infant being hot and restless during sleep ; abundant perspiration, more especially about the forehead and scalp, may then be noticed ; at this time the infant may suffer from convulsions and not infrequently laryngismus. His limbs may be more or less tender, so that he cries on being moved or danced about in the nurse's arms, and usually some beading of the ribs can be detected. In the majority of cases the abdomen is habitually distended with wind, and there is mostly constipation, though, on the other hand, the stools may be loose and curdy. The child may be anæmic and the spleen may be felt to be enlarged.

As time goes on it is noted that there is a delay in the appearance of the teeth : if the first two incisors have been cut, a long interval, perhaps many months, elapses before the appearance of the others, and the teeth that have been cut are apt to become carious, from a deficiency in their enamel. The muscular system is almost certain to suffer; the child cannot sit up from weakness of the lumbar muscles, and the spine bows out from laxity of the ligaments ; the infant does not use its limbs like a healthy child, making no, or poor, attempts at crawling ; its legs are weak, it cannot bear its weight on them or even put them to the ground.

Concurrently with many of these phenomena, marked changes are noted in the bony skeleton. The bones may be tender to the touch, and the infant resent being jumped about. It is probable, however, that this tenderness is produced by slight hæmorrhages, which are really scorbutic. Scurvy and rickets frequently are associated together. The skull early shows these changes, though, if rickets does not supervene till the middle or end of the second year, the bones of the skull may escape. There is a marked exaggeration of the frontal and parietal eminences, with some flattening of the upper surface, so that there is a sort of table-land at the vertex, the head assuming a more or less quadrate shape. Sometimes there is flattening of the occipital bone behind, so that the back of the head looks as if pressed in. In severe cases there are broad shallow grooves corresponding with the sagittal and coronal sutures, and consequently running at right angles with one another. The fontanelles are widely open and may remain so long after they should be closing up, and the edges of the bones where they come together to form the sagittal, coronal, and lambdoidal sutures are thickened. Instead of, or in combination with, these hypertrophic changes at the eminences and edges of the bones, there may be atrophy or thinning of the central parts of the occipital or parietal bones, which has been termed cranio-tabes. These weak places can be felt by gentle pressure exerted with the finger on the occipital or parietal bones, of course avoiding the sutures, the bone perhaps bending and bowing in almost like parchment beneath the finger. It has been questioned to what extent cranio-tabes is the result of rickets, as it is present at times in undoubtedly syphilitic children, and also in those suffering from various wasting diseases. We doubt whether its connection with syphilis is anything more than a casual one, but it is certain cranio-tabes may be detected in weakly infants a few months old who exhibit no other signs of rickets, and also in newly born infants. Whether

it is always to be accepted as pathognomonic of commencing rickets is an open question ; but when present in infants over six or eight months of age it is almost always in our experience accompanied by signs of undoubted rickets.

Characteristic changes take place in the chondral ends of the ribs and in the shape of the chest, the latter being most marked in children who suffer from bronchitis. The ribs are enlarged or beaded where they join their cartilages : these may be felt or seen at a glance when the chest is exposed. The shape of the chest-walls is altered in consequence of the softening of the costal ends of the ribs ; the rigidity of the chest walls is impaired at this spot, so that there is a falling in of the ribs on each side, while the sternum and

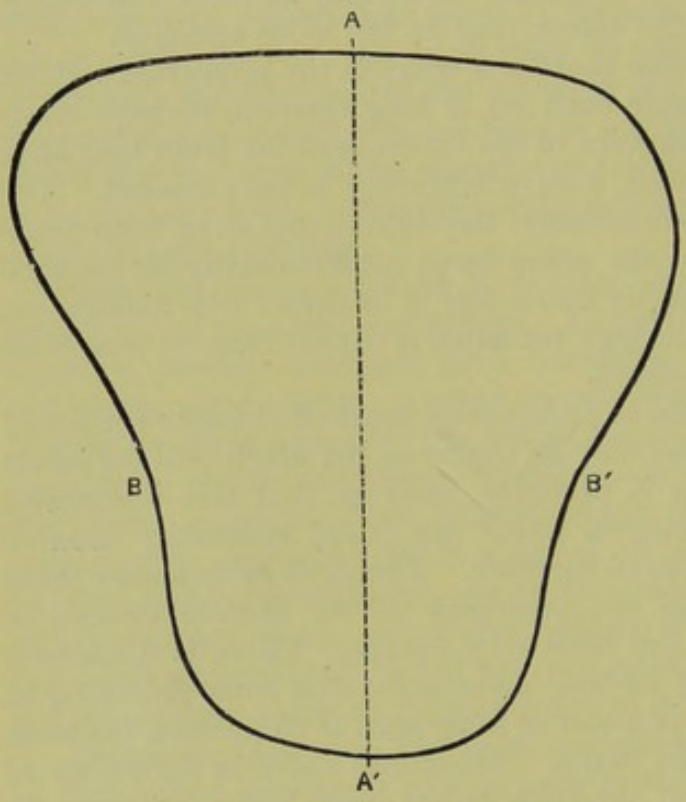

Fig. 32.—Tracing of Chest Wall of a Rickety Boy of 2 years of age.

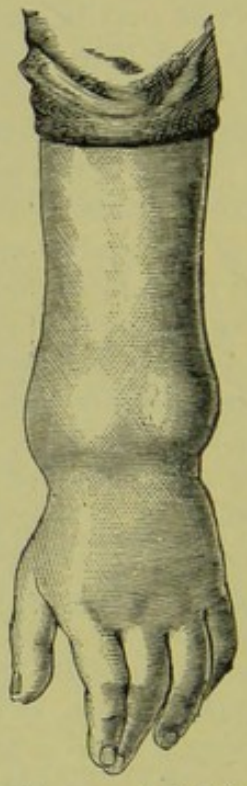

Fig. 33.—Enlargement of Epiphyses of Lower End of Radius and Ulna Child of 18 months.

cartilages are thrust forward (see fig. 32). The sides of the chest, especially the region included between the fourth and eighth ribs, bend or curve inwards, so that a more or less broad vertical groove is formed on each side of the chest. The angles of the ribs are often exaggerated or undergo a sharp bending or 'kink' at this spot. With these changes is mostly associated a widening of the arch which the ribs make inferiorly, and the abdomen is distended and round. If the child be watched, especially if there is any bronchial catarrh, the chest walls will be noticed to fall in at the groove on each side, and the tip of the sternum is drawn in during inspiration. All degrees of chest deformity may be present, from the extreme degree noted above, to a slight prominence or keel-like ridge in front, formed by the sternum, which makes what is called the 'pigeon-breast.' The clavicle often joins in the deformity, its normal double curve being exaggerated. The extremities show peculiar changes, more especially at the lower epiphyses of the radius

and ulna, and the tibia ; the shafts are very apt to bend and in the worst cases may fracture. The lower ends of the radius and ulna are swollen, the swollen portion involving the irregular layer of cartilage, in which calcification is proceeding (see fig. 35), which separates the cartilage of the epiphyses from the shaft ; in the worst cases this enlargement is very striking (see figs. 34 and 35). The tibia is usually more or less bent, the curve varying in position and degree ; the lower end is, however, most commonly bent inwards (being an exaggeration of the natural curve), so that the convexity is outward (see fig. 44 *et seq.*), a deformity which is produced by the child whilst sitting on the floor, with its legs crossed under it, shuffling with its legs so as to change its position. The distortion often takes place before the child learns to walk. The deformity known as 'knock-knees' is produced later, after the child has begun to walk (see fig. 43). The other long bones, the femur (see fig. 37 *et seq.*), radius and ulna, and the humerus, are apt to bend : the bowed humerus is sometimes produced by the attendants lifting the child by grasping its arms, just below the shoulder. If the child can sit up the spine is apt to become bowed, an exaggeration of the natural curve taking place in the cervical region, while the dorsal curve is exaggerated and involves the lumbar, so that the spine bows out backwards, a result largely due to the weakening of the ligaments (see fig. 41).

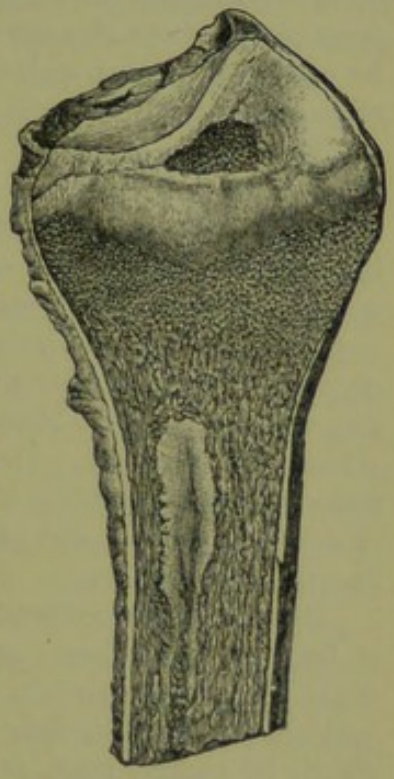

Fig. 34.—Section through Radius of case figured in fig. 33, showing exaggerated depth and irregular borders of the proliferation and columnar zones of cartilage.

It must not be supposed that all the changes in the shape of the bones take place in any one case, and the degree of deformity differs according to the severity of the case. As before remarked, the shape of the head may be quite normal, and only the epiphysial swelling and deformity be noted in the ribs and fore-arms. Sometimes muscular weakness is the symptom which most strikes the friends : the child is dyspeptic, has a rounded belly and pale face, the teeth are late in appearing ; the child, who is perhaps eighteen months or two years old, cannot stand or walk, and medical advice is sought because the parents think the legs are paralysed ; or the child is brought to a doctor, as it is supposed he has spinal disease, on account of the bowing backwards of the spine ; or the pigeon-breast is the most marked and striking symptom which alarms the friends.

The phenomena noted in connection with the nervous system in rickets are among the most important. The whole nervous system appears to be affected, the nerve centres are in an unstable condition and readily discharge on the slightest provocation. General convulsions are common, more especially during the early stages of the disease ; they vary much in their severity, sometimes being slight and passing away quickly, but, on the other hand, it is no uncommon thing for a rickety child of a year, eighteen

months, or two years to die in a few moments in a fit. Laryngismus is common, and indeed is almost confined to those who are rickety. Tetany is also common in rickety children. A hypertrophic condition of the brain, with a large head, is not uncommon. Rickety children are exceedingly liable to bronchial catarrh and broncho-pneumonia, and in them all chest troubles are apt to be serious. They are liable also to suffer from dyspeptic troubles, especially diarrhœa.

In the severest forms of rickets the child is apt to become markedly anæmic, and when this is so there is usually enlargement of the spleen. It has been doubted if splenic enlargement is present in uncomplicated rickets, or in those cases only which are combined with syphilis. We certainly have seen cases where the spleen was enlarged, where no history of syphilis could be obtained. With enlargement of the spleen there is frequently a marked enlargement of the liver.

The course of rickets is towards recovery, but progress is frequently very slow, especially in those cases where there is chronic derangement of the digestive organs. The child is certain to be late in walking ; instead of 'feeling his feet' by the end of the first year, he is utterly helpless when his legs are put to the ground, and at the end of the second or even the third year, rickety children may be seen who are quite unable to bear their own weight on their legs. All this time, perhaps, the child is incapable of much exertion and is easily tired. Many dangers attend rickets on account of the weakly state of the child. He is especially liable to catch cold ; this may be followed by bronchitis and broncho-pneumonia. The latter is necessarily dangerous on account of the weakness of the ribs and feebleness of the respiratory muscles.

Bronchitis and collapse of lung, or broncho-pneumonia, are exceedingly apt to be fatal when they complicate rickets. One of the effects of rickets is to stunt the child's growth, as well as to leave him with many deformities, which will be discussed in detail later on. The lowering of the child's health produced by rickets may last for many years, but in the vast majority of cases the symptoms and signs of rickets, if they come under treatment, disappear, and the child may grow up into a healthy adult.

Fœtal Rickets. Osteogenesis Imperfecta.—It is not surprising to find that the term fœtal rickets has been used in rather a loose sense in the past, and that any deformity of the limbs occurring in the newly-born has been attributed to rickets. It is certain that the majority of such cases have only a superficial resemblance to true rickets. After a critical examination of a number of (such) fœtuses, Ballantyne came to the conclusion that 'to describe with any degree of clearness and exactness the morbid conditions of the fœtal bones is an impossibility at the present time.' He has described, under what he designates type A, a condition found at times in newly-born infants which has more or less a resemblance to rickets. In such there is an abnormal softness of the bones, giving rise to cranio-tabes and curving of the long bones. There is clearly a failure of nutrition during the last few months of pregnancy. In this class, fractures are apt to occur during ante-natal life, or during or after labour from slight violence. We have seen several of such cases in which one or more fractures occurred in the femur or other long bone, and these made good recoveries. In our

cases there was cranio-tabes, slight beading of the ribs, but no bending of the shafts of the long bones.

Cases of this type would seem to resemble the osteo-porosis produced by Stoeltzner in puppies by feeding them on raw meat and distilled water—i.e. a food deficient in lime salts. The bony changes in these cases appear to differ from those seen in typical rickets.

In a case described by Drs. F. M. Sandwith and Symmers, of Cairo, the resemblance to rickets seems to have been more close than in the above cases. The infant lived thirty-eight days. At the *post-mortem* it was noted that there were cranio-tabes, enlargement of the epiphyses of the long bones, and marked bending of the shafts. A microscopical examination of the beaded ribs and upper end of the femur showed appearances which were interpreted as rickets. (See also Achondroplasia and Osteopsathyrosis.)

Morbid Anatomy.—The most striking appearances in connection with rickets consist in the changes of the bones. In the first place, chemical analysis shows there is a deficiency of lime salts in their constitution, and an excess of organic matters. Normal bone contains, roughly, 65 per cent. of inorganic constituents and 35 per cent. of animal matters; in rickets, all degrees of decrease of inorganic matters may take place, but in a severe and well-marked case the proportions are reversed, so that there is only about 35 per cent. of mineral basis and 65 per cent. of gelatinous or organic matters (A. Baginsky). That there is a deficiency in calcium salts is evident from the spongy nature of the bone, its softness, and the readiness with which it 'bends'; while the spaces between the bony trabeculæ are seen to be filled with juicy material. If a rib taken from a well-marked case of rickets during the acute stage be examined, it will be found not only to be wanting in rigidity, but it can be bent about like a thin lath, and, if doubled up, fractures or 'gives' with the greatest ease; the fracture may be only partial, or perhaps the ends of the bones are only held together by the fibrous and muscular tissues attached to them. In the same way the forearm of the cadaver may perhaps be bent by taking it in the two hands and applying moderate force, or it may 'kink,' and on dissection both radius and ulna will be found to be fractured. Other long bones may behave in a similar way if sufficient force is applied. The ribs, where they join the cartilages, will be noted to be much swollen; fractures, recent and old, may be present at the angles of the ribs and the lower ends of the radius and ulna where they join the epiphyses. A section can readily be made with a strong knife through the enlarged end of the rib, and if made in a longitudinal direction (see fig. 35), it will be seen in most cases that the pleural side is more prominent than the external side of the swelling, and, moreover, the enlargement is produced by the expansion of that portion of cartilage—the proliferation and columnar zones—in which certain changes are going on preparatory to the deposition of lime salts in the matrix of the cartilage. If a comparison be made with the end of a healthy child's rib, it will be seen in the latter that between the cartilage of the rib, which is yellowish and opaque, and the cancellous tissue of the rib, there is a line of translucent and bluish cartilage, about $\frac{1}{8}$ inch in breadth at birth, and about $\frac{1}{24}$ inch at a year or eighteen months old (Kassowitz); this line is perfectly regular and straight; the breadth of it depends upon the rapidity with which growth is going on, which is greater during the last months of fœtal life

and those immediately succeeding birth than it is later. In rickets the activity of these preparatory changes in cartilage is enormously increased; the multiplication of cartilage cells takes place with great rapidity, and with this there is a softening of the cartilage and matrix, and a consequent increase in size of the proliferation and columnar zones, so that the translucent line seen in normally growing bone is increased in breadth to perhaps $\frac{1}{4}$ inch or more, and there is a bulging or swelling in this position which is visible through the skin of the chest walls and corresponds to the junction of the ends of ribs with their cartilages (see fig, 35). Not only does this normal line become a broad band of jelly-like material interposed between the cartilage and bone, but the boundary between it and the cancellous tissue is very irregular and ill-defined, inasmuch as an erratic calcification of the matrix is going on, and trabeculæ of calcified material with wide medullary spaces are being formed instead of true cancellous tissue. A spongy structure is built up which is wanting in strength and rigidity. Similar changes are going on beneath the periosteum: there is a calcification of the inner layer, and spongy bone is built up instead of the firm, hard, compact tissue which forms the outer shell of healthy bone (see fig. 36). It is clear that, if the compact hard bone which forms the shaft is replaced by trabeculæ or arches of brittle, badly formed bone, the bone will readily bend and snap, and be simply held together by the fibrous periosteum and perhaps some of the fibroid material which forms in the substance of the bone itself. The bones may remain soft and brittle for many months, but finally they harden, perhaps in a faulty position, and a sort of sclerosis or eburnation of bone takes place, so that the compact tissue of the bone is abnormally hard. Should a fracture take place there is a large amount of callus formed at the seat of fracture. In acute cases, or in those in which the hæmorrhagic diathesis is present, bleedings large or small may be found beneath the periosteum and along the line of junction between the epiphysis and the shaft.

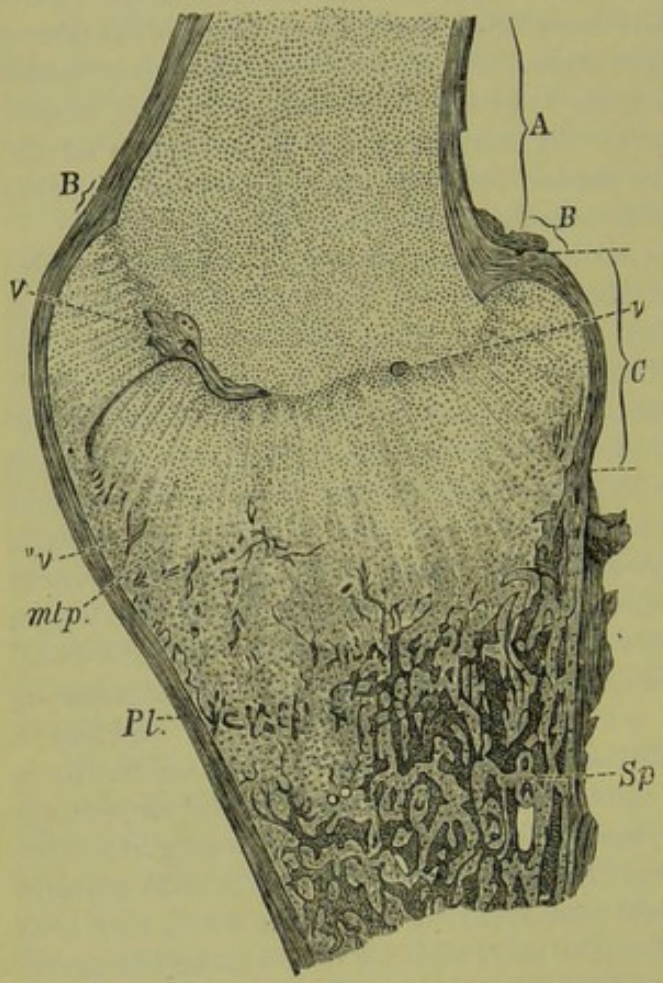

Fig. 35.—Longitudinal section through the junction of a Rib and its Cartilage, from a Rickety Child of 2 years. ×10. (Kassowitz.) *Pl*, pleural side; *A*, normal cartilage; *B*, proliferation zone, deeper than normal; *C*, columnar zone, depth and breadth much increased; *mtp*, deposition of lime salts in the cartilage—'metaplastic' ossification; *Sp*, spongy tissue, with wide spaces filled with soft grumous material, containing many cells; *v*, *v*, *v*, blood-vessels.

The bones of the skull are abnormally soft and can be readily cut with a knife, and are much more readily bent or doubled up than are healthy bones. Their edges are thickened and spongy on section, much juicy-looking fluid exuding ; the ossifying centres are usually thickened, so that the frontal and parietal eminences are exaggerated. In some cases prominences or bosses may be present on the parietal or frontal bones, near the sutures ; but it has been denied that these are really rickety changes, though they certainly do occur in rickety subjects. Instead of, or in association with, the hypertrophic changes just referred to, certain atrophic changes take place, the bone becoming thin, almost transparent, in places ; this thinning of the bone is chiefly present in the parietal and occipital bones. If the dura mater be stripped off and the bone held up to the light, it will be seen to be thin in places, perhaps almost as thin as parchment ; at these spots it readily yields to the pressure of the finger, bending in under the slightest force. Rickety skulls are usually large ones ; they not only look large in consequence of the thickness of the prominences on the parietal and frontal bones, but their capacity is increased, the brain being larger than usual ; it is possibly the pressure of the brain within that causes the atrophic changes in the bone.

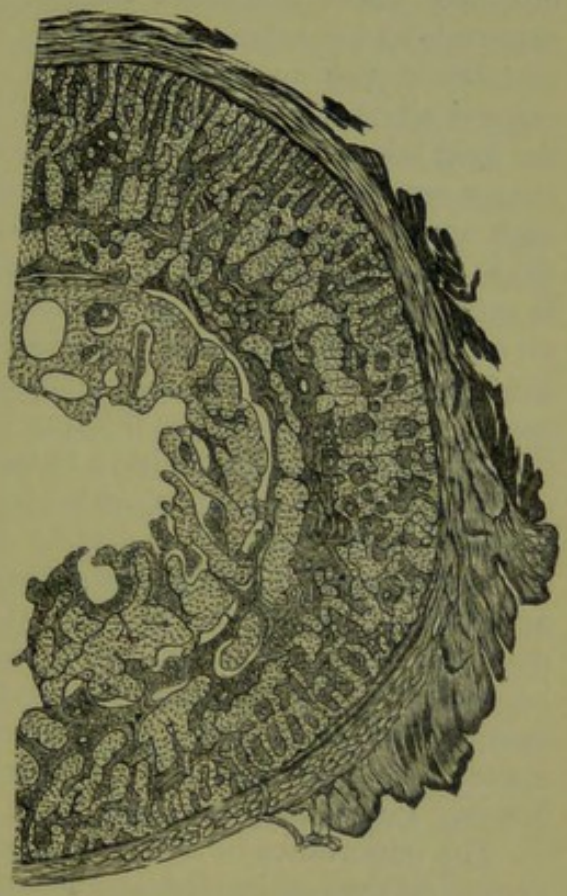

Fig. 36.—Transverse Section through the Shaft of the Ulna from a Rickety Child of 13 months. ×10. (Kassowitz.) Showing spongy tissue beneath the periosteum instead of the compact tissue of normal bone.

The changes found in the internal organs are not usually very marked unless death has taken place, as it not infrequently does, from broncho-pneumonia : then varying degrees of bronchitis, pneumonia, and collapse of lung are present. The brain is frequently found of large size, the convolutions well marked, the substance fairly firm ; such brains are said to contain an excess of the neuroglia elements. The liver and spleen are usually enlarged and firm, and the former on section has a 'gummy' or more or less translucent appearance.

Examinations of the blood in rickets have been made by Felsenthal, who examined the blood in twelve cases of rickets, varying in age from six months to two years. He found the number of red blood corpuscles nearly normal, but the hæmoglobin diminished (40 to 50 per cent.—Fleischel) ; the number of white corpuscles was increased two to five times. In severe cases some of the red corpuscles were nucleated.

Treatment.—If rickets is due to the mal-assimilation of the products of digestion or to faulty digestive processes, we can hardly hope to discover any

specific for its cure, but must direct all our efforts to secure that suitable nourishment in appropriate quantities is taken, and that the digestive apparatus shall be in good working order. Directly the first symptoms make their appearance, whether they are tenderness of the bones, sweating about the head, or enlarged epiphyses, spongy gums, hæmaturia, we should carefully inquire into the diet, as it is probable that the child is either not digesting its food properly, or it is not being properly fed. The condition of the digestive organs and the state of the blood act and react on each other, the intestinal juices are weak because the blood from which they derive the materials to form their secretions is weak and poor in quality, and the blood remains of poor quality because the digestive juices are feeble and unable to convert albumen into peptones, and supply the first step towards converting the food taken into blood. The child suffering from rickets in the acute stages requires albuminous and fatty foods in the most easily digested forms, such as cream, whey, raw meat juice, while all forms of peptonised or tinned foods should be interdicted. Probably it will be found that a child so affected is suffering from dyspepsia, the abdomen is large and distended with gases given off during intestinal digestion, while large masses of undigested curd are being passed. The treatment must be commenced by cutting down the supply of curd of milk, by diluting it largely with whey or barley water. In the worst cases milk may have to be withdrawn entirely for a while, and raw or semi-cooked meat juice, with barley water, substituted. In older children pounded raw meat may be given. Dextrin and maltose in any form are preferable to sugar in excess or starches. Cream in small quantities will mostly agree, though fat in the form of cod-liver oil is often more readily digested than any other form. A well-made emulsion may be given at any time, beginning, if there is much digestive disturbance, with a few drops only, care being taken not to give an excessive quantity. Orange, lemon, grape, or apple juice should be given in all cases where there is tenderness of the bones. Potato pulp is useful in the same condition.

The importance of fresh air, especially sea air, in the treatment of rickets, cannot be over-estimated, and when the disease first declares itself a change to the seaside or into the country, if the weather is warm enough, is likely to be attended with the greatest benefit. In urging the friends to send the child out into the open air the tendency which rickety children have to bronchitis must not be forgotten, and the importance of warm woollen garments must be insisted on; especially is this important where there is much sweating. If the weather is cool, the child's feet should be carefully wrapped up while he is out in his carriage; a bottle of hot water at his feet will often prevent a chill.

The most careful handling must be practised in severe cases, as the bones easily fracture or a hæmorrhage may take place. The prone position on soft cushions in a cot or carriage is better than much nursing in the arms, as the limbs are easily bent and the spine bows out if the child is allowed to sit up much.

Of medicines, the most important are those which assist digestion or correct the faulty condition of the mucous membrane of the stomach and bowels, and those which aid nutrition and improve the character of the blood. Vomiting, constipation, dyspepsia, and diarrhœa must be treated by appro-

priate medicines : small doses of mercury and chalk, rhubarb and soda, pepsine or bismuth ; care should always be taken to overcome the constipation so often present. Of tonics, cod-liver oil emulsion, or cod-liver oil in combination with malt extract, is by far the most important, though in practice it is common to find it is being given in excessive quantities and at a time when the digestion is enfeebled. In such cases it may be given by inunction. Phosphate of soda with tartrate of iron and glycerine is a useful tonic, assisting the action of the bowels and combating the anæmia so often present. Iodide of iron is also useful.

Small doses of phosphorus have been given by Kassowitz, Wegner, and A. Jacobi, who claim for it an almost specific action. Other physicians have been disappointed with the results obtained by its administration. It may be given in doses of $\frac{1}{200}$ to $\frac{1}{100}$ gr. in cod-liver oil, two or three times a day.

Rickety Deformities.—Distortions of the lower limbs as a result of rickets form a large and important group of the deformities of childhood. Most commonly all the long bones of the limb are affected, and there may or may not be distortion of the articular surfaces at the knee. In many instances the deformity is limited, or at least most marked either in the shaft of the femur, the lower third of the tibia, or the lower end of the femur.

Curvature of the shaft of the **femur** takes place either with its convexity forwards or in severe cases forwards and outwards. There is then a wide space between the thighs, and the quadriceps stands out very prominently over the convexity of the bone ; the patient is short and stunted-looking, the gait waddling, and there is knock-knee or bow-leg to a greater or less degree.

The whole of the shaft takes part in the curve, as is seen in fig. 37. In this child the deformity was extreme, and was accompanied by so much rotation of the lower end of the femur upon a vertical axis that the leg and foot faced directly outwards instead of forwards. A condition of *coxa vara* was no doubt also present in this case. Osteotomy was performed at the most convex part, and the limb turned round as well as straightened, so that ultimately the feet were natural in position (fig. 39). Sometimes the curve is limited to the lower end of the diaphysis.

Rickety deformities of the **upper limb** are seldom of such extent as to interfere with the perfect use of the arms or to require operative treatment. Obviously this is because no such strain is put upon the arms as upon the legs in childhood. It is rare for even the application of splints to be necessary, and we have hardly ever had occasion to straighten forcibly, never to osteotomise, a rickety deformity of the arms. The distortions are most commonly produced by the child crawling upon the hands, and consist chiefly in bending the shaft of the bones. We have, however, seen a condition analogous to *genu valgum*, but reversed—i.e. instead of the normal outward obliquity of the fore-arm in extension, it was directed inwards so that the convexity of the bend was outwards at the elbow (*cubitus varus*) ; this disappeared during flexion as in *genu valgum*, and was probably due to a similar bony condition, though we could not satisfy ourselves of the exact seat of deformity. A similar condition may occur as a result of separation of the lower epiphysis of the humerus and irregular union. In the humerus the deformity consists usually in curvature with the convexity outwards.

The rickety deformities chiefly amenable to surgical treatment are those

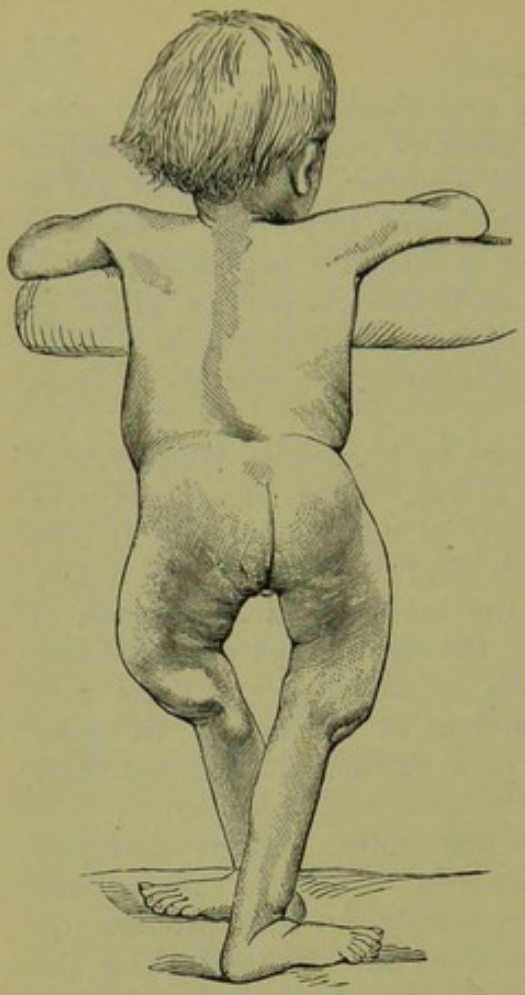

Fig. 37.—Rickety Deformity of the Femora, caused by the attitude shown in the next figure. There was no doubt a condition of 'coxa vara' in this case.

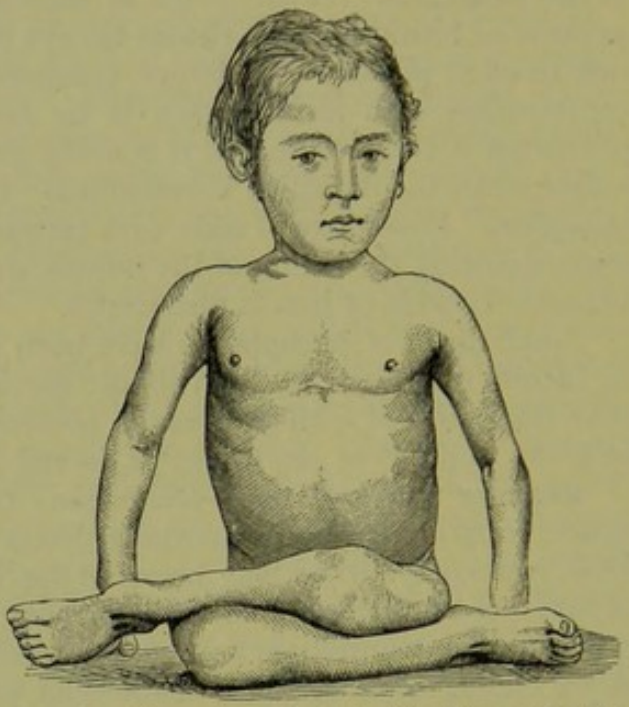

Fig. 38.—Shows the attitude habitually assumed by this child, which resulted in the deformity shown in fig. 40.

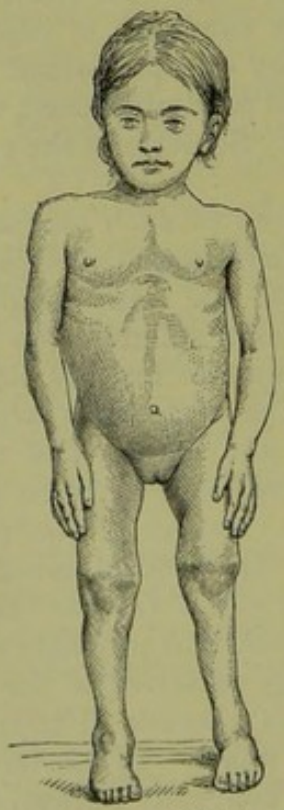

Fig. 39.—The same child shown in the last two figures. The limbs have been straightened by osteotomy.

Fig. 40.—A child aged 7 years, showing extreme stunting from premature Synostosis, as well as various deformities, all the result of Rickets. The child could not stand alone.

of the spine and limbs ; distortions of the chest and pelvis can only be improved by general management of the health, and prevented from getting worse, though gymnastics directed especially to exercise the inspiratory muscles other than the diaphragm, and to increase the inspiratory capacity, are of great value in the treatment of rickety chests. For the pelvis, even if the distortion is noticed before adult life, nothing can be done except to prevent the deformity from being increased.[1]

The **rickety spine** is met with in two forms : in one there is a general curve convex backwards, *kyphosis* (fig. 41), affecting the whole dorso-lumbar region ; in the other there is *lordosis* (fig. 40).

The first form is that met with in infants and young children before they begin to walk ; the other variety is usually secondary to deformities of the lower limbs, and is therefore most frequently met with after the age of two years. Lateral curvature is considered later.

The kyphotic rickety spine is readily distinguished from other spinal curvatures by the age of the child, the evidence of rickets elsewhere, the extent of the curve, which is large and rounded, never acute or angular, and the flexibility of the spine, so that by laying the child flat or holding it horizontally by its arms and thighs, face downwards, the curve speedily disappears. Care must, of course, be taken in applying this test. Finally, there is no pain, except in some cases the general rickety tenderness, and no evidence of caries in the shape of abscess, paralysis, &c. The attitude of a child suffering from rickety spine is well seen in fig. 41 as compared with that in caries.

Fig. 41.—Rickety Curvature of the Spine. The Antero-posterior form.

All that is required in this condition is the general treatment of the rickets and recumbency, not implying by this that the child is to be kept in bed in a stuffy room, but that it is not to be kept sitting up on its nurse's lap, except for very short periods at a time. These means should be continued until the health is improved, and the spinal muscles strengthened by friction and salt-water bathing. Unless neglected, the spine always recovers, and regains or rather develops its natural curves.

The lordosis of rickets may be mistaken for a secondary deformity due to hip disease, congenital dislocation of the hips, &c., but the absence of these conditions is readily made out, and other rickety deformities will be found present. Its appearance is seen in fig. 40, which may be compared with that of a case of congenital dislocation (*vide infra*).

[1] Chance, quoted by Noble Smith, found pelvic deformity in only 16 cases out of 600 rickety patients, while Reeves found it in 210 cases out of 1,000.

It should be remembered that lordosis always results from some cause tending to throw the upper part of the spine forward in standing, such as caries of the upper part of the column, stiffness of the hip joints, distortion of the legs, or undue weight in the upper part of the body or head; in very rare instances lordosis may result from caries of the spine, directly, chiefly when the arches are the seat of disease: it is then due either to actual destruction of the arches or to muscular spasm. Lordosis combined with a lateral curve may result from unilateral deformity of the lower limb in infantile paralysis, loss or shortening of one leg, &c.; all these possibilities should therefore be kept in mind before it is concluded that the condition is simply rickety.

As the lordosis is usually secondary, as already stated, to deformities of

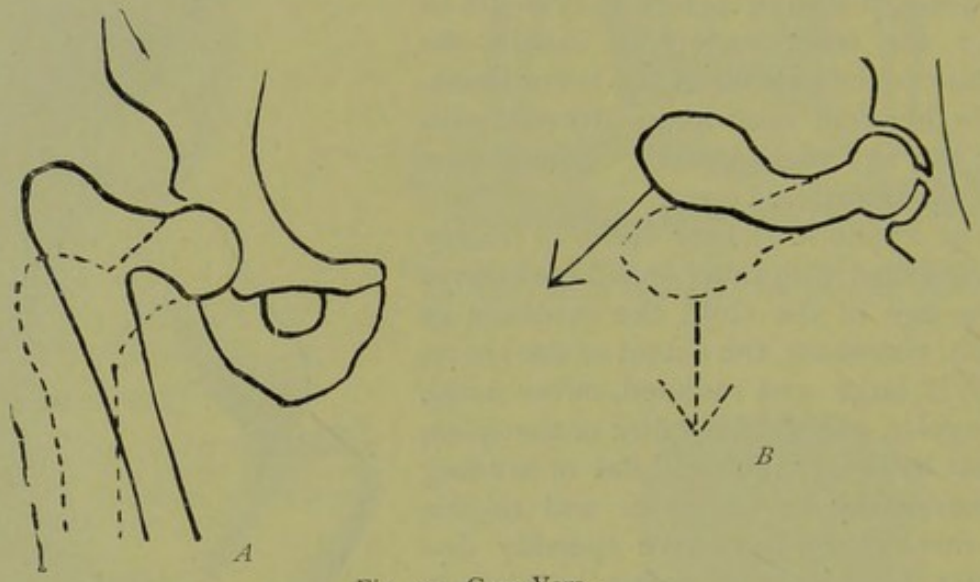

Fig. 42.—Coxa Vara.

A, Diagram of Pelvis and Femur, showing depression (angular deformity) of neck. The dotted line is the natural form. (Adapted from Rose and Carless by H. Irving, M.B.)

B, Diagram of view of upper end of Femur from above (bird's-eye view), showing antero-posterior distortion of neck. The arrows pointing away from the great trochanter in each case show how the curve of the neck will by rotation of the shaft on a vertical axis produce eversion of the limb. The dotted arrow shows the direction of the foot in the natural condition, the other the effect of coxa vara. (By H. Irving, M.B.)

the legs, its treatment must be secondary to that of the limbs, and no special applications or apparatus are required.

Where it is compensatory to angular curvature, it is, of course, necessary, and does not admit of treatment.

Coxa vara.—A deformity of the neck of the femur consisting in a curvature downwards or depression of the line of the neck in relation to the line of the shaft of the bone, together with a forward curve of the neck, is not seldom seen in cases of very severe rickets, and produces a condition which has been described as 'coxa vara'—it is a 'bowing of the hip.' Since the neck of the femur is depressed the trochanter rises and becomes prominent, and the limb is shortened. Nélaton's line or Bryant's triangle will show displacement. The limb is also everted, and an awkward, waddling gait and some stiffness result. The condition is readily distinguished from 'congenital dislocation' of the hip by the absence of undue

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mobility. Though most commonly due to rickety deformity, coxa vara may result from injury, or from chronic or acute disease of the upper end of the femur, or displacement of the epiphysis of the head. A certain amount of pain, especially after long walking, and a limitation of movements of rotation inward and of abduction are found. We are inclined to think that a certain degree of this curvature of the neck of the femur is exceedingly common in cases of rickety deformity (see figs. 40 and 43). The treatment is that of the disease with avoidance of anything that throws stress or weight upon the femoral neck. Only in extreme and firmly ossified cases is any operative treatment required. In such condition osteotomy of the upper end of the femur and rotation and abduction of the limb would be justifiable. The deformity may appear at any time after the child begins to walk.

In marked cases the upper border of the neck of the femur is much longer than the lower, to a degree varying with the extent of the curvature.

The curvature in a horizontal plane as well as in a vertical is important to remember, since it accounts for the eversion of the limb, which is sometimes so marked that the prominence of the neck can be felt in front of the groin. Rarely the limb is inverted.

It must be remembered that while coxa vara occurs commonly in the rickets of young children, it is also met with, and is perhaps of more importance, in the rickets of adolescence, or 'late rickets.' In these cases it may readily be mistaken for hip disease, or synovitis of adolescents, and the pain and deformity produced may be very considerable. It is in such cases that operation, either simple section or removal of a wedge from the neck of the femur, may be required. For a full account of the question with references, *vide* Keetley's 'Orthopædic Surgery.' Mr. Keetley was the first to describe the condition in late rickets. We have met with it as a congenital condition associated with talipes.

Fig. 43.—An ordinary case of Knock-knee.

Knock-knees.—Deformity of the lower end of the femur, resulting in knock-knee or *genu valgum*, occurs in several different ways besides the one already described. The inner part of the shaft at the epiphysial line sometimes grows more rapidly than the outer (Mickulicz); hence the inner half of the shaft is longer than the outer, the inner condyle descends lower, the line of the knee-joint becomes oblique, and the tibia is set at an obtuse angle with the femur. This condition may be due to premature synostosis at the outer half of the growing line (Ollier and Tripier), a condition found so often in rickets, and explaining largely the stunted form of extreme cases. (*Vide* figs. 43 and 46.) Sometimes the same results follow from absolute overgrowth of the inner half of the epiphysis and the internal condyle as

compared with the outer. In other instances, dependent upon the irregular ossification characteristic of rickets, the outer condyle does not develop, and though the inner half of the epiphysis is not absolutely larger than in health, it is so relatively to the aborted external part. Again, the soft, ill-developed rickety bone, though symmetrical at one time, actually wastes or is absorbed as the result of pressure, and a corresponding deformity results. No doubt in some of these children a yielding of soft, ill-formed ligaments is the primary condition, and the bone changes only occur as the result of the slight obliquity produced by this yielding. The deformity is, however, sometimes congenital.

In explaining the cause of the particular kind of deformity it must be remembered, first that the femur is normally set at an angle with the tibia and not vertically upon it ; secondly, that the patient often assumes attitudes in which the weight of the body and limbs so presses upon certain parts of the shafts of the bones that they yield and curves result. Such deformities are produced by habitually sitting cross-legged, as is seen in figs. 44, 45, &c. Other reasons are that in certain cases congenital inequality in length of the limbs throws the weight of the body both unequally and obliquely upon one leg ; and again, where the deformity has arisen before the age at which walking begins, the pressure of the nurse's arms may produce deviation. Congenital or acquired valgus, slight degrees of infantile paralysis, or any cause tending to throw the weight out of the normal line, will in some instances prove the starting point. In all cases it is clear that, as the bones are soft and unduly yielding, a pressure that would have no effect upon a healthy bone will cause deviation in a rickety child, and that, when once the curve is started, it will always tend to increase more rapidly.

It is not improbable that the irregular ossification of rickets prevents the normal architecture of the bone from being built up and so weakens it—i.e. the special arrangement of arches and struts in the cancellous tissue is not preserved.

Sometimes knock-knee is due to distortion of the tibia rather than the femur, and it will usually be found that the upper tibial articular surfaces are misshapen and bevelled off. This is, however, generally a secondary condition. That deformity of the tibia is the usual and principal cause of knock-knee we cannot admit.

Bow-leg, *genu varum* or *genu extrorsum*, is a deformity which, though dependent upon the same general causes as knock-knee, differs from it in most instances in its mechanical causes ; thus it is rarely dependent upon a local inequality of growth in the lower end of the femur, but is usually a general as opposed to a local curve of both femur and tibia, and is not limited to the region of the knee. It is most commonly found in one leg, the other being the subject of knock-knee, and in such cases it will nearly always be found that the knock-knee has appeared first and the bow-leg later ; in fact, the bow-leg is the result of the knock-knee. If such a patient is stripped, it will be found that the axis of the trunk is directed from one shoulder obliquely downwards to the hip of the knock-kneed limb : then the line of pressure, following the axis of the thigh of that side if produced, would pass through the region of the opposite knee : hence yielding to this pressure produces an outward bowing of the whole of the opposite limb. It

is true that the curve of bow-leg is not quite even, and is usually sharpest at the weakest part of the leg—the lower third of the tibia ; much more rarely there is a true *genu varum*, or bowing out, mainly at the knee itself ; in such cases the head of the fibula is usually very prominent.

Double *genu valgum* occurs when the changes in both legs begin at the same time and go on at the same rate ; double bow-leg results either from local changes exactly opposite to those of knock-knee, or, more often, is started by the position assumed in sitting by the child, and increased by the weight of the body subsequently. Thus it is common to see children sitting on the floor with both thighs somewhat abducted and rotated outwards ; in this position the limbs rest on the hips and ankles, and the knees are quite unsupported. The weight of the limbs then tends to bend them outwards, and produces bow-leg, while, if the feet are crossed one over the other, the curve will be most marked at the lower third of the tibia, and the leg which

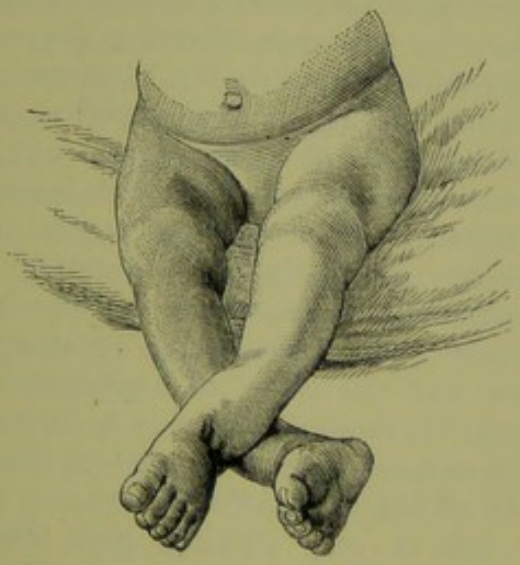

Fig. 44.—Shows how sitting 'cross-legged produces Curvature of the Tibiæ. The right foot is resting on the ground.

Fig. 45.—An ordinary case of Bow-leg.

rests upon the other will have more of an anterior, and less of an external, curve than its fellow (fig. 44).

Deformities of the **tibia** are more complex and difficult to explain than those of the femur ; besides the general outward curve already described as a part of bow-leg, there are found curvatures of the tibia alone, the femur remaining quite or nearly straight. The most common curve in the tibia is a sharp bend with its convexity outwards and forwards at the lower third.

Sometimes there is a projection outwards and backwards of the upper part of the shaft, just below the tuberosities, giving almost the appearance of a subluxation backwards at the knee joint. There is sometimes a condition of hyper-extension in these patients, but the appearance is, we think, often due to the distortion mentioned (figs. 40, 45).

In some cases there is a bend forward and inwards at the middle of the shaft, or rather, as this is associated with *genu valgum*, it is to be described as a bending outwards and backwards of the lower half of the leg upon the upper.

It is common in severe cases of *genu valgum* to find a well-marked rotation of the tibia upon its vertical axis, just as already described in the femur, so that, instead of looking inwards and forwards, the inner or subcutaneous surface of the tibia looks almost directly forwards (or sometimes the rotation is inwards—Reeves); the upper third of the tibia may look almost directly forwards, the lower third inwards and backwards. In such cases the inner border of the tibia is very strongly marked, forming a prominent ridge somewhat spirally twisted, ending below at the convexity of the forward curve, and above at the inner side of the internal tuberosity (fig. 46). In many cases, especially in those of long standing, whether this inner border is well marked or not, there is a prominent spur-like buttress of bone developed below the inner tuberosity at the insertion of the internal lateral ligament; this spur, the existence of which was, we believe, first pointed out by Mr. Clement Lucas, is probably the result of ossification of the ligament as a result of strain and irritation, somewhat as in the case of 'rider's bone' and other instances of bony overgrowth at the attachment of greatly used muscles. The prominent ridges, as stated by Mr. Noble Smith, are most marked when the disease is arrested and the stage of hyperostosis has come on. Sometimes there is a flat surface of bone running up from the spur to the inner condyle of the femur (Macewen); in severe cases this is very striking, and the spur reaches down far below the direct insertion of the ligament. Two other conditions associated with these deformities require notice: one is that the patella in severe cases of knock-knee tends to ride outwards upon the external condyle, and even to be dislocated quite to its outer surface during flexion of the limb. This is the result partly of deficient size of the external condyle, and partly of the bony curves, so that the quadriceps, acting in a straight line, does not make traction in the axis of the bones. The patella may also sink so deeply into the intercondylar notch in flexion that its position may be marked by a depression. The other condition referred to is the direction and arch of the foot. In knock-knee the foot would naturally point outwards in consequence of the alteration in the axis of the limb, while in bow-leg the toes point usually, though not always, forwards or slightly inwards. Besides this, there is in some instances flat-foot more or less severe. It has been asserted that flat-foot is really the cause of *genu valgum*, but that this is not so in by any means most cases is

Fig. 46.—A case of severe Rickets, showing most of the commoner deformities, as well as dwarfing from Synostosis.

readily shown. Very often, instead of flat-foot, there is a condition of *pes cavus*, together with a peculiar spasmodic contraction of the great toe. Both the cavus and the spasm of the flexor of the great toe are evidently due to the efforts made to obtain a firm grip of the ground in order that the instability caused by the knock-knee may be counteracted. Sometimes the great-toe spasm exists when flat-foot is present, and it is seen in bow-leg and curve of the tibia alone as well as in knock-knee. The foot is inverted to prevent strain upon the internal lateral ligament of the ankle, the flexors of the toes, and tibialis posticus, as well as to allow the foot to be placed flat upon the ground ; this tends to bring the bearing point upon the outer side of the foot and to remove the ball of the great toe from the ground ; then, to compensate for this, the toe is flexed so that the last phalanx may take a share in the support of the body. These points are to some extent shown in the preceding figures.[1]

To summarise, then, the following deformities may exist in the lower limbs as a result of rickets :

1. 'Coxa vara' or a curvature of the neck of the femur downwards and forwards, or less often backwards.
2. Curvature of the shaft of the femur, with its convexity forwards, or forwards and outwards throughout its whole length, together with rotation of the lower half upon the upper through a vertical axis.
3. Diaphysial overgrowth on one side of the growing line, absolute, or relative from synostosis of the other half.
4. Overgrowth of either condyle, with absolute or relative smallness of the other condyle.
5. Curvature of the lower third of the femur, with its convexity inwards (according to Macewen the commonest cause of *genu valgum*).
6. Curvature of the shaft of the tibia as a whole, the convexity being directed outwards.
7. Curvature of the upper part of the tibia, so that the convexity is directed backwards and outwards : possibly this distortion is sometimes at the epiphysial line.
8. Curvature of the shaft of the tibia at the middle, the convexity being directed forwards, or forwards and inwards.
9. Curvature of the shaft of the tibia at its lower third, the convexity looking forwards and outwards, more rarely directly forwards.
10. Rotation of the tibia spirally upon a vertical axis.
11. Overgrowth of the ridges on the tibia, especially the internal border and the region below the inner tuberosity ; similar outgrowths sometimes occur about the internal condyle and along the concavities of the curves of the femur, as well as in the neighbourhood of any of the epiphysial lines.
12. Dislocation of the patella outwards.
13. Flat-foot, *pes cavus*, spasmodic contraction of the flexor longus pollicis.
14. The muscles and ligaments on the concavity of the curves in either direction may be contracted and shortened, those on the convexity stretched and weakened.

[1] Macewen believes that flat-foot occurs in children before walking, but that on walking the cavus and toe spasm are developed.

15. The pelvis and lower limbs may be stunted as a whole from lack of development or premature synostosis.

Late Rickets.—Though perhaps hardly coming into the category of children's diseases, mention must be made of the so-called 'late rickets,' or 'rickets of adolescence,' in which deformities, 'coxa vara,' knock-knee, and more rarely bow-leg, come on between the ages of twelve and twenty years or thereabouts, the deformity being a bony and not merely a muscular or ligamentous one.

This condition has been attributed to a disease allied to osteomalacia ;

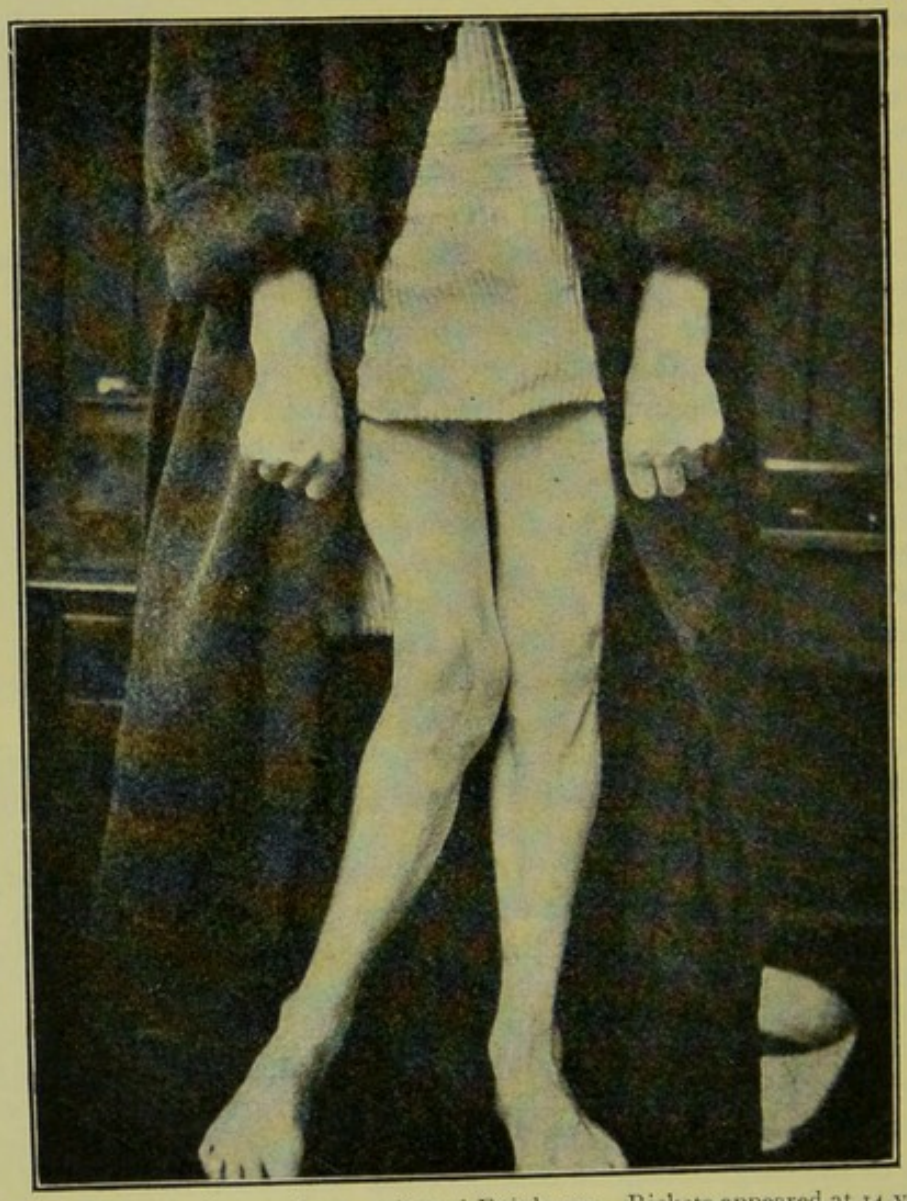

Fig. 47.—Late Rickets. Genu valgum, enlarged Epiphyses. Rickets appeared at 14 years of age.

it has also been described as relapsed rickets, and by Mr. Lucas has been said to be associated with masturbation and albuminuria. As to these alleged causes we may say that it is not often, we think, relapsed rickets, for we have seen many instances where there was no evidence that rickets had ever existed in childhood. It is not osteomalacia, for the patients never die of the disease, the process becomes arrested, and it does not occur under the con-

ditions met with, nor attack the parts affected in osteomalacia. It is certainly not due to, nor even associated with, either albuminuria or masturbation in by any means all instances. We have examined such patients a good many times, and in only one was there even a trace of albumen in the urine, and, as is well known, this may occur quite apart from the condition under discussion ; in none of our cases was there any evidence of masturbation. It is, we believe, due simply to weak health, bad air, long standing, poor food — in short, to bad hygienic conditions at a time when growth is active in the limbs—in fact, mainly to those causes which produce rickets in earlier life ; but in consequence of the greater strength of the skeleton and its more complete ossification, as a rule it only produces deformity in those parts on which the greatest strain is thrown ; in some cases there is well-marked enlargement of the epiphyses, of recent appearance, and not dating back to the usual time of rickets : this we have seen, and other cases have been recorded where both the external and microscopical appearances were identical with rickets.[1] The affection is, we think, best described as late rickets ; it furnishes a large number of the patients upon whom osteotomy in adult life is performed.

Summary.—A child, then, suffering from knock-knee the result of rickets will present the following appearances in addition to evidences of rickets in other parts. As he stands the femora will be seen to project markedly forwards and outwards, the extensors of the thigh being firm and prominent. There is often some flexion of the thighs upon the pelvis, and of the legs upon the thighs ; and secondary lordosis, resulting in a peculiar doubled up and crouching attitude. The legs are set at an obtuse angle with the thighs, the patellæ are displaced outwards, and the internal condyles of the femora look forwards and inwards, instead of directly inwards ; the whole limb is in fact rotated outwards. The tibial ridges are unduly developed, and there is a spiral twist in the leg. The feet are directed outwards, though the toes are somewhat adducted, and spasmodically grasp the floor, the flexors being strongly contracted, especially that of the great toe ; the arch of the foot is exaggerated, or may, on the other hand, be lost. In walking, one knee passes in front of the other, in severe cases to such an extent that the appearance is that of a person walking cross-legged. The patient's height is much less than it should be from the actual length of the limbs, and he is easily tired and complains of aching of the legs, especially on the inner side of the knee if the deformity is increasing. In other instances, however, though much deformed, the child is as active and sturdy as his fellows, and makes no complaint of pain or tiredness ; when this is so, the distortion is usually not increasing. On examining the knees more closely it is found that on flexion of the joint the leg can be brought into the same line with the thigh—a result due to the slipping back of the tibia from the more prominent part of the condyles to the posterior surface. The internal condyle can be felt to be larger and to descend lower than the external, so that if the limb is placed in such position that the lower borders of the two condyles are on the same level, the axis of the femur is much more oblique than in a healthy limb (Reeves). The patella in extension keeps its natural position ;

[1] *Vide* Clutton, *St. Thomas's Hospital Reports*, 1884, and Mickulicz referred to in Macewen's book.

while in flexion in severe cases, as already noticed, it slips outwards and leaves the intercondylar notch plainly perceptible, the appearance being much that of fig. 46. On attempting to straighten the limb during extension this will be found impossible, though a little lateral movement may take place, and the tendons of the biceps and the ilio-tibial band of fascia will become very tense. The head of the fibula is sunken, and concealed deep within the angle between the tibia and femur. The seat of pain and the tubercle at the insertion of the internal lateral ligament have been already alluded to.

The degree of deformity present varies greatly, but never reaches nearly the extent in children that it does in adults ; in an adult case we have seen the leg almost at a right angle with the thigh, and in another that we operated upon there was 19½ inches between the malleoli when the inner condyles were in contact. In double *genu valgum* ten inches' deviation would be an extreme case in a child, and five inches a severe one.

In measuring the deformity it is best to lay the child upon a flat, hard surface ; the legs must then be fully extended and rotated inwards until the front of the lower end of the femur looks directly forwards ; the two internal condyles are then to be put just touching one another. A vertical line is then drawn through the umbilicus and centre of the pubes downwards to the level of the malleoli, and on measuring the distance from the inner malleolus on each side to the vertical line the amount of deviation will be ascertained. In double *genu valgum* the line will, if the limbs are symmetrical, pass through the point of contact of the condyles, while in bow-leg it will lie far within the arc of the upper part of the limb, but may pass to the outer side of, or through the ankle.

Knock-knee in children does not always depend upon rickets, and it is important to recognise this fact. It may simply be the result of lax ligaments without any primary or even secondary alteration in shape of the bones ; thus a child may have marked *genu valgum* while standing up, but on lying down it may be possible to bring the legs perfectly straight, and to produce the deformity again by steadying the thigh and abducting the leg ; a distinct gap will then be felt between the femur and tibia on the inner side, and lateral rocking may be easily shown. In such patients the deformity may after a time become permanent from stretching of the muscles and ligaments on the inner side and contracture of those on the outer aspect.

A similar deformity in one of our patients was the result simply, apparently, of hysterical contraction of the muscles on the outer side, with weakness of the internal set, '*muscular spasm*' (Guérin).

Treatment of Rickety Deformities.—The degree of deformity, the age of the patient, and the state of the disease, whether stationary or getting worse, and the amount of care and trouble that can be bestowed upon the child, are the points to be considered in the treatment of these cases. Thus it is useless to attempt to treat by instruments or splints a very severe case of distortion, while, on the other hand, it is rarely necessary to perform osteotomy upon a child under three years old because the application of splints with or without previous forcible straightening, if it is a case of curve of the tibia alone, will usually suffice for a cure. Again, if the deformity has been stationary for some time and it is probable, therefore, that the post-rickety sclerosis of bone has taken place, it is useless to think of straightening the leg without operation,

while ir the curvature is getting worse, it is probable that the bones are still sufficiently soft to yield to pressure. Besides these considerations comes the very important one of the amount of care and time that can be bestowed upon the child ; it is not only justifiable, but necessary, to perform osteotomy upon many children who could be straightened perfectly well without operation if they could be seen frequently by the surgeon, be kept off their legs, and their splints properly applied, but who are neglected, allowed to get about anyhow, and their splints are applied wrongly or not at all. In such cases it is mere waste of time to do anything short of operation ; hence we have frequently osteotomised or forcibly straightened the limbs of children between two and four years old, and we entirely disagree with the view that it is barbarous to operate upon young children who could be straightened without operation if it were possible to give all alike the same care and time. At any rate, it is practically a choice between their remaining crooked and osteotomy or fracture. The general constitutional treatment of rickets has been already considered elsewhere. The local treatment consists in operative and non-operative means.

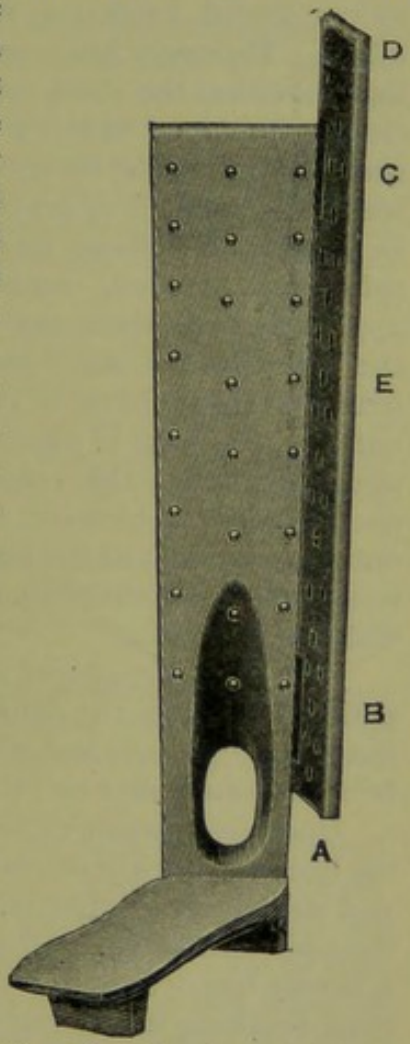

Fig. 48.—Splint for knock-knee; the letters denote the position of the webbing straps, see p. 234.

Treatment without Operation.—In a young child with the deformity increasing but not very severe, who can be well looked after, the treatment of knock-knee consists in forbidding him to stand at all, in bathing and rubbing the limbs well to improve their circulation and muscular power, and in using firm, steady traction in the direction of straightening the limb, as if to break the leg across the knee, for ten minutes at a time night and morning, such force as can be borne without pain being employed, and care being taken that the limb is fully extended. For the rest of the day and at night the child should wear a light, slightly hollowed, straight splint, long enough to reach from the top of the trochanter to just below the sole of the foot. This splint should be fixed to the upper part of the thigh and the lower part of the leg by inelastic webbing straps, while over the prominence of the knee an elastic strap should be applied to draw the knee outwards against the splint ; we prefer this plan to bandaging only. As soon as the child's health is improved, or if the case is very slight, a shorter splint may be employed and he may be allowed to walk about wearing it. A light iron splint such as Thomas's may be used instead of the wooden one.

If the distortion is at all severe, a practical difficulty will be met with in applying and keeping on the wooden splint : it will be found that the splint slips round to the antero-external aspect of the limb instead of remaining at the outer side ; when this happens no traction is exerted upon the knee, and the splint is useless. In such cases, if the iron cannot be obtained, a

back splint rather broader than the limb and as long as the outside one should be first applied, and then the outside splint put on with its edge resting against the edge of the back splint. The two splints can be joined together so as to make a single half-box splint—a plan first used, we believe, at the Victoria Hospital, Chelsea. We have devised a splint which we find efficient and satisfactory (fig. 48). It is a combined back and outside splint, with a footpiece set at an angle such that the outward rotation of the limb is prevented, and, by the use of elastic webbing straps, the knee is drawn outwards towards the outside splint. The letters indicate the position of the webbing straps, of which that at E should be elastic. We are indebted to our friend Professor Young for the drawing from which the figure is taken. Thomas's knee splint may also be used for these cases ; its advantages are that the child can get about from the first, and that elastic traction can be employed with it ; its disadvantages are that it is somewhat troublesome to get made correctly, except at the price of a guinea, and that it is somewhat difficult to prevent rotation. Many other forms of appliance may be bought, but those mentioned are in our opinion the best. Whatever splint is employed, complete extension of the limb is necessary for the apparatus to produce any effect.[1] For bow-leg it is only necessary to apply the splint on the inner side instead of the outer, and it is much easier to manage, since there is little tendency to rotation of the splint. Lateral curve of the tibia is treated in the same way, but the splint need not reach above the knee ; the anterior curve requires a back splint with a foot-piece, and is more troublesome to manage, pressure being difficult to apply without causing pain at the heel. A simple anterior curve is, however, a much less serious deformity than the other, and is much more likely to improve without apparatus.

Operative Treatment of Rickety Deformities.—Operation is required in patients in whom the deformity is severe, in those who have recovered from the rickety process and whose bones are sclerosed, and in those who cannot be well looked after or submit to prolonged treatment.

Operative measures are of three kinds : fracture after partial division of the bone with saw or osteotome, forcible straightening without external wound, and straightening after tenotomy, &c. In cases of curvature in the shafts of the tibia and fibula at the lower part of the leg in young children, before sclerosis has occurred, we consider forcible straightening a good and simple plan, resulting in a green-stick fracture just at the curve. It is, in any case suitable, easily done by taking the child's limb in one hand just above, and in the other just below, the deformity, taking care to have hold of the tibia and fibula, and not of the foot, otherwise the strain would come upon the ankle joint ; the limb is steadily and forcibly bent straight by the hands ; a certain amount of jerking is, however, sometimes useful. Tenotomy and subsequent straightening in cases of genu valgum we look upon as highly objectionable : it weakens the joint and only temporarily straightens the limb.[2] As to forcible straightening in cases of genu valgum, we have strongly

[1] Hueter treats *genu valgum* by simple flexion, and Little thinks well of it, but suggests sitting *à la Turque* as useful.

[2] *Vide* Lannelongue, *Le Bull. Méd.* ; also *Annals of Surgery*, January 1888.

condemned it in our early editions, but having asked Mr. Murray of Liverpool to give his experience, he wrote thus in 1901 :

'During the last three years I have practised somewhat extensively a method of treatment that was recommended by Professor Ogston at the Glasgow Meeting of the British Medical Association—viz. immediately and forcibly correcting the deformity, and then applying the splints. I have thus straightened more than four hundred knock-knees, and have every reason to be well satisfied with this line of treatment. But in speaking of osteoclasis for genu valgum, I wish it to be clearly understood that I practise it chiefly as a substitute for splints, and consequently refer only to the treatment of this deformity as it occurs in quite young children, that is to say, in children under five years of age, or in those a year or two older who are markedly rickety.

'Many surgeons, I believe, practise osteoclasis for curved tibiæ, but comparatively few do so for knock knee. The objection, it is said, being that in so doing you produce a separation of the lower epiphysis of the femur, and so may interfere with the subsequent growth of the limb. Now I have on several occasions forcibly straightened a knock-knee on one side only, and have examined the children eighteen months afterwards, and found absolutely no difference in the length of the limbs. And further, at the time of operation, I examine for the seat of fracture, and find that it almost invariably takes place at a point where the lower end of the femur joins the shaft, and quite an inch above the epiphysial line.

'My hands are the only osteoclasts I have ever used, and in forcibly straightening a knock-knee (say that of the right side), standing to the right of the patient, the child of course being under chloroform, I grasp the thigh firmly with my left hand about two inches above the patella, using my index finger supported by my other fingers as a fulcrum, and hold the thigh perfectly steady with this hand; then, with the right hand grasping the leg just above the ankle, gradually straighten the limb, the knee joint being kept over-extended the whole time.

'After osteoclasis I put the limb in plaster of Paris, which is kept on for a month ; the plaster is then removed and the child kept off its feet for a further period of six weeks, after which it is allowed to run about, constitutional treatment being, of course, adopted from the first.

'There is no doubt that in children over four years of age considerable force is sometimes necessary ; if, however, in attempting to forcibly straighten a crooked bone one has to use so much force as to render it uncertain where the fracture will take place, then you had better desist and perform an osteotomy.'

Mr. Murray, in addition to writing the above account, has been good enough to come over and show us his *modus operandi*, and we must admit that, strictly within the limitations of age and rigidity of bone that he mentions, and provided his exact method is followed, we are convinced that the operation is safe and practicable ; but Mr. Murray's method must be absolutely followed, and the exact site of the fracture determined ; it is not, moreover, every surgeon who has Mr. Murray's skill. Other methods of treatment do not require further notice.

Osteotomy.—The general principle of an osteotomy is partially to divide with a saw or chisel the shaft of the bone in the neighbourhood of the deformity through a small wound, then to complete the fracture, straighten the limb, and treat it like an ordinary compound fracture.

Of the various operations devised by Ogston, Macewen, Chiene, Reeves, Schede, and others, for remedying genu valgum, in our experience that of Macewen and the section of the femur above the condyles by means of a saw from the outer side are the best. This plan was, we believe, first employed by our late colleague Prof. T. Jones. Supracondyloid osteotomy with a fine Adams' or keyhole saw is, we think, the most generally useful method. In the case of osteotomy of the tibia we prefer to saw through the tibia and

fracture the fibula forcibly, or, if that cannot be readily done, we divide the fibula with an osteotome through an incision on the outer side of the leg.

After straightening the limb it is put up in a back and side splint, inner or outer according to the deformity, or in a Macewen's splint, and left for a week; at the end of that time we take it down and mould it accurately into position under chloroform: the callus is soft and moulds easily; the limb is then ready for a plaster-of-Paris or Thomas's splint, which should be kept on for three or four weeks and then taken off, and the limb well rubbed, the joints flexed, and then the splints or the splint (fig. 48) replaced for another week; after that the child may be allowed gradually to put his weight upon it. In heavy children an extra week should be given, and a light wooden splint worn for another month or so. It is a good plan to put on a Thomas's knee-splint after the first month, or even sooner.

In severe cases of tibial curve, especially of anterior curvature and in some of those at the upper part of the leg, the deformity cannot be remedied by a simple section, but requires the removal of a wedge of bone; this is a very much more serious operation, and one that we think should not be performed for the anterior curve alone, for besides its severity it does little to remedy the distortion unless a great amount of bone is taken away, and the tendo Achillis divided as well. This anterior curve is also much less important than the lateral one, and has more tendency to improve without operation. If osteotomy is required in such a case, the oblique section of Gowan is probably the best.

Osteotomy is a simple operation in most cases, but it has its dangers and its mortality. The popliteal artery has at least three times been wounded; severe bleeding has also occurred from the anastomotica magna, death has followed in some few cases, and gangrene of the leg in one at least—a case of our own, in which we removed a wedge from the upper part of the tibia. In this, our only serious casualty, no vessel was wounded, but either from pressure of the bones in their altered position, or from the splints being put on too tightly, the limb had to be amputated subsequently. There is no comparison between simple section and excision of a wedge in severity. For details of the various operations we must refer to the orthopædic and general surgical works.

Drilling holes in the bone and subsequent fracture, with modifications of this plan, have, we think, no advantages over the saw and osteotome; which of these is used is nearly a matter of indifference.

Multiple osteotomies, i.e. section of femur and tibia at one or more points, are sometimes required; when this is so we prefer to do one at a time on each limb, though Macewen has many times done several with perfect success. Deformities of the fibula alone from rickets are never important.

Osteotomy of the femur with a saw from the outer side is best performed by placing the limb upon a sand pillow, with the knee *slightly* flexed, and making a puncture with a large tenotome on the outer side of the limb, just in front of the border of the tensor vaginæ femoris, and a finger's breadth above the level of the adductor tubercle. The knife is then carried across the limb, keeping as close to the bone as possible, taking care not to thrust it through the skin on the inner side. In this part of the incision the blade should be held flat, i.e. in the same plane as the surface of the femur; as soon as the inner side of the limb is reached the knife is turned with its edge against the bone and withdrawn. It should during withdrawal be gently pressed against the bone so as to divide the periosteum and form a track for the saw. As soon as the knife is taken out of the wound the narrow saw is thrust sharply with a jerk into the skin wound and its point made to strike the femur; it is then carried readily over the front of the bone and its point felt beneath the skin on the inner side. The limb is well steadied and the bone sawn; care being taken to saw at right angles to the axis of the femur. In sawing, the hand should be tilted, so as to divide mainly the outer and front parts of the shaft, until nearly the whole thickness is sawn through. It is a matter of experience how far to saw —usually about two-thirds of the way through is sufficient; a useful guide is the depth of the saw from the front of the bone as felt through the soft parts. When the bone is nearly divided the saw is withdrawn, the thigh steadied by the hand nearest the patient's trunk, and the limb bent inwards by adducting the leg with the other hand. The bone sometimes snaps sharply and sometimes yields: in the latter case sclerosis has not

probably gone so far, and the fracture is more or less green-stick. One of our house surgeons remarked that the patient had less pain after these yielding fractures than when the division was complete, no doubt because there was no complete separation and less mobility of the fragments.

Should the saw have been withdrawn too soon, and it is found impossible with reasonable force to fracture the limb, it is usually easy to reintroduce the saw and divide the bone further: the groove already made is usually found without much trouble; failing this, the best plan is to enlarge the opening and divide the bone with an osteotome.

Section of the tibia is done in the same way, the puncture being made over the anterior border of the bone at the line of greatest curvature. It is usually possible to fracture the fibula; if not, it should be divided with an osteotome through an incision over it. Macewen's operation we need not describe, as for general use we prefer the method already mentioned, but we may say it consists in incomplete section of the femur with a graduated osteotome from the inner side, through an incision in the soft parts. His guides are 'a line drawn a finger's breadth above the level of the upper border of the external condyle, and a line drawn parallel to and half an inch in front of the tendon of the abductor magnus.' The point of intersection of these lines is to be the centre of the incision. In none of these operations is any ligature or suture required, and antiseptics should be rigidly carried out. The wound in the soft parts is healed usually in a week, or a point of superficial granulations alone remains, and it is only occasionally that the dressings require changing from oozing of blood. It is well to squeeze all the blood out of the opening before putting on the dressings.

The deformity resulting from non-apposition of the fragments after these operations gets modelled down after a few months just as in a fracture. Oblique section of the bone as in a splice, a plan suggested by Mr. Gowan, is sometimes worth trial; it causes less immediate deformity, but is somewhat more difficult to manage.

Achondroplasia

Achondroplasia is a fœtal bone disease, which runs its course between the third and sixth months of the intra-uterine life, and gives rise to a stunting and deformity of the long bones, which persist through life.

Depaul and, later, Parrot were the first to describe this condition and differentiate it from fœtal rickets. Parrot named it 'achondroplasia,' while Kaufmann described it under the name of 'Chondrodystrophia fœtalis.'

The cause is quite unknown, but there is a tendency for it to run in families, as, in some instances, women who have suffered from the disease have borne infants similarly affected. It is well known that certain breeds of cattle and certain dogs, such as dachshunds and Scotch terriers, have short, curved legs and comparatively long bodies, due to or resembling this condition. It is interesting to note that many little glazed earthenware figures which have clearly been modelled from achondroplasic dwarfs are found in the tombs of ancient Egyptians. That such dwarfs existed in ancient times is certain, and also that they were deified. According to Dr. E. A. Wallis Budge these statuettes are representations of the god Ptah-Seker-Asar, the triune god of the resurrection.

The achondroplasic fœtus is often born dead; others who have apparently suffered in a slighter form survive, and growing up show in after life the peculiar dwarfing of the limbs characteristic of this peculiar disease.

The chief anatomical feature consists in a failure of enchondro-ossification during the third to the sixth month of fœtal life. Those bones which normally remain cartilaginous till after the sixth month—as, for instance, the

sternum, patella, costal cartilages, tarsal and carpal bones, escape deformity. The bones which are formed in membrane show no deformity—as, for instance, the vault of the skull and clavicles ; whilst the long bones of the arms and legs, the metatarsal and metacarpal bones and phalanges, as well as the pelvis, are affected. The base of the skull is foreshortened and the centres of ossification prematurely united.

A histological examination shows that the epiphysial cartilage has failed to undergo the changes necessary for the formation of bone ; there are no columns of cells, no proliferation of nuclei, and an absence of blood vessels in the area of what should be ossification. There is perhaps a layer of

Fig. 49.—Achondroplasia in a boy of 7 years of age. (Drs. Jeffreys Wood and Hewlett's case.)

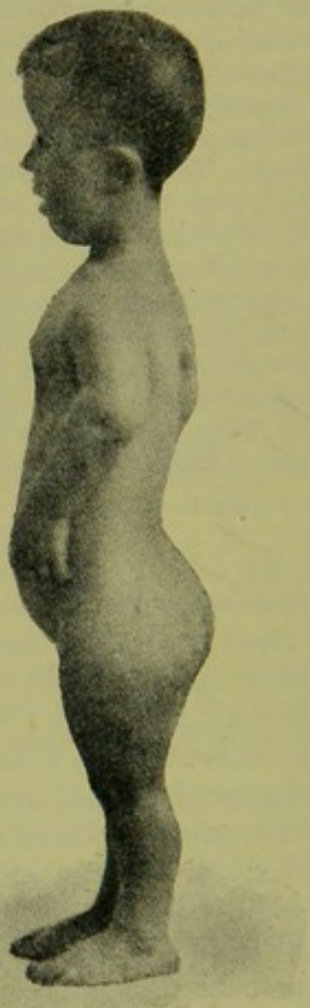

Fig. 50.—Side view of boy in fig. 49.

fibroid tissue between the cartilage and the cancellous tissue. In other cases there is evidence of some partial enchondro-ossification. On the other hand the periosteal ossification is not interfered with.

At birth the achondroplasic fœtus shows striking deformities : the arms and legs are perhaps half their normal length, the bones are thick and the normal curves greatly exaggerated ; the epiphyses are enlarged. The fingers of the hands if the palms are laid flat markedly diverge, forming the trident hand (J. Thomson). The skin hangs in folds and furrows. The head and trunk are of normal size, but the root of the nose is depressed by

reason of the foreshortening of the base of the skull. There may be macroglossia, obesity, prominent abdomen especially, and other minor associated abnormalities.

As the child grows up it is usually late in walking and awkward in the use of its limbs, but its intellectual powers are unaffected. The arms are short, and when hanging down the fingers perhaps reach the iliac crest or trochanters. (See figs. 49 and 50.) The gait is waddling, and there is marked lordosis. The legs are short, so that in some instances the child can bend down and kiss his toes without bending his knees. The shortened ribs, which may be beaded, lead to a deformity of the chest which closely resembles rickets. The hands like those of the fœtus are trident, spreading out. Drs. Jeffreys Wood and Hewlett give the following dimensions of three cases observed by them :—

Boy aged 7 yrs., 37 in., 38½ lb., 22½ in. circum. of head (see figs. 49 and 50).
Boy aged 8¾ yrs., 36 in., 38¾ lb., 22½ in. circum. of head.
Girl aged 11 yrs., 42½ in., 53½ lb., 23½ in. circum. of head.

A still further arrest of development is described by Ballantyne as 'Phocomely,' in which no bone formation occurs at all in the limbs (see also 'Cleido-cranial Dysostosis, page 244).

Lateral Curvature of the Spine.—This affection in its most common form is a disease rather of early adult life than of childhood, being seldom found before puberty, hence only the more important features will be considered here. There are, however, certain forms of scoliosis that belong to childhood more particularly : such are the rickety lateral curvatures and those due to empyema or unilateral limb-shortening, as well as, of course, the congenital cases. It must be remembered that in infants the normal curvatures of the adult spine do not exist.

It is now well recognised that the deformity is a compound one, that there is never a pure lateral curve without rotation, nor pure rotation without a lateral curvature, although it may in some cases require close observation to verify this, and the more so that rotation conceals to a greater or less extent the lateral deviation by bringing the spinous processes nearer the middle line.

As soon as any lateral bending in one segment of the spine occurs, two things necessarily happen if the child maintains the erect posture : first, compensatory curves must take place in the other parts of the spine to balance the primary curve and maintain equilibrium ; next, the obliquity o. the articular processes, and in the dorsal region the powerful rotation action of the ribs when they are approximated, must result in rotation of the vertebræ upon a vertical axis.[1] Hence in a case of lateral curvature we almost always see compensatory curves in the opposite direction, and invariably more or less rotation ; the term rotato-lateral curvature is therefore the more exact title. Scoliosis is convenient as a short synonym. Scoliosis in children may be the result of—

1. Congenital malformation of the spine, in which imperfect segments of vertebral bodies are intercalated on one side of the spine only. (Bland Sutton, 'Med.-Chir. Trans.' 1884.)

[1] Judson of New York attributes the rotation to the fact that the ribs are attached to the spine behind the bodies—the latter, as it were, are free in the thoracic cavity, and therefore liable to rotate, while the spines form part of the thoracic wall.

2. Congenital deficiencies in the limbs of one side, so that the action of the muscles and the weight of the normal limb are unbalanced.

Occasionally scoliosis is secondary to the form of congenital torticollis which is due to malposition in utero.[1] It results also from the acquired form of wryneck.

3. Shortening of one leg from any cause : for instance, a flexed, anchylosed hip or knee gives rise to shortening and compensatory scoliosis.

4. Imperfect development or sinking in of the chest-wall on one side, as in atelectasis or empyema.

5. Muscular and ligamentous weakness combined with faulty attitudes.

6. Rickets.

7. Caries, especially if one side of the body only is involved.

Various other types of scoliosis have been described, but they may all be practically grouped under one or other of the above heads.

The mode of production of rotato-lateral curvature by the above causes is obvious except in cases of Group 5, of which a word or two more must be said. It is usually stated that this form of scoliosis is a disease of the upper classes, and is found in girls who loll about or sit in ungainly attitudes for long hours, writing or working, during their most active period of development, while at the same time no sufficient exercise is given to their muscles. While it is true that weak spines or slight degrees of curvature are often thus produced, the disease is common enough among the poor, and, as it is usually neglected in its earlier stages, is seen in much worse degrees. It is also not rarely found in muscular, well-developed people in early adult life. It is, moreover, at times produced in young girls by carrying heavy babies or other burdens too great for them.

The whole spine should in all cases be carefully examined with the patient stripped, and the back should be inspected in different positions of curvature and of the limbs, the course of the spines and the level of the scapulæ and iliac crests being noted.

If a weak or tired spine is examined with the patient stripped and standing or sitting upright, it will perhaps be seen at first to be held fairly straight, but often after a minute or two the weight is thrown to one side, the lumbar vertebræ curve with their convexity towards that side, and a compensatory dorsal curve appears with its convexity to the opposite, usually the right, side, while a slight alternating curve in the cervical region is sometimes readily seen. At the same time flickering contractions of the spinal muscles as they become tired are often visible. In an early case all these bends can be straightened out by an effort of the patient, or by bending forwards or by lying down. If, however, the patient is neglected the curves tend to become permanent, for the weak muscles become contractured on the

[1] *Congenital Scoliosis.*—A boy of 13 years was seen in September 1898, who was said to have been born with a crooked spine and had also congenital club-foot, which was operated upon. At the time of the visit there was very severe scoliosis, with the lumbar convexity to the right. He was very rigid and had great deformity of the chest. No movement affected the position at all, and there had been no material change during the last year. No cause for the curvature was found in the chest or limbs, and the talipes was quite corrected. In this case the scoliosis was probably due to the same malposition in utero which produced the talipes.

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concave side, the ligaments become shortened, the intervertebral discs thinned and compressed, and the shape of the vertebral bodies and articular surfaces at last altered. But while this is going on the vertebræ rotate upon a vertical axis so that the bodies come to face towards the convexity of the curve, and the ribs become bent in such a way that there is a sharply convex bend backwards close to their angles on the same side; this produces a prominence also on the convex side, while in front, in order as it were to reach the sternum, the ribs are usually more or less flattened and straightened out. The converse of all this takes place on the opposite side of the spine. There is still a further change resulting from this: the scapula on the convex side is pushed out by the bulging ribs and projects backwards, while it is raised or lowered above the level of its fellow according to the exact seat of the curve; this is so marked that 'growing out of the shoulder' is usually the first sign noticed and the popular name for the affection. The scapula on the concave side also often projects sharply backwards and towards the mid-line, since it cannot rest evenly against the flattened chest wall (*vide* fig. 51). A projection of the hip on one side or the other according to the curve will also be noticeable.

Fig. 51.—Lateral Curvature of the Spine

All degrees of deformity may be met with, from the mere weak spine, with no permanent curves but with a tendency to collapse in any direction, to deformity, where the ribs on one side are overlapping one another and lying within the crest of the ilium, while the whole trunk is distorted and misshapen. Sometimes an antero-posterior curve (kyphosis) coexists with the scoliosis, and it is very important not to be misled by this; still more important is it to remember that in cases of caries there is sometimes a lateral curvature before any angular curve appears: this may occur either in caries of the bodies or, as pointed out by Reeves, where there is disease of the articular processes or costo-vertebral joints. The diagnosis is to be made by noting the rigidity of the spine and usually the greater severity of the pain in the case of caries, as well as by the history of the patient. The exact position of such curve is by no means constant, and, though a curve convex to the left in the lumbar and convex to the right in the dorsal region is the commonest condition, the lower curve may be dorso-lumbar or the sides may be reversed, and so on. This, of course, depends largely upon the cause of the curvature; thus in empyema the amount and position of the collapse will determine the curve. Sometimes, especially in rickety cases, and probably in those due to partial atelectasis,

the curvature is local and the compensatory curves are so slight and diffuse as to be nearly imperceptible. In some cases curvature of the spine is to be looked upon as compensatory and advantageous, and not as a morbid condition ; such are slight curvatures which make up for inequality in the length of the limbs and the slighter degrees of curve due to empyema ; thus in one case the curve may help to hide the deformity and in the other assist in filling up a suppurating cavity.

Aching pain of greater or less severity, and a general feeling of tiredness, with depression of spirits and tonelessness, are the principal subjective symptoms of lateral curvature. The pain is usually in the side and not in the back or chest and abdomen.

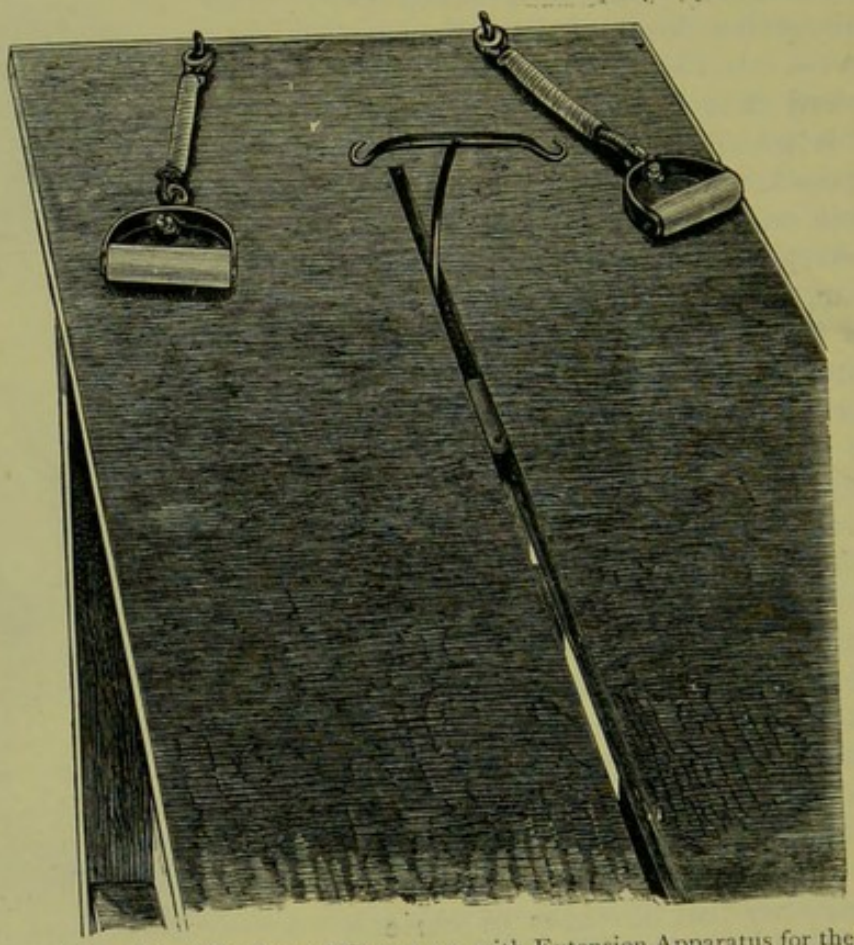

Fig. 52.—Reclining Board for Lateral Curvature, with Extension Apparatus for the Head and Arms. The head straps have been omitted for clearness, and only part of the couch is shown. Both head and hand straps are fitted with india-rubber accumulators.

Treatment.—Scoliosis due to congenital malformation of the spine itself or to deficiency of an entire limb, as well as that due to collapse of the chest wall after empyema or severe atelectasis, is necessarily not entirely and in many cases not at all remediable, while curvature due to rickets, weakness, bad habits, or a shortened leg may in its early stages be entirely cured and in almost any stage prevented from getting worse.

In any case the aim must be to remove first the cause tending to increase the deformity, to improve the general health, to strengthen the muscles and ligaments, and to avoid pressure and strain upon the weak parts. In the rickety scoliosis of young children the rickets must be treated and the child

never allowed to remain sitting up for any length of time ; its general posture must be flat upon its back or face, or upon its side, with pillows so arranged as to straighten out the curves. The principle is not to keep the patient lying down, which would of course in no way strengthen the muscles, but to give the parts just such exercise as will make them develop, and in the intervals give them complete rest.

Fresh air, friction to the spine, with frequent change of position and proper exercises, diet and medicine, will readily cure any case in which there are no fixed curves, while in the more severe cases in older children the same treatment must be adopted. In an ordinary case, the result of weak muscles and joints, and improper postures, the lines of management are to avoid tiring the muscles and ligaments, and yet to strengthen them by exercise ; to avoid the postures which have produced the deformity ; to counteract their effect by opposite positions, thus stretching contractured muscles and ligaments, &c. It is impossible here to enter into details of the various exercises required or of the different apparatus recommended, but it may be said that, in addition to all means of strengthening the health and improving the tone of the muscles —friction, salt-water douches, general exercise, and so on—a careful examination should be made with the child stripped entirely to see what positions and movements tend to correct the deformity, and these should be made the subject of regular practice at intervals through the day. A reclining board such as that figured (fig. 52), or some similar one, horizontal bars, trapezes, dumb-bells, Sayre's suspension apparatus, and so on, are all useful as means of strengthening the muscles.

Regular walking exercise for frequent short periods should be taken, the patient lying down afterwards, and constant watchfulness to correct any tendency to loll must be observed. Busch's plan of making the patient lie prone, with the chest and head over the end of a couch, then bending downwards and raising the front half of the body against gradually increasing resistance, is a good method of exercising the spinal muscles. Bending the body forward with the knees straight and trying to touch the toes with the hands, then recovering and bending backwards with the head well thrown back ; keeping head and shoulders back and leaning towards the side of greatest convexity, then recovering the upright posture ; lying down with a large hard pillow or Barwell's sling under the convexity of the ribs ; raising the arm on the concave side and pulling the body up by it by means of a horizontal bar or trapeze : all these are good movements. For private patients much time is saved to the surgeon and expense to the patient by instructing a professed masseuse or gymnast to carry out such manipulations as the surgeon may order.

It is a good plan to let the patient sleep in a Barwell's sling or put a hard pillow under the convexity of the chest and remove the one under the head, or substitute a thin one for it. Of forcible 'redressement' we have no experience, but careful moulding of the deformity with the hands is worth doing.

All spinal supports are to be reserved for cases where the deformity is extreme or rapidly increasing, and must be used with the greatest caution, and never relied upon except in conjunction with the exercises and other means already indicated. As a means of treatment alone they are as harmful as they are wrong in principle. No cases of lateral curvature must ever

be given up to the care of an apparatus maker. For details as to spinal supports, modes of measuring the deformity, &c., the works of Reeves and others may be consulted, but, as a rule, the less supports are used the better.

Dysostose cléido-cranienne.—This curious affection appears to run in families and is characterised by retarded or imperfect ossification of the bones of the skull and clavicles. The first account was given by Marie and Sainton (*Soc. méd. des hôp.*, 1897 and 1898), who gave the name of dysostose cléido-cranienne héréditaire. G. Carpenter (*Lancet*, January 1899) described five cases in one family—father and four children, three other children remaining normal. According to Comby, upwards of thirty cases have been described.

The cause is quite unknown ; presumably it is due to some developemental failure at an early period, as the clavicle commences to ossify in the second month of fœtal life. The anomalies are not entirely confined to the cranium and clavicle, as there may be some malformation of the vertebræ, sternum, and other bones (Comby). The bones of the cranium are thin and porous, and a number of Wormian bones may be present at the sutures, especially the sagittal and lambdoidal ; the base of the skull is foreshortened. The essential feature is that there is an arrest of development and of ossification, partial or total, of the bones of the cranium and clavicles. The clavicles may be entirely absent or vestiges remain associated with the rudimentary episternal bone, and in some cases an unattached acromion process (Hamilton).

On examination of the patient, the clavicles are found absent, or there is a rudimentary clavicle or clavicles, with loose attachments of the episternal bone and acromion process. The muscles in the neighbourhood are unaffected. In consequence of the absence of the clavicles, the shoulders can be brought together in front and various forms of contortions may be made with the arms and shoulders.

The shape of the head varies ; in the majority of cases it is affected as well as the clavicles. The cranium appears large as compared with the face, the frontal and parietal eminences being like bosses while the occiput is flattened. The fontanelles and sutures remain membranous for many years ; even in adult life the anterior fontanelle may remain open.

The general state of the health does not suffer and the intelligence is normal.

There is no treatment likely to be of service.

Antero-posterior Curvature.—Occasionally cases of antero-posterior curvature (kyphosis) are met with in children, both in infants and in those of older growth, and it is especially common in backward and mentally deficient children. These must be distinguished from the common rickety kyphosis. They give rise to an appearance closely resembling the stooping and bent back of old age, and may be mistaken for cases of caries. Absence of rigidity and pain and of evidence of rickets will usually enable these cases to be recognised, but it is well to watch them closely for a considerable time before assuming that there is certainly no caries. Exercises are the best means of treatment.

CHAPTER XIII

TUBERCULOSIS

Etiology.—To become tuberculous an individual must not only be infected by the bacillus tuberculosis, but at the time of infection must present somewhere in his body a suitable soil for the propagation of the organism.

There seems little doubt that anyone living under present conditions in a large city has plenty of chances of becoming tuberculous, and if he does not, it is not so much from lack of opportunity of infection as from his tissues being incapable of playing the part of host. There is reason to believe that the dust of dwellings is frequently the carrier of the germs, and that the bacilli gain entrance into the lungs by the inspired air. There is evidence to show that the bacilli may find their way into the alimentary canal by means of raw milk taken as food. The infant may also become infected by its habit of putting all sorts of things to its mouth, to say nothing of the 'comfort' which is alternately on the floor and in the mouth.

The relative importance of the 'soil' as compared with the 'seed' has been much discussed. In past times, before Koch's discovery, the tuberculous or strumous diathesis derived from inheritance was looked upon as playing a very important part in predisposing to tuberculosis. That it does play an important part is certain, as experience teaches that a vulnerability or a predisposition to become tuberculous runs in families, and indeed the same is true of measles, scarlet fever, and other infectious diseases. But it is not easy to distinguish between the influence exerted by heredity and the influence exerted by bad food, exposure to cold, bad air, and by other conditions which lower vitality and render the individual a ready prey when infected. There can be no doubt that some infectious diseases, such as measles and whooping cough, predispose to tuberculosis by rendering certain groups of lymphatic glands, as the cervical and bronchial, for instance, a suitable soil for the propagation of the specific bacilli.

The age of the individual appears to have an important influence. The fœtus rarely suffers from tuberculosis. Newly-born calves are apparently rarely attacked, though born of mothers affected with well-marked tuberculous disease. Tuberculosis is not a common disease in infants under six months of age; it is rare to find infants under this age suffering from mesenteric disease, tuberculous meningitis, or tuberculous disease of glands or bones. The disease is more common between the ages of six months and a year, but after a year old and onwards it becomes exceedingly common.

With the exception perhaps of children under six months old, the susceptibility to tuberculous disease is greater during early than adult life. It cannot be said with any accuracy what proportion of our child population suffers from tuberculosis, and statistics cannot be of much value on account of the impossibility of diagnosing tuberculosis of the internal organs, especially in the milder forms.

Pathology.—It is safe to say that of all the organs of the body, the lymphatic glands, especially those which drain mucous membranes, are the most likely to become tuberculous during early life. The groups of glands most often affected are the cervical, bronchial, and mesenteric. The cervical group drain the mouth and pharynx, and assuming that the bacilli are arrested in the mouth or nose from air inspired or food taken, they enter the lymphatics and become arrested in the cervical glands, and if the soil is favourable will develop here. Extension may take place over a wide area, the local glands becoming affected, and later possibly distant parts. In the same way, if the bacilli enter the bronchial tubes they are probably arrested in the bronchial glands. Tuberculosis of the mesenteric glands presumably arises in a similar manner, from bacilli entering the alimentary canal in milk, or they may be swallowed in the saliva or sputa. In the vast majority of cases it is likely that the route taken by the infective germs is by the cervical, bronchial, or mesenteric glands. While in a large number of cases local foci are first formed in these glands and distant foci develop secondarily, yet this is apparently not always so, as it is presumably quite possible for the bacilli to find no resting place in the glands, but pass through them to some distant part, as for instance the cerebellum or the epiphysis of a long bone, where they find a suitable soil for development. In many cases the tuberculous process spreads by direct contact ; thus frequently the roots of the lungs are invaded by extension from tuberculous bronchial glands which accompany the bronchi into the lungs. A lung is sometimes affected secondarily by contact with the caseating body of a dorsal vertebra. Tuberculous peritonitis often arises from contact with caseous mesenteric glands or contact with tuberculous intestines.

Besides the lymphatic glands, tuberculous disease of bone is exceedingly common during early life, as for instance caries of the spine, chronic hip disease, chronic osteo-myelitis of the small bones of the hands and toes. Dactylitis is very frequently associated with 'strumous nodes' or 'cold' subcutaneous abscesses. What determines the growth of tubercle in a particular body of a vertebra or the epiphysis of a hip? Presumably the infective germs have entered the system by the ordinary channels, but why is a particular spot selected? It is impossible to say why that particular spot should be a suitable soil, but it is by no means unlikely that, in some instances at any rate, an injury followed by some chronic inflammation may be the predisposing cause. There can be little doubt that the bacilli travel in the blood current and are thus conveyed from, say, the bronchial glands to distant parts of the body, as the brain, a vertebra or the hip-joint, or they may be conveyed by means of the venous blood current to the lungs and set up there new foci. In tuberculous disease of the bones in relation to the tympanic cavity, suppuration perhaps predisposes and the infection enters from the throat.

With regard to the internal organs, there is strong evidence to show that the lungs are more frequently affected than any other internal organs, but at the same time it must be said that during early life tuberculous lesions are much more widely distributed throughout the body than they are in adult life. A general tuberculosis in which lungs and abdominal organs share is very common. In 155 cases of tuberculosis dying in the Manchester Children's Hospital, it was found *post-mortem*—

The lungs were affected in	. . . .	141 or 91 per cent.
„ bronchial glands were affected in	. .	122 or 78 „
„ mesenteric glands „	. . .	101 or 65 „
„ liver „	. . .	98 or 63 „
„ spleen „	. . .	86 or 55 „
„ intestines „	. . .	85 or 55 „
„ brain and membranes „	. . .	72 or 46 „
„ peritoneum „	. . .	69 or 44 „
„ kidney „	. . .	65 or 40 „

A careful examination of these cases was made with a view to try to come to a conclusion as to the route by which the infection had entered the system. We came to the conclusion that in at least 50 per cent. of the cases the bronchial glands or lungs were first affected ; that in 12 or 13 per cent. the abdominal organs were primarily affected, making it probable that the intestines and mesenteric glands had been affected by food or milk containing tubercle bacilli. In the remainder of the cases the lesions were so abundant and widespread, that it was impossible to say which were the earliest foci. In some cases the cervical glands were caseous or cretaceous. We must bear in mind that the figures just given only refer to cases of tuberculosis dying of meningitis or from exhaustion the outcome of hectic fever, malnutrition or diarrhœa. They are no certain guide to the numerically much larger number of cases of local tuberculosis which do not die, but in whom the tuberculous process gradually comes to an end. A large proportion of children suffering from tuberculous peritonitis recover, the lesions probably never being widespread. In a large proportion of children with caseous glands in the neck, or bone tuberculosis, the lesions remain local and recovery takes place. The figures, however, certainly point to the frequency with which the infection enters the system by the inspired air. If the bacilli enter the bronchi, they are arrested in a cul-de-sac and are under favourable conditions for entering the lymphatics, while if they enter the alimentary canal they are likely to be passed along with the liquid contents of the intestines. There is, however, evidence that infection does take place from the intestines, as in some of our cases the lesions were confined entirely to the abdominal organs.

The *post-mortem* examinations made by G. F. Still upon infants and children dying either of tuberculosis or with tuberculous lesions in the bodies, led him to the conclusion that 17 per cent. of the cases of tuberculosis in children under 3 years were intestinal in origin. If all ages up to 12 years were included, the proportion was greater—namely, 29 per cent. Guthrie found evidence of primary abdominal infection in 26 per cent. of his cases, and Carr in 16·7 per cent.

These facts, taken in connection with the fact that cow's milk forms a large proportion of the food of early life, and that 30–50 per cent. of the cows in this country suffer from tuberculosis, suggest that the infection finds entrance into the body by milk.

On the other hand, the tubercle bacillus is very widely distributed and abundant under conditions of modern civilisation, and the risk is not so much from infection as that some organ in our bodies should be in a condition suitable for the cultivation and growth of the bacilli. According to Schmaus, 40 to 50 per cent. of all cadavers, excluding nursing children in our large cities, show lesions of a tuberculous nature, and that 25 per cent. of patients dying from other diseases have healed or latent foci. But if macroscopical appearances were not alone considered, but a careful search made for the tubercle bacilli, as was done in a series of 500 cases, 97 per cent. revealed evidence of tuberculosis past or present! It is quite possible, therefore, that the frequency with which the abdominal glands are found tuberculous may be explained on the ground that they in common with all lymphatic glands during early life are especially vulnerable, and not that the 'port of entry' is the intestine.

Koch denies that bovine tuberculosis will grow in human soil, and is entirely sceptical with regard to abdominal tuberculosis being due to tuberculous milk. On the other hand, Raw, as the result of his researches, believes that while human and bovine tubercle bacilli are distinct varieties, the caseous lesions of gland, bone, &c., so common in children are due to bovine tuberculosis transferred from the cow by means of milk.

The whole question of tuberculosis is far from being settled.

One point is worthy of remark, and that is with regard to the different degrees of malignancy exhibited by tuberculous processes. Compare, for instance, an acute miliary tuberculosis running a course of a few weeks, and a tuberculosis of a cervical gland or patch of lupus which shows but little tendency to spread or at least spreads very slowly. There is an immense difference between the rate of progress in some cases of phthisis and others. It is clear, inasmuch as the tuberculous process is spread by contact, that the location of the lesion is important in regard to prognosis. Thus a bronchial gland surrounded by lung is a far greater danger to the individual than a caseous cervical gland. It is perhaps difficult to say how far a rapid or a slow process is dependent upon the bacilli themselves, whether they are of a malignant or mild type, or whether it is a question of soil alone. In the old days the mild type or slowly progressing process in which caseation slowly took place was not recognised as tuberculous, but was designated strumous; while the more acute type represented by the 'grey granulation' was essentially a tuberculosis. To become strumous was not a very serious affair; to become tuberculous meant a death certificate at no distant date. To-day we recognise that strumous processes are slowly progressing tuberculous processes, and as such are in danger of involving important organs; while, on the other hand, we know that tuberculosis of the lungs and abdominal organs may at almost any stage become arrested, and that a large number of cases of local tuberculosis end by complete recovery.

Practically there is nothing to be gained by the use of the word **struma** or **scrofula**, nor of the several 'types' associated with strumous disease.

While tuberculous disease may make its appearance in the unhealthy, or in those in whom there is a family history of tubercle, yet it constantly crops up in those who are apparently in perfect health, and in children where there is no history whatever of any family tuberculous disease.

We will give a short summary of the differences which distinguish tuberculosis in childhood from that of adult life.

1. Frequency with which the lymphatic glands are affected in children.
2. Frequency of tuberculous lesions of bone and subcutaneous tuberculous abscesses.
3. The frequency with which the abdominal organs, peritoneum, intestines, and mesenteric glands are affected.
4. The frequency with which tuberculous meningitis and caseous lesions of the brain occur.
5. The frequency with which tuberculosis of the lungs begins at the roots by infection from the bronchial and pulmonary glands.

The student who attends the in-patient and out-patient departments of a children's hospital, and whose opportunities have been hitherto the study of tuberculosis as it affects adults rather than children, will be struck with some of the differences as just summarised. The form of tuberculosis of adults which is most common is a tuberculous disease of the lungs, proceeding from apex to base. Among children he will see a large number suffering from tuberculous cervical glands, spinal disease, hip disease, dactylitis, subcutaneous tuberculous abscesses. He will probably note more cases commencing with abdominal tuberculosis than pulmonary tuberculosis, and he will frequently come across tuberculous meningitis and tuberculous tumours of the brain. He cannot fail to note also the large number of children who completely recover from tuberculous disease.

For the most part tuberculous disease will be found described in the chapter devoted to the diseases of various organs; we will describe here acute and chronic general tuberculosis.

Acute Miliary Tuberculosis

Acute miliary tuberculosis is perhaps commoner in early life than it is in after years; it occurs at all ages during childhood, though it is rare before the end of the second year. Like tuberculous meningitis, with which it is often associated, it usually supervenes in children already tuberculous, and occurs but rarely in children who up to the time of falling ill had been in robust health. There is usually a history of more or less ill health for some time previous to the attack; there is a history perhaps of whooping cough or measles some months before, which has left the child weak, and from which it has never really recovered. Sometimes the symptoms of a tuberculosis of the lungs or abdomen are unmistakably present, and then acuter symptoms supervene which mark the onset of the miliary form of the disease.

Acute miliary tuberculosis occurs usually in two forms: the 'typhoid form,' so called because it is apt to simulate enteric fever, and the broncho-pneumonic form, in which the symptoms present are those of acute pneumonia, the latter being set up by the presence of miliary tubercle.

Symptoms.—In the **typhoid form** the commencement is usually insidious, and is commonly preceded by a period of ill health, during which time the child has been noticed to waste, to be feverish at night, to cough, and not infrequently to suffer from diarrhœa or pass slimy, unhealthy-looking stools. The child is languid, irritable ; its appetite is very uncertain, and it cares but little for its toys. Often there are decided signs of intestinal catarrh ; the appetite is completely lost, the tongue is coated, and the abdomen distended. An examination of the chest may give no decided result, or only some rhonchi may be heard, and there may be no very decided cough. In this stage, if the symptoms are acute, the resemblance to an irregular attack of enteric fever is very close, especially if rose spots resembling those of typhoid are present, as is sometimes the case. The diagnosis is especially difficult in young children of three or four years of age, who are perhaps very irritable and resist any examination of the chest or abdomen, the difficulty being to distinguish acute miliary tuberculosis from enteric or subacute intestinal catarrh with some patches of broncho-pneumonia. A careful and continuous record of the temperature is important ; the temperature should be taken morning, afternoon, and evening ; the variations are usually considerable, sometimes varying from 99° to 104° F., the highest being usually at 4 or 5 P.M. Too much stress, however, must not be laid on an intermittent temperature with considerable flights, as in some children a patch of broncho-pneumonia without marked physical signs will be accompanied by a striking intermittent temperature, and, moreover, we have seen a case of miliary tuberculosis when the temperature only reached 101·5° or 102° in the afternoon or evening. Enlargement and tenderness of the spleen may be present in an early stage ; in some cases there is a marked feeling of hardness about it. In one of our cases rigors, with enlargement of the spleen and an intermittent temperature, suggested malaria, but the case turned out to be acute tuberculosis.

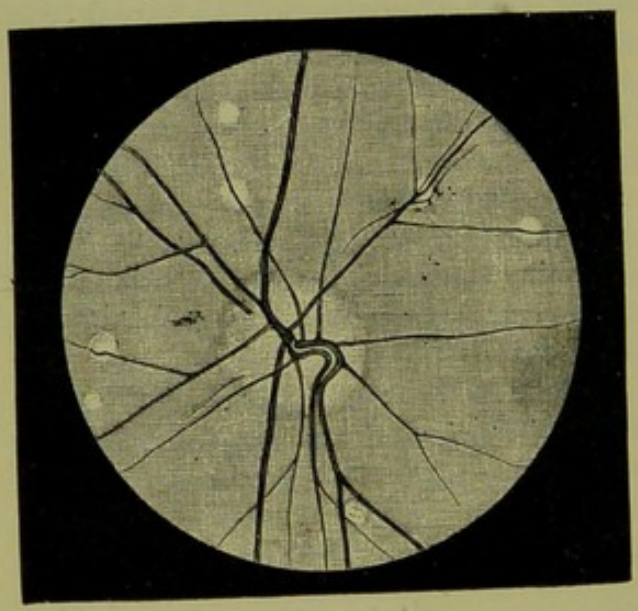

Fig. 53.—Miliary Tubercles of the Choroid ; slight optic neuritis. (From a drawing by P. H. Mules.)

Sooner or later, mostly in the course of a week or two, more characteristic symptoms declare themselves. There is a dry hacking cough, especially troublesome at night ; some crepitation or loose râles are heard at the apices, roots, or bases of the lungs, and not infrequently a sub-tympanitic or high-pitched note may be elicited on percussion, or perhaps there may be signs of fluid at one or both bases, with a pleuritic rub. In some cases there is marked dyspnœa, out of proportion to the pulse-rate and fever ; it is caused by the presence of miliary tubercles scattered through the lungs, with perhaps some disseminated emphysema or broncho-pneumonia. The hectic

continues, and probably sooner or later, in the majority of cases, cerebral symptoms due to meningitis or the softening of the brain which accompanies it, supervene.

One of the most important physical signs which may be present is that of miliary tubercles in the choroid ; the discovery of these may not infrequently clear up the diagnosis of a doubtful case. Unfortunately the restlessness and irritability of children suffering from tuberculosis often render it impossible to make a thorough ophthalmoscopic examination. The tubercles appear as small, rounded, yellowish bodies, scattered about the fundus ; one or more may be seen near the disc, but usually they are eccentrically seated : five or six may often be counted. Often a branch of a retinal artery or a vein may be seen to cross in front of one. They appear very rapidly, being apparently formed in the course of a few days ; if there is tuberculous meningitis, the disc may be swollen and indistinct.

In a case recorded by Proebsting the detection of tuberculous bacilli in the urine decided the diagnosis of a doubtful case in favour of miliary tuberculosis. In this instance the miliary tuberculosis was secondary to chronic tuberculosis of the kidney.

The duration of the disease varies, in some cases being short, often only three weeks ; in others, perhaps the majority, it is longer, the patient lingering for six or seven weeks. The supervention of tuberculous meningitis or broncho-pneumonia quickly brings the end.

The broncho-pneumonic form occurs most often in children from two to five years of age, and in the vast majority of cases is mistaken for an attack of simple broncho-pneumonia. There is often a history of measles or whooping cough shortly before the attack, and probably there has been a period of ill health with wasting. The symptoms are precisely those of acute broncho-pneumonia ; there is fever, dyspnœa ; râles or crepitation are heard over an extended area of lung, with more or less impaired resonance over a corresponding area. The disease usually runs its course in about ten days to two weeks, death resulting from exhaustion and more or less asphyxia. The family history or previous health may suggest tuberculosis in any given case, but no definite diagnosis of tuberculous broncho-pneumonia can be made unless tubercles are seen in the choroid. The supervention of meningitis suggests tubercle, but a simple meningitis may accompany or follow broncho-pneumonia, especially in infants and young children.

It must be borne in mind that acute or at least **subacute general tuberculosis,** which is not of the miliary form, may occur disseminated through all the organs. A tuberculosis may run a course of six weeks to two months, accompanied by hectic and wasting, and the principal lesions found *post-mortem* are not miliary tubercles, though these may be present, but ragged cavities in the lungs, caseous bronchial and mesenteric glands, and caseous masses in the liver, spleen, and kidneys. In these cases the diagnosis may be difficult or impossible for the first few weeks, but careful examinations of the apices of the lungs will generally decide the question.

Diagnosis.—Acute miliary tuberculosis may be confounded with acute disseminated tuberculosis, in which the tuberculous growth takes the form of caseous nodules or other forms rather than the typical purely miliary form. The diagnosis is of very little importance except as regards the acuteness

of the case, the miliary form being necessarily the most rapidly fatal. Both miliary tubercles and caseous infiltrations may be found in the same organ. Acute miliary tuberculosis may be mistaken for typhoid fever, subacute intestinal catarrh, acute broncho-pneumonia, acute endocarditis, and pyæmia, and we may add influenza when the attack is prolonged, as it sometimes is for many weeks.

In making a diagnosis the family and personal history is of great importance; if other children or older members of the family have died of tuberculous disease, the probabilities in a doubtful case will naturally be in favour of tubercle; but it must not be forgotten that apparently healthy children with a good family history will sometimes die of acute tuberculosis. A history of a recent attack of measles or whooping cough would be suggestive, but children with such a history may of course have typhoid or any other acute attack. There cannot be much difficulty in distinguishing a typical attack of typhoid fever from one of acute tuberculosis, but it may be quite impossible to make a diagnosis between an irregular and an erratic attack of typhoid and tuberculosis. In both diseases there may be some looseness of the bowels, abdominal distension, and intermittent fever; in both the spleen may be enlarged. It is only by having the patient under observation for some days, and frequently examining the chest, that a diagnosis can be made. A short hacking cough, hectic fever, great variations of temperature, dyspnœa out of proportion to the temperature, and crepitation heard in the chest, would favour the diagnosis of acute tuberculosis. Any cerebral symptoms, such as convulsions, squinting, drowsiness, muscular rigidity, or paresis suggesting meningitis, also favour the diagnosis of this disease.

Some cases of subacute broncho-pneumonia, where the distribution is patchy and the temperature markedly intermittent, closely simulate acute tuberculosis, and for a few days or a week a certain diagnosis cannot be arrived at. It is only perhaps when the pneumonia clears up, and the temperature tends to normal, that the suspicions of tuberculosis are relieved.

In acute endocarditis the temperature is apt to be hectic, and in the absence of a bruit the diagnosis may be difficult. The presence of a bruit would necessarily prove the case to be almost certainly acute endocarditis, in spite of it resembling tubercle in other ways.

Prognosis.—If the diagnosis of acute miliary tuberculosis can be definitely made, the prognosis cannot be otherwise than exceedingly grave. There can be little doubt that in a few cases, in an early stage, before the miliary tubercles are widely extended, recovery may ensue; but when the tuberculosis has become general very little hope indeed can be entertained.

Morbid Anatomy.—The amount of emaciation present depends upon the chronicity of the case; we have seen at the *post-mortem* cases in which there was a fair amount of subcutaneous fat in those who had died of acute miliary tuberculosis. On opening the chest, the lungs are found to be in a condition of deep inspiration, almost as if they had been injected with some fluid from the trachea, while miliary tubercles are seen on the surface or beneath the pleura. On section the lungs are found stuffed with miliary tubercles, of a grey colour and the size of millet seeds, usually so crowded that not a cubic

inch in the whole lungs will be found free. They are mostly more crowded at the apex than at the base. Caseating or suppurating bronchial glands are almost certainly present. Frequent miliary tubercles are present in the glands. Miliary tubercles will be found crowded together in the liver, spleen, kidneys, and serous membranes—frequently also in the choroid, and on the vessels at the base of the brain.

In other less acute cases caseous masses and peribronchial tubercles may be found in the lungs, and may be associated with more or less miliary tuberculosis. It is curious to note that many observers have failed to find the tubercle bacilli in miliary tubercles, and others have found granular masses suggestive of spores (Biedert, Ribbert, Malassez, and Vignal).

Treatment.—If the diagnosis of acute miliary tuberculosis can be made with certainty, little can be hoped for from the administration of drugs. The treatment must in such cases be a treatment of symptoms. If the temperature takes high excursions towards evening, quinine, antipyrin, or phenacetin may be given to anticipate the rise, and the patient packed or sponged with cold water to reduce it. The troublesome cough may be relieved by codeia jelly or minute doses of opium. The strength should be maintained by a liberal diet of beef tea, soups, port wine, Burgundy ; extract of malt and cod-liver oil should also be given. Iodoform sometimes appears to be useful, though it can hardly be said to have any power in arresting the disease ; it may be given in powder with sugar in half- to two-grain doses. The combination of digitalis and bark has appeared to us to produce a temporary improvement, but any permanent change for the better cannot be looked for. Creasote and guaiacol have also been used.

Scrofula and Tuberculosis.

Liability to Tuberculosis.—In certain children there is a characteristic tendency to inflammation from trivial causes ; this inflammation is apt to occur in, or rather pick out, the lymphatic tissues ; once aroused, it tends to spread, attacking often distant parts of the body. If its course is slow, the foci of disease tend to become caseous ; once started the progress seldom stops, or rather, though it may be arrested for a time, it is apt to be set going again by slight causes, even after long intervals of time. This tendency is found to run in families, some members showing one form of lesion, some another. At times different forms occur at different periods or even simultaneously in the same child.

There is often, though by no means always, a characteristic appearance of the patient, but it is quite common to find the disease under discussion in children not answering to either description. The types usually described are : 1. Sanguine type—the child is tall, slight, graceful, with small fine limbs, clear skin, and fine silky hair ; the intelligence is bright. 2. Phlegmatic type—the child is short and thick-set, with coarse skin and limbs, thick features, and a dull, flabby aspect. 3. 'Pretty strumous' type —which is intermediate between the two former.

Anatomically, in the subjects of 'acute miliary tuberculosis' we find always, or nearly so, somewhere in the body, caseous foci. We ought

therefore to be on our guard against the onset of tuberculosis in vital parts in all cases where such caseous foci exist; for instance, the common chronic osteomyelitis of the finger may be the only discoverable lesion in an apparently robust child, yet that child is infected with tuberculosis and may at any time develop other foci, and may die of visceral tubercle; hence none of these diseases should be looked upon as trivial. It must, however, be remembered that there is evidence to show that there is some antagonism between local 'scrofulous' lesions and general visceral tuberculosis, or rather, that so long as the local lesion is unrepaired the internal organs escape, while recovery from the local disease may be followed by general infection. This has given rise to the view that the local disease acts as a sort of safety valve. It is probable that the truth is that so long as the local lesion remains quiescent no general infection takes place, but if from any cause the tuberculous material gains access to the neighbouring vessels or lymphatics, a rapid dissemination of the tubercle is brought about. The disease often lies dormant for years or for a long lifetime, and the patient may never show any further sign of tuberculosis; we must therefore not condemn all these children as hopelessly tuberculous. Indeed the tendency to develop tuberculous foci often dies out after a time, and the child becomes quite sound. Such children should be taken care of more watchfully than others need be, and no source of irritation, however slight, be allowed to continue; carious teeth, little patches of herpes or eczema, slight injuries, and so on should be seen to at once, lest chronic inflammation should ensue and a tuberculous nidus be established. The diet in all such cases should be especially nourishing, and the usual remedies of cod-liver oil as an article of food rather than a medicine, iodine in some form, iron, and, above all, sea air, should be provided where practicable. In the richer class of patients such children should go to school by the seaside.

Details of management of individual lesions will be found in the various special chapters.

Tuberculous Adenitis.—As already pointed out, the lymphatic tissues are those most commonly and most extensively attacked by tuberculosis, and lymphadenitis is commoner than lymphangitis, since any solid material taken into the lymphatic vessels is apt to be arrested in the adjacent gland. The thick lips and nose and the red patches and eczematous eruptions of children are, as pointed out by Curnow, 'reticular lymphangitis.' Under certain circumstances chilblains are probably a similar condition. Irritating matters passing up the lymph stream are not, however, by any means always arrested at the nearest glands, partly because the course of the lymphatics varies and the most commonly affected glands may be avoided by a bye-route and those further on attacked, and partly because the material probably may sometimes pass through one gland and involve the next, or after one gland has become inflamed it may become a source of infection to the next in the chain. Hence search should be made for sources of irritation out of the usual path if none are found in the common positions. If one obvious enlarged gland exists the presence of others should always be suspected. The first thing, then, when a child is brought with an enlarged lymphatic gland, is to examine the whole area draining to that gland for some source of irritation, past or present: this will be facilitated by the

following table, where the principal lymphatic glands and their collecting areas are given.[1]

TABLE SHOWING THE DISTRIBUTION OF THE LYMPHATIC GLANDS AND THEIR DRAINAGE AREAS[2]

Head and Neck

GLANDS	DRAINAGE AREA
Suboccipital . . . . } *Mastoid* . . . . }	drain posterior half of head.
Parotid	drain anterior half of head, orbits, nose, upper jaw, upper part of pharynx.
Submaxillary . . .	drain the lower gums, lower part of face, and front of mouth and tongue.
Suprahyoid or submental .	drain anterior part of tongue, chin, and lower lip.
Superficial cervical . . (lying beneath platysma)	drain external ear, side of head, and neck and face.
Retro-pharyngeal . . .	drain nasal fossæ and pharynx (upper part).
Deep cervical:	
Upper set along carotid sheath: (Internal jugular set)	drain mouth, tonsils, palate, lower part of pharynx, larynx, posterior part of tongue, nasal fossæ, parotid and submaxillary glands, interior of skull, and deep parts of head and neck.
Lower set in supra-clavicular fossæ:	drain upper set of lymph glands, lower part of neck, and join axillary and mediastinal glands.

Upper Extremity

Supracondyloid[3] . . .	drain three inner fingers.
Axillary	drain upper extremity, dorsal and scapular regions, front and sides of trunk and breast.

Lower Extremity

Anterior tibial and popliteal:	drain the deep lymphatics of the leg, and receive some vessels from the skin of the leg and foot, chiefly the outer side.
Inguinal:	
Femoral set (superficial):	drain superficial vessels of lower limb and partly of buttock and genitals, also perinæum.
Horizontal set (superficial):	drain abdomen below umbilicus, buttock and genitals.
	The deep vessels of the lower limb go to the deep glands along the femoral vein.

[1] Curnow, *Lancet*, 1879. Leaf, 1898. *Surgical Anatomy of the Lymphatic Glands.*
[2] Mainly from Curnow and Treves.
[3] Occasionally there are glands in the bend of the elbow.

Abdomen

Glands	Drainage Area
Iliac	drain the pelvic viscera and the deep vessels of the genitals partly.
Lumbar	drain all the lower glands, uterus, testes, ovaries, kidneys.
Sacral	drain the rectum.

Roughly, the umbilicus is the watershed draining to the axilla and groin, but the vessels cross and overlap both vertically and horizontally.

Perhaps the most commonly enlarged glands are those of the neck and submaxillary regions, parts obviously much exposed to irritation; thus eczema of the scalp, the irritation of pediculi, &c., give rise to enlargement of the occipital and upper cervical glands; herpes about the nose to irritation of the parotid or submental glands; while carious teeth, ulceration of the gums, and so on, affect the submaxillary and cervical groups. The upper set of cervical glands are found enlarged from irritation of the meatus externus in cases of otorrhœa and in cases of tonsillitis. As already mentioned, a lymph gland overlies the tonsil, and is usually enlarged in affections of that structure, which is not perceptible from the neck under ordinary circumstances. Treves points out that those glands which drain areas rich in lymphoid tissue are the ones most commonly enlarged; hence the cervical, bronchial, and mesenteric groups are those most often affected.

The enlargement of lymphatic glands is sometimes acute at first, and they are then tender and painful; in other instances the swelling is chronic and painless from the beginning. The glands form hard, rounded, or oval masses freely movable in the deeper tissues and beneath the skin, unless there has been cellulitis around the gland (periglandular inflammation). In chronic cases the overlying skin is natural, and usually several glands can be felt; often a chain of them, varying in size from a pea to a walnut, can be traced. A mere transitory irritation may start inflammation in a gland, and then, though the local source has entirely disappeared, the enlargement may persist and other glands in the chain be affected, as already described; hence we must not conclude that there has been no primary source of irritation, and that the glandular affection is spontaneous, because we can find no cause for the enlargement. Cold, or some trifling injury, a sore upon the skin or mucous surface, soon healed and forgotten, or perhaps never noticed, is sufficient to set up chronic tuberculous adenitis, which may spread and last for months or years. Primary adenitis not due to absorption is probably very rare. Treves points out that cervical adenitis may be caused by extension from within the chest or other distant parts.

After a time, unless the process subsides, the glands become very hard, and by their size and number give rise to great disfigurement and occasionally to more serious trouble. Goode, of Cincinnati, has recorded a case of death in a baby five months old from pressure of a caseous gland upon the carotid sheath. These swellings are seldom painful; after a time one or more patches of softening may appear, and as the process goes on the skin

becomes red or livid, and finally thinned and perforated ; thin, watery, sero-purulent fluid with flakes of lymph and cheesy matter then escape, more rarely fairly healthy-looking pus ; occasionally the discharge is clear glairy fluid, like the contents of some mucous cysts, but in such cases there is almost always some more purulent matter at the bottom of the cavity, which can be squeezed out. The discharge may go on indefinitely, and an ulcer is formed which has little tendency to heal, and is bounded by thin, livid, undermined, unhealthy edges. If healing does take place the scar is puckered and unsightly, often with bridges or tags of thin insensitive skin hanging from it, and little black spots due to accumulation of dirt and secretion in the hollows of the scar. Such is the condition seen in an old 'scrofulous neck.'

If such a gland as that above mentioned is examined in the early stages of the process, it will be found firmer and paler than in health, but not otherwise obviously altered ; a little later patches of yellow cheesy material of various sizes will be found scattered through the gland, sometimes in one or two large foci, at other times in numerous small ones ; the capsule of the gland is thickened. Later still, these caseous foci break down, the greater part of the gland tissue is destroyed, and the gland itself becomes converted into a bag of cheesy or flaky pus and detritus, with walls composed of the capsule and more or less of the gland tissue remaining unsoftened. It happens, however, sometimes that, instead of the gland breaking down and softening in the centre, suppuration takes place in the cellular tissue round it—*periglandular abscess* ; this burrows round the gland and isolates it, so that there is a solid mass of gland tissue lying in an abscess cavity, and perhaps attached to the surrounding tissues only by the structures passing to its hilum. In this last case, when the skin gives way, instead of a deep ulcer there is seen a round pinkish or yellowish-white mass projecting from the middle of a circular sore, the edges of which are loose, undermined, thin, and livid ; there is often but little discharge, and no tendency to heal, or, indeed, to alter much one way or the other. Where many glands are enlarged, all stages, from the first primary enlargement to the last-named condition, may be seen at once, and sometimes the whole neck from ear to ear is marked by ulcers, scars, and enlarged glands in various stages. In such cases it will usually be found that many teeth in one or both jaws are carious, and acting as sources of irritation.

It must, of course, be remembered that all such glands do not go on to suppuration, and perhaps in children there is more chance of resolution than in adults ; however, the majority do suppurate if they remain enlarged for more than a short time.

Co-existing with the glandular abscesses and sores will often be found superficial ulcers, round or irregular in form, often scabbed over, and only discharging at times. The edges of the sores are usually unhealthy and undermined, and their bases glazed or covered with coarse, unhealthy granulations and caseous detritus : some of the ulcers are no doubt caused by the discharge of broken-down glands ; in these a small aperture will be found leading down to the underlying gland ; others are probably due to abscesses beginning in lymphatic vessels, due to tuberculous lymphatic emboli, or rather thrombi—tuberculous lymphangitis, 'strumous nodes' ; others again probably to local cutaneous tuberculosis.

Diagnosis.—Tuberculous adenitis and ulcers may be mistaken for syphilitic ulceration, which gives rise to very similar appearances, except that ulceration predominates over the glandular enlargement. It must be remembered that congenital syphilis and tuberculosis may co-exist. The presence of other evidences of syphilis will nearly always clear up a doubt.

Simple acute adenitis is recognised by its short history and by the pain and great tenderness of the part, as well as by the presence of an acute source of irritation, such as an alveolar abscess or acute tonsillitis, and by the fact that usually only one gland is enlarged, though several may be tender.

Simple non-tuberculous chronic adenitis may occur as the result of acute inflammation, but this usually rapidly subsides under treatment and affects

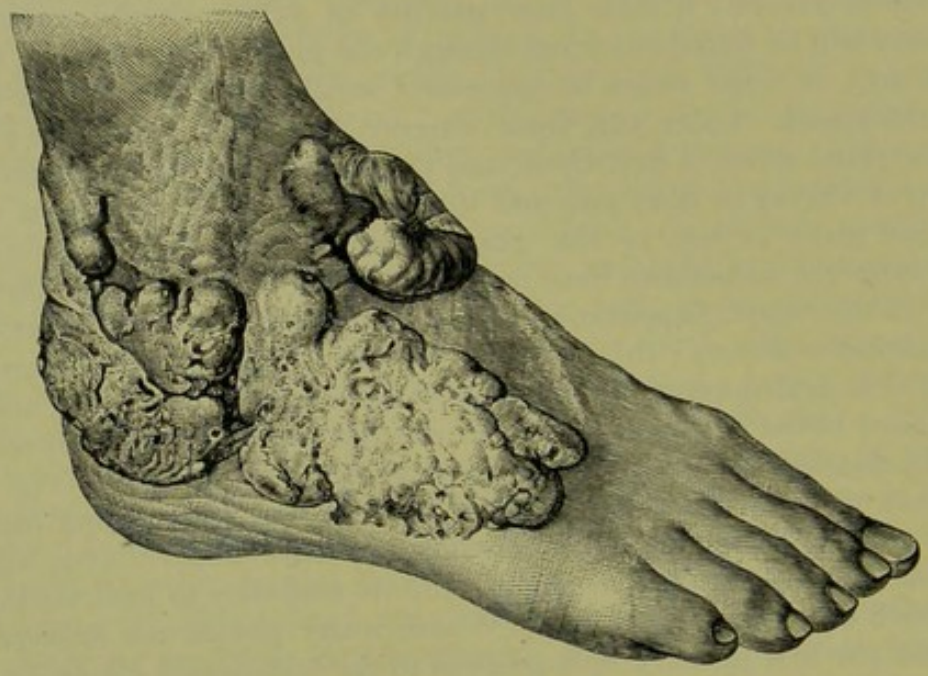

Fig. 54.—Tuberculous Ulceration of the Skin of the Foot, showing imperfectly formed scar-tissue overlying the tuberculous granulations. A form of so-called Lupus hypertrophicus.

but one gland ; if the affection is obstinate, suspicion of its tuberculous nature should be aroused.

Lupus ulcers are the only other condition likely to be mistaken, and as these are also tuberculous, the mistake is of little importance. The presence of well-defined lupus tubercles is the distinguishing feature.

Tuberculous abscess of the skin, 'scrofuloderma,' 'scrofulous gumma,' and 'strumous node,' are the names applied to small tuberculous foci probably in the lymphatics which, at first hard and solid, usually break down, though sometimes they are absorbed. These little swellings are often found in the thickness of the skin itself about the limbs, face, or trunk. Occasionally the mischief spreads, and a large cold abscess or tuberculous ulcer may result.

Chronic tonsillar hypertrophy is considered by Treves to be 'almost pathognomonic of scrofula' ; though very common in tuberculous children, we

think it is often met with in those who show no other signs of tuberculosis; it may occur during the first few months of life. Infantile leucorrhœa and certain vulvar ulcers have been supposed to be tuberculous; many cases of aural suppuration certainly are so.

Treatment.—The treatment of tuberculous adenitis consists at first in carefully removing all sources of irritation; carious teeth, enlarged tonsils, patches of eczema, nasal catarrh, otorrhœa, chafed heels, and so on, should all receive attention according to the seat of the enlarged glands and the source of the trouble. Next, the general measures of diet and health already mentioned must be carried out. As to the local treatment of the glands themselves, this must be managed according to the stages of the disease. (1) In the early stage, before caseous foci have appeared, after removal of the source of irritation, the glands should be left quite alone, in the hope of their subsiding. If no improvement takes place in a fortnight, the glands should have a piece of unguentum hydrargyri oleati, of the size of a small pea, gently rubbed over them night and morning. Painting with tincture of iodine we do not approve of; it is far more likely to increase the irritation of the glands than to lessen it. Should the enlargement not yield to these means, and should the stage of caseation, known by a duration of two or three months with considerable enlargement and much hardening of the glands, be reached, the best treatment is to cut down upon and shell out the glands entire—a very easy operation at this stage where only one or two glands are involved, a much more difficult and sometimes impossible one where many glands in a chain are enlarged and there is periglandular inflammation. In favourable cases an incision through the skin and fascia, and then through the sheath of the gland, followed by pressure at each side with the fingers, will render enucleation of the mass quite easy. All the glands felt to be enlarged should be removed, all bleeding stopped, and the edges carefully brought together, no drainage being used if the wound is clean. The resulting scar is slight, and much less unsightly than that left in cases where suppuration has gone on.

In the next stage, when the gland has softened down, if there has been no periglandular mischief, it may be still possible to dissect the mass out, and, if so, this is the quickest and best method; it is, however, impracticable if the glands have become matted to the surrounding tissues: in such cases the abscess should be opened by an incision about half an inch in length; a long incision is not necessary, but it must be sufficient for free manipulation and drainage. After opening the abscess a Volkmann's spoon is passed in, and all the gland tissue carefully and thoroughly scraped away: if any is left the wound will not heal, but the part remaining will caseate, break down, and keep open a sinus; hence, if all the gland cannot be scraped away, the most satisfactory plan is to enlarge the incision and dissect out the remaining parts. Injection of chronic glandular abscesses with a solution of iodoform in ether is worth a trial where operation is not allowed; we have seen them completely disappear under this treatment. Where, as often happens, two or more glands near, but not fused with, one another have broken down, the further ones may often be reached, as pointed out by Mr. Teale, by thrusting the spoon through the adjacent walls and thus emptying all the cavities through one opening. The wound should be well dusted with

iodoform and drainage provided for. When the abscess has already burst and left a sinus, the same treatment should be adopted. Where ulcers have formed with undermined edges, these should be scraped or clipped away flush with the healthy skin : a large wound may thus be sometimes left where there was but a small opening before, but the ultimate result will be a much less unsightly scar, as well as more rapid healing, if this devitalised skin is removed ; all the unsightly tags and bridges will thus be avoided. Where there is a protruding isolated gland in the middle of a sore, if it is soft it may be scraped away. We cannot too strongly urge that on every ground it is far wiser to remove glands by clean excision as soon as they have become chronically enlarged, and before there is any breaking down or inflammation round the gland.

Mr. Teale has pointed out that where one superficial gland is enlarged and suppurating there is usually another, lying beneath the deeper fascia, and that, unless this is cleared out, the source of discharge is not removed and the sinus will not heal. It is necessary to look carefully sometimes to find the channel leading to the deep gland, but it is there and must be followed by the spoon, and the second mass removed. Mr. Teale uses a special dilator to stretch the sinus, but a dressing or sinus forceps will usually be found to answer all purposes.

Iodoform is the best dressing to apply to these sores at first, and later on they do very well with iodide of lead ointment. Application or injection of turpentine is also often of great value.

Where several sinuses are left in the neck it is a good plan to use, as advised by Treves, a gutta-percha or leather stock to keep the parts at rest (the sawdust collar will be found useful for this purpose), and in other parts of the body efficient pressure by pads and bandages or by a truss is often useful.

Where depressed scars remain after gland diseases Adams's or Reeves's operations may be employed. The former loosens the skin by subcutaneous division of the scar, and by daily manipulation keeps it from becoming reattached till the hollow is filled up. Reeves props up the depressed skin upon a wire passed beneath it, which may be left in permanently, or removed if it sets up irritation. We have had a good result from the latter method. A far better plan, however, in most cases is to excise cleanly the whole scar, and bring the edges of sound skin accurately together by means of sutures ; thus a linear cicatrix takes the place of the irregular puckered or depressed scar.

Where the popliteal or inguinal glands are involved the limb should be kept extended and fixed to a splint. Suppurating popliteal glands are apt to give rise to serious trouble ; the matter tends to burrow far up the limb. In one case we had to amputate the thigh where an abscess, beginning in the popliteal lymphatics as the result of an irritated chilblain, eroded the popliteal artery, opened into the knee joint, and burrowed up to the pelvis.

Acute adenitis, if seen before suppuration has occurred, will usually subside if the source of irritation is removed and the part well fomented after smearing it with extract of belladonna. If pus forms it should be let out as soon as possible.

SCHOOL OF MEDICINE
UNIVERSITY OF LEEDS

General Surgical Tuberculosis

A condition perhaps best described as 'general surgical tuberculosis' is common, the term being applied to those cases where there are tuberculous foci scattered far and wide over the body in various tissues. Thus children are seen with ulcers of the hands, abscesses or still unsoftened nodes along the course of the lymphatics of the fore-arm, and a supra-condylar gland enlarged: perhaps a patch of ulceration on the cheek and submaxillary adenitis, phlyctenular ophthalmia, tuberculous osteo-myelitis of one tibia, with disease of the tarsus on the opposite side, and so on. Such a combination is by no means a rarity: not very long ago we had in the hospital a boy with disease of one hip, one elbow, one ankle, and sacro-iliac disease; in another the shoulder, ankle, and wrist were all excised for tuberculous disease. Such cases, if they are neglected, gradually lose strength and sink, but good food and sea air, combined with removal of the disease as soon as it is evident that spontaneous repair is impossible, will often work wonders.

Operation should be deferred till it is seen what nature can do; but if with the improvement in the child's health no progress is made locally, or if there is pain or much discharge, the affected tissues—bones, joints, &c.—should be removed. We have often been surprised at the rapid and complete repair effected in such children, and even in the cases looking most desperate locally, resections or scrapings will sometimes succeed and amputations prove unnecessary.[1] But in all these children relapses will occur if the health is again allowed to fail from bad food and hygiene.

As regards details of local treatment in such cases, iodoform mixed with an equal quantity of boric acid and dusted on, or iodoform ointment, is a good dressing. A mild carbolic ointment or occasional applications of turpentine, is as good as anything. Where operation is called for, all dead and carious bone should be excised or scraped and gouged away, all soft caseous and pulpy granulation tissue removed, and undermined livid edges of skin clipped off. The incisions may sometimes be closed with sutures and primary union obtained; where possible this should be attempted. If, however, the destruction of the skin renders union impossible, the wounds should be left freely open; they often heal with great rapidity and leave but little deformity. Amputation is sometimes required for tarsal and knee joint disease, but in the upper extremity *we have never seen a case that required it*, except in the fingers, though some have at first appeared hopeless enough. Caries of the spine in such children is the most serious condition, from its inaccessible position; but even this is not hopeless. It is not so common as might be expected to find visceral tubercle in these patients, and this is probably one of the reasons why they have been called scrofulous and not classed as tuberculous. The term 'surgical tuberculosis' has been used to imply that operative treatment can do much for them, and that the lesions are external. The following case illustrates this.

Surgical Tuberculosis.—Edward C., aged 9 years 6 months. Admitted November 7, 1885. No tuberculous history. Always healthy till two years ago, when an abscess

[1] See, however, chapters on Bone and Joint Diseases.

appeared at the back of the leg, and others subsequently elsewhere; they have continued to discharge since. Four months ago he fell upon the elbow, and an abscess formed, which was opened, and has been discharging since; joint stiff. On admission, a sinus over the outer end of the left clavicle, leading to bare bone. Abscesses and enlarged glands in the neck; a sinus on the left buttock and another over the inner condyle of the left humerus. 26th, several small loose sequestra removed from the cavity in the clavicle, close to and involving the acromio-clavicular joint; abscess in neck scraped out and a deep gland beneath the fascia scooped away; some caseous bone scraped from inner condyle of humerus. 27th, much pain in elbow, which subsided partially by the 29th; he did fairly well, and was sent out on December 11 with all the ulcers &c. doing well, except the elbow, which remained swollen and tender. Such cases are very frequently met with.

Non-tuberculous Abscess

Chronic Abscess.—Chronic abscesses, whether tuberculous or not, may now be dealt with much more speedily and satisfactorily than in former times. In all cases, of course, the source of irritation should be looked for and if possible removed; unless this is done success cannot be reasonably expected.

In some instances, if the contents of the abscess are drawn off through an aspirator and an emulsion of iodoform in glycerine injected (from ℥j–℥ss being a usual quantity to use), the abscess will slowly subside. This method is not, however, likely to succeed where any irritating or much caseous material is present. In such cases the abscess should be freely opened, and its contents and whole lining most carefully scraped and rubbed away; this part of the proceeding must be done thoroughly or the operation will fail.

The abscess cavity should then be well washed out with perchloride of mercury lotion of strength 1 to 3,000, and, after being thoroughly dried out, either a mixture of iodoform and boric acid in equal parts should be dusted in, or some of the iodoform emulsion injected. The wound is then to be carefully and completely sewed up, all excess of fluid being squeezed out just before the dressings are applied. The dressings should consist of wood-wool wadding or some similar substance packed carefully on over a layer of wet gauze. The dressing should be so applied that the walls of the cavity are accurately kept in contact and firm pressure made. In successful cases the wound need not be disturbed for ten days or a fortnight, when it will be found soundly healed. If, as sometimes happens, the wound heals but the abscess refills, either the source of irritation at a distance has not been removed, or the cleaning out of the cavity has not been complete; the operation should be repeated, and will probably be successful. In cleaning out the cavity it is useful to twist an artificial sponge tightly into all parts of the cavity and screw it round so as to entangle and wipe out all caseous material. In all cases of chronic tuberculous or simple abscess, whether in connection with gland or bone disease, we have great faith in well swabbing out with turpentine the cavity left after removal of the disease. Though painful and irritating when kept in contact with the skin, it is quite free from any such objections in the deeper tissues, and wounds may be closed and primary union obtained after free use of this agent. We think it is of special value in tuberculous disease.

Deep Cervical Cellulitis—Angina Ludovici—is a very serious affection; the mischief apparently begins as a periglandular inflammation, goes on to sloughing, and may perforate the cheek. There is at first a brawny infiltration of the submaxillary region; the skin in milder cases is pale and marked by turgid veins; in the more severe and acute cases, however, a deep brownish-red discoloration appears. The whole neck may be involved, and there is great swelling, with marked prostration, and sometimes dyspnœa or dysphagia from mechanical pressure. The disease is met with usually in children under three years of age, often in infants, and occurs under similar conditions to cancrum oris. Early and free incision is urgently required; usually much foul brown serum or sero-pus escapes. Free stimulation and abundant nourishment are required, with removal from insanitary surroundings. The mortality of these cases, which much resemble those of scarlatinal cellulitis, is considerable.

Case.—Female, age 1 year 9 months; neck swollen a fortnight ago; on admission, right side of neck tense, hard, brownish-red; swelling reaches to clavicle; swelling incised, serum only escaped; much fever before incision; skin sloughed freely, and pneumonia set in, child dying on seventh day.

Post-mortem.—Abscesses in lungs and sanguineous pleuritic effusion.

CHAPTER XIV

THE SPECIFIC FEVERS

Feverishness.—Children more often than adults are apt to suffer from attacks of feverishness, the temperature rising suddenly without any obvious cause, remaining raised for a day or two, much to the alarm of the friends and the medical attendant, and returning to normal without any clue having been obtained as to the cause. Perhaps the fever is less acute, but is continuous for some weeks, rising in the evening and falling in the morning, without any diagnosis being made. It is hardly needful to insist that in any given case no effort should be spared to find out the cause of the fever, the chest being stripped and carefully examined by auscultation and percussion, while the skin and fauces should be minutely scrutinised in a good light. Inquiries should be made as to what the child has taken in the way of food prior to the attack. If the attack is sudden, the temperature rising to 103° or 104° or more, epidemic influenza, acute pneumonia, scarlet fever, or acute dyspepsia from the ingestion of unsuitable food will doubtless be suggested.

In children under three years of age, a high temperature with convulsions is often due to acute pneumonia, and a careful examination of the lungs, especially at the apices, should be made ; in older children there may be no convulsions, but usually, if the physical signs are not distinctive, there is some stitch in the side felt on coughing, with more or less dyspnœa. In scarlet fever there is usually vomiting and often diarrhœa, and the appearances in the throat and skin soon become distinctive. During the first twelve or twenty-four hours it may be difficult to distinguish between scarlet fever and an acute gastro-intestinal infection, as sometimes the latter will produce severe symptoms of vomiting, diarrhœa, and fever. Or there may be no diarrhœa or sickness and only feverishness. The diagnosis in epidemic influenza has often to be made from the fact that it is prevalent in the house or neighbourhood rather than from the symptoms, which are so frequently indefinite ; a temperature of 104° or 105° with convulsions is not uncommon. In many cases it is wise to wait before giving a definite opinion. In infants and young children the cause of an unexplained high fever may prove to be an acute otitis which has been overlooked till pus has made its appearance at the external meatus ; such cases are very apt at first to be mistaken for meningitis (see fig. 53).

In some feverish attacks we have noticed an enlargement of the cervical glands, either the deep cervical at the angle of the jaw, or the glands under the upper part and posterior edge of the sterno-mastoid, without any appearances

of irritation in the tonsil or pharynx ; possibly there may be such a disease as an acute idiopathic adenitis, or some poison may perhaps be absorbed from the pharynx and enter the glands without setting up any local lesion at the point of absorption.

Such cases have been described by E. Pfeiffer, Heubner, Rauchfuss, and in this country by Dawson Williams, under the name of **gland fever.** The attack, according to Pfeiffer, is sudden and the fever moderately high ; there is complaint of tenderness in the neck, and some of the cervical glands, usually those at the posterior border of the sterno-mastoid, or the occipital glands, are swollen and tender. In exceptional cases the axillary and inguinal glands are involved ; there may be abdominal tenderness. In a few days the temperature falls and the glands become normal. In a few instances

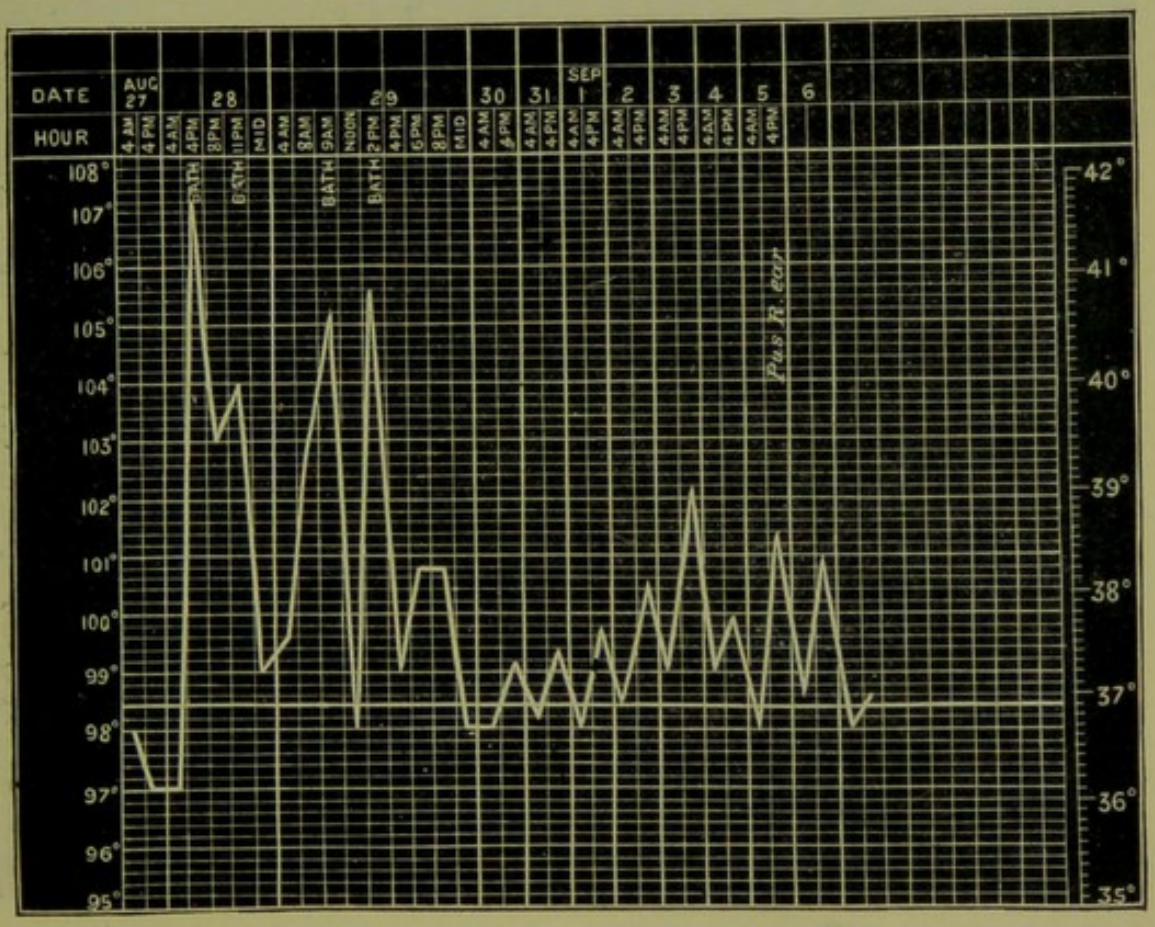

Fig. 55.—Temperature Chart showing high temperature due to an acute otitis in an infant of 7 months.

the attack has been more severe and has lasted longer. In these cases no abnormal appearances have been detected in the tonsils or nasal mucous membrane. The glands never suppurate. Pfeiffer has noted several of these cases in one house at the same time, the disease being infectious or epidemic.

We are, however, rather inclined to think that while 'gland fever' does undoubtedly take place, it is doubtful if it can be said to rank as a specific fever. 'Gland fever' often occurs in scarlet fever and other various forms of tonsillitis ; the throat may be apparently well or hardly abnormal, yet the cervical glands are swollen and tender, and the patient feverish.

Acute cerebral congestion or **'sunstroke'** may be accompanied by high fever, quickly followed by death, though fortunately this is not always the case. In many cases with a high temperature and cerebral symptoms, such as coma, delirium, or torpor, it is often difficult to say whether there is some cerebral disease, or whether the high temperature and poisoned blood are not causing the cerebral symptoms, the brain itself being normal. When the temperature rises more slowly, taking several days to reach its greatest elevation, as is the case in measles, typhus, typhoid, and smallpox, a diagnosis cannot be made for a few days, till characteristic symptoms appear. The hard cough, suffused eyes, and rash of measles, the headache, delirium, and coma of typhus, the backache and papules of smallpox, settle the diagnosis.

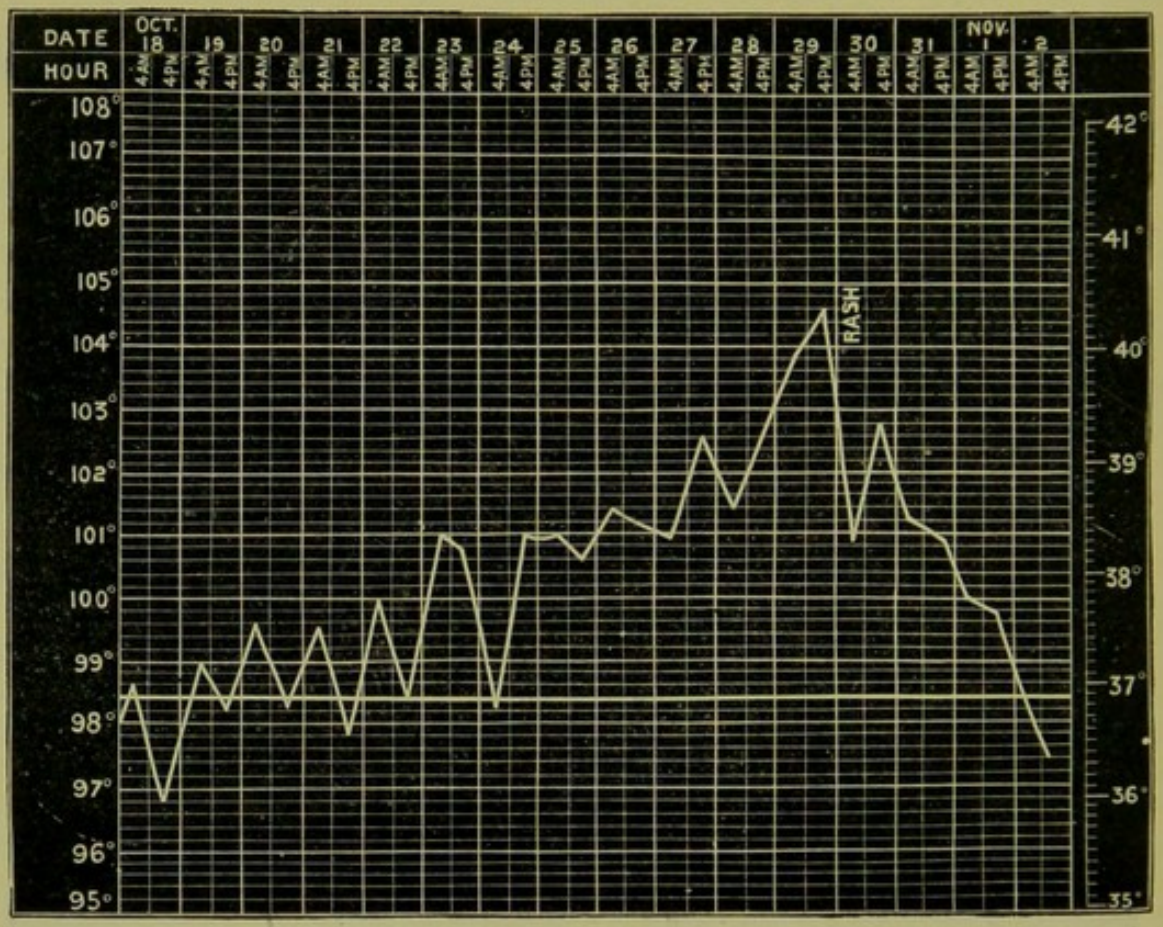

Fig. 56.—Temperature Chart of a case of Erythema Nodosum. The girl was in hospital convalescent from Acute Pneumonia. The cause of the fever was unknown till a number of typical nodes made their appearance.

This is sometimes the case in erythema nodosum ; there are some few days of fever with no definite symptoms, and then the characteristic red flattened nodes make their appearance (see fig. 56).

The diagnosis as to the cause of fever is often very difficult when the fever assumes the intermittent or remittent type, going on for some days or weeks without any characteristic symptoms developing. Such cases were formerly designated 'low' or 'continued fever,' and while it is not wise to use such indefinite terms, we must be prepared to find cases of intermittent fever in children in which it may be quite impossible to make a diagnosis. A sub-acute or chronic gastro-intestinal catarrh, creeping pneumonia, a low

form of enteric fever, a tuberculous peritonitis or suppuration may be present. There may be, as Dr. Foxwell suggests in these cases, a condition of general catarrh, including both alimentary and respiratory tracts. In all such cases a most careful examination should be made of the chest, abdomen, and retina for disseminated tuberculosis, on the chance of detecting something which will throw light on the attack ; an examination of the blood for Widal's reaction should be made. We must not forget that some of these cases of protracted remittent fever are in reality cases of miliary or local tuberculosis in which healing eventually takes place. We feel sure we have seen such cases.

Some children seem very prone to feverish attacks, and these may be repeated from time to time without any obvious cause being found ; much in the same way as children suffer from recurring or cyclic attacks of vomiting. These attacks of **recurring fever** are in many instances very mysterious, and in turn the stomach, the tonsils, and perhaps influenza are blamed for the attacks. The temperature may rise to 103° or 104° F. and continue without marked remission for perhaps a week or ten days ; the child does not feel very unwell, there may be no vomiting, and a rapid recovery is made with no complications. Within a few months or less the attack is repeated, to be followed again by others recurring at intervals perhaps for years. Eventually, as the child grows older, the attacks decrease and cease altogether some time after puberty. Such children are likely to be operated on for 'adenoid overgrowths' perhaps more than once, but, as far as our experience goes, without the slightest benefit. In some cases at least, careful dieting, especially as regards the avoidance of excess in taking starches and sugars as suggested by Dr. Eustace Smith, has apparently diminished the number of attacks. Others have suggested that uric acid in excessive quantities in the blood is the real factor ; we think it probable that attacks of recurring fever, cyclic vomiting, and migraine owe their origin to some obscure nerve disturbance. The attacks of recurring fever are apt to occur like recurring vomiting in 'highly strung' or neurotic children. Dr. Savage has seen several cases of nervous breakdown in later years in those who have suffered from these fever attacks when children.

Before discussing the specific fevers in detail we may make some remarks on their etiology and pathology, only concerning ourselves with those which loom large during early life. We will refer to a few of the most important points. The attack begins with the entrance of the micro-organisms into a susceptible individual, but a latent or *incubation* period intervenes before marked symptoms appear. In the large majority of cases the organism enters the mouth, either in the dust of the air, or in some way through the food. During the period of incubation the organism is multiplying in the tissues of the body, producing albumoses or toxins. The individual is not ill, but may suffer from headache, and there may be an odd rise of temperature in the evening. Then there are a few days more or less of premonitory fever, before the rash or exanthem characteristic of the illness makes its appearance. Then follows the eruptive period or period of the exanthem ; during this time the disease becomes fully developed and is distinguished by a characteristic rash in many instances. The period of the disease is for the most part limited and gradually comes to an end by the establishment of immunity,

—that is, in spite of the presence of the organisms in the body they no onger produce toxins capable of giving rise to pyrexia or illness ; this immunity may last a lifetime. Diphtheria bacilli may be found in the secretions of the fauces many weeks after convalescence has been established ; indeed they may be found in the secretions of healthy persons attendant on the sick. It is clear therefore there is an acquired immunity as a result of an attack, and also many persons are immune to some diseases though they may never have had an attack. But such immunity may be temporary only. An artificial immunity may be established by inoculation of the individual by attenuated micro-organisms or by the blood serum of animals who have been rendered immune by repeated injections of the virus of the disease.

Scarlet Fever

Scarlet fever is a specific fever of a highly infectious and dangerous nature characterised by tonsillitis, fever, and a diffuse rash ; it occurs in epidemics, but is always more or less endemic in large populations. It is easy to understand the occurrence of epidemics in a small population where the fever exhausts the soil, as it were, by attacking all those susceptible to its influence, and then disappears for a while to prevail at a later period, when the infection is reintroduced and the population contains again a number of the unprotected. It is more difficult, however, to understand the cause of epidemics in large cities where the infection is always present, unless we assume the existence of some unknown influence which favours the spread of the disease at one time more than another by rendering those who are unprotected by a former attack more than usually susceptible to the infection. Thus epidemics of scarlet fever are more common and widespread in the autumn than at any other period, and it would appear that at this season either the poison is apt to be more intense, or individual susceptibility greater. Individual susceptibility varies greatly with age ; infants under six months of age are rarely attacked, during the second year the susceptibility is greater, while children during the fourth to the seventh years are most often attacked. The susceptibility then appears to diminish as age increases, though, as already remarked, varying strangely from time to time. Thus it may happen that a medical man or nurse may come in contact with scarlet fever cases for weeks or perhaps months without contracting the disease and yet finally take it. In one case which came under our notice a probationer nurse was engaged in nursing in a scarlet fever ward for six months without being attacked ; many months after, while nursing in a surgical ward at another hospital, she contracted a smart attack of scarlet fever from a sporadic case arising in the ward. In another case a child had a severe attack of scarlet fever twenty-nine days after admission to the scarlet fever ward. In this case it was supposed to have had an attack of scarlet fever, for which it was sent in ; but second attacks of scarlet fever are rare ; they do, however, undoubtedly occur, as in the following case :

Scarlet Fever ; second attack.—Thomas R., aged 6 years. Vomited June 26, rash noted same day ; admitted to hospital June 29. There was a well-marked rash, the tonsils were swollen, with patches of exudation ; there were two or three degrees of fever for a few days. Discharged August 20. He vomited August 21 ; admitted August 25 with a typical attack of scarlet fever. There was a well-marked rash, tonsillitis, and fever.

Scarlet fever is apparently not so infectious as measles—a large number of children and adults escape being attacked ; thus Biedert found in an epidemic which prevailed in an isolated village (Neunhofen) where the inhabitants freely mixed with one another, and where no isolation of the fever patients was possible, that about 58 per cent. of the children unprotected by a former attack contracted the disease, though only about two-thirds of these had well-marked symptoms, the rest having sore throats only. In different epidemics the number attacked varies extremely.

The *mortality* varies in different epidemics ; thus, in the fever ward of the Children's Hospital, Manchester, it has varied from 6 to 25 per cent. in different years ; during the years 1873–1897, the average mortality among 3,319 cases treated was 12 per cent. During the eighteen years 1880–1897 (inclusive) 2,840 cases were treated with an average mortality of 9·6 per cent. This average mortality closely corresponds with the figures given by Collie of the mortality in the London, Stockwell, and Homerton fever hospitals, where, in upwards of 10,000 cases of scarlet fever, the mortality was 12·5 per cent. As in all probability many of the milder cases of fever never come into hospital at all, 10 per cent. mortality given by W. Squire as the average appears to be as nearly correct as possible. Age influences the mortality very considerably ; the mortality is high during the first three or four years of life, amounting to 25 to 30 per cent. ; it continues high till the age of five or six years is reached, declining after this till the age of twenty-one, again increasing after this epoch.

Table showing mortality in 2,840 *cases of scarlet fever at different ages*

—	Boys	Deaths	Per cent.	Girls	Deaths	Per cent.	Total	Deaths	Per cent.
Under 2 yrs.	70	15	21·4	82	27	32·9	152	42	27·6
2–5 ,,	481	80	16·6	489	66	13·4	970	146	15
5–10 ,,	628	31	4·9	686	46	6·7	1314	77	5·3
10–14 ,,	174	4	2·2	230	6	2·6	404	10	2·4
	1353	130	9·6	1487	145	9·7	2840	275	9·6

Are there any morbid conditions of body which predispose to scarlet fever? Very little is definitely known about such conditions ; individual susceptibility varies in the most erratic manner, or at least is governed by no known laws, and it cannot be said that ill-health in any way either favours or protects from attacks. To this, however, must be added that it is our experience that operation cases and surgical cases with open wounds are more liable to contract the disease than are healthy children. The so-called **surgical scarlet fever** is simply scarlet fever occurring in a surgical case (vide *infra*).

The strong and healthy appear to be as frequently attacked as the weakly, and the attacks are often fatal to such ; it is by no means uncommon to see on the *post-mortem* table children who have succumbed to malignant scarlet fever looking fat and plump, and who were apparently in the best of health when attacked.

The *transference of infection* from the sick to the healthy takes place in various ways ; it may be by direct contact, the breath or the exhalations from

the fever patient may be inhaled, or the infection may be carried by means of clothes or wearing apparel or bedding which have been in contact with the sick, and which have been fouled by the discharges from the mouth or nose. It is highly probable that the excretions of the patient are infective, the urine, fæces, and especially the discharges from the ear or nose. The poison of scarlet fever appears to retain its vitality for many months, fever breaking out again and again in houses which have been imperfectly disinfected. One of the common—but often unsuspected—sources of infection in schools and the general population is that individuals who have had mild and unrecognised attacks mix with others and so spread the infection. It is probable that healthy children or adults may act as 'carriers,' the scarlet fever organism being present in their throats. Milk appears to have been the vehicle of infection in some epidemics.

Incubation.—Mostly two to five days, though it may be much less, perhaps only a few hours; forty-eight to seventy-two hours is a common period, but in many cases where slight sore throat precedes for some hours the more definite symptoms it is impossible to state the period of incubation with exactness. In the majority of cases, if the initial vomiting be taken as the first symptom, it will be found that the incubation is under three days. It cannot be said with certainty that it may not be more than five days, but such cases must be very exceptional.

Premonitory Symptoms.—The invasion in the case of children is usually sudden, the first symptom being nearly always vomiting; this may come on after a hearty meal. There may also be diarrhœa. In older children and in adults there is usually nausea if not vomiting, sore throat, headache, shivering, and loss of appetite. 'Sore throat' with vomiting in a child or adult is extremely suspicious of scarlet fever, especially if fever is present. The temperature usually runs up quickly to 103° or 104°, and perhaps the patient sits over the fire on account of feeling chilly; in some cases there is slight delirium. An attack of vomiting and diarrhœa coming on suddenly with feverishness (103°–104° F.) is very probably the commencement of scarlet fever, and in such cases death may take place within twenty-four hours of the onset.

Symptoms and Course.—**Medium Forms.**—The premonitory symptoms are usually followed within twenty-four hours by the characteristic rash. This is said to make its appearance first about the neck, but there is no certainty about this, and traces may be seen of it on the backs of the hands and wrists, or on the thighs or abdomen, when it is present nowhere else. In some cases it is first visible on the back. At first the rash is faint though perfectly characteristic, taking two or three days to reach its height. In other cases it disappears in the course of twenty-four to forty-eight hours, having at no time been more than a fine faint rash. When typical it cannot be mistaken for any other rash. Viewed from a short distance, the whole body excepting the face is of a uniform bright red colour; examined closely, it consists of a multitude of red points which correspond with the hair follicles; these points are surrounded by zones of erythematous redness which, joining with one another, give a general diffuse red appearance to the skin. Sometimes the rash consists of the points only without the erythema; in this case the redness is necessarily less vivid. In rough skins the rash may be coarsely punctiform; that is, there is a condition of 'goose skin,' each point

being large and the rash therefore coarse. Sudamina are not uncommon. In other cases the rash is patchy on the limbs, and when this is so, the case may simulate measles; the patches consist of clusters of fine papules or points with much surrounding erythema, while normal skin is present between the patches. Sometimes the rash is hæmorrhagic, minute extravasations of blood taking place into the skin; this may occur in mild cases. It is, however, much more common in malignant cases. Purpuric patches are not uncommonly found after death that were not present during life. Towards the end of the first week the rash, which has been fading for several days, is succeeded by desquamation, which is free or slight according to the intensity

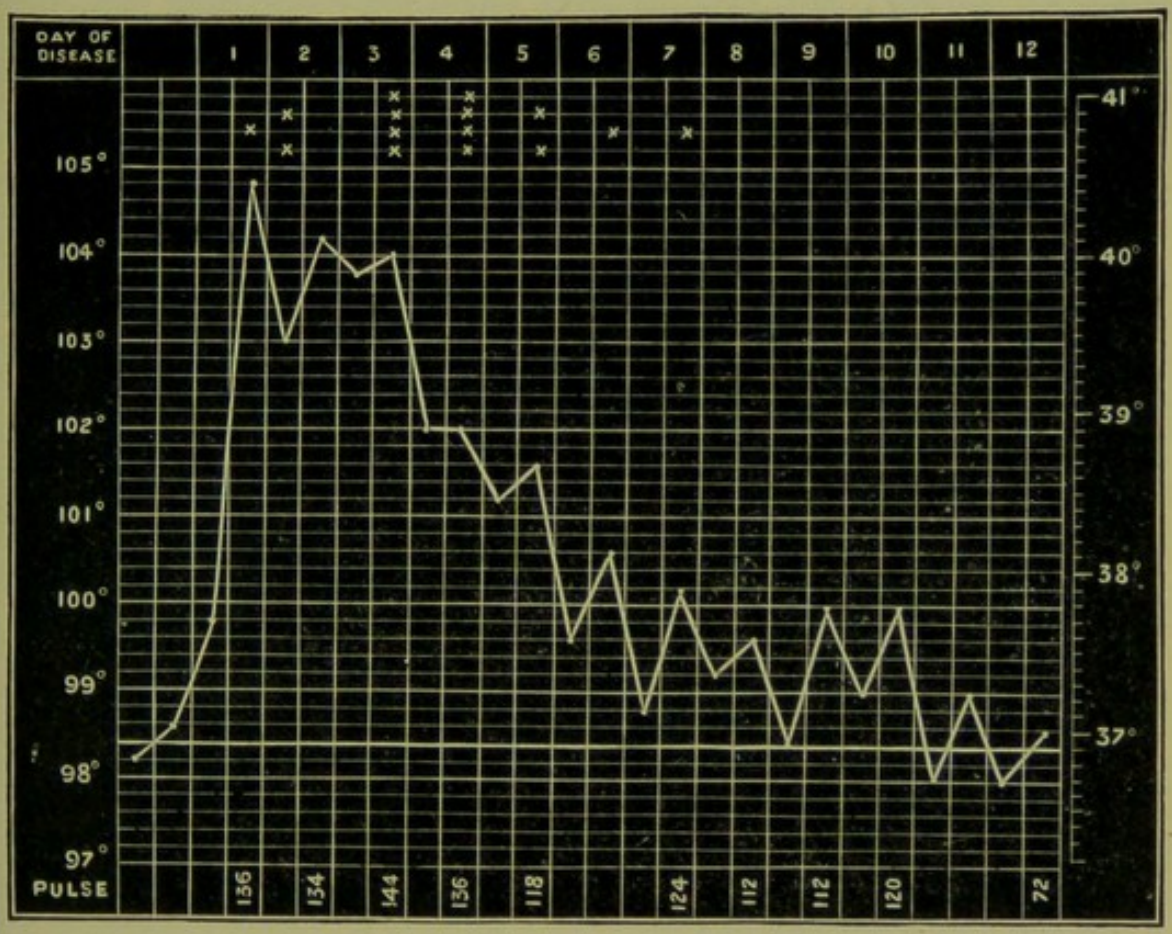

Fig. 57.—Temperature Chart of a case of Scarlet Fever, medium attack. M. K., aged 13 years.
*, Rash present.

of the rash. This exfoliation of the epidermis generally goes on for many weeks, being present longer about the hands and feet. The tonsils are red, swollen, and covered with an excess of mucoid secretion, yellow points corresponding to the tonsillar crypts are usually present; sometimes there are patches of yellow exudation; the soft palate, uvula, and pharynx are more or less congested. The nasal mucous membrane is frequently involved, so that there is much discharge from the nose. The deep cervical glands at the angles of the jaw are usually enlarged. The tongue is coated with a thick white fur; not infrequently there is a dry glazed central band on the dorsum; in the course of a few days the tongue cleans, leaving a red clean glazed tongue with prominent fungiform papillæ—i.e. 'the strawberry tongue.'

The eyes are often suffused and the conjunctivæ injected, and with this there is often sleeplessness or delirium, no doubt due to a congested state of the membranes of the brain. In rare cases the delirium is severe and the patient violent.

The pulse is quick, varying from 120 to 150, often faster than the temperature or the general state of the child would have led one to expect ; the temperature varies, mostly reaching 103° or 105° in a moderately sharp attack (fig. 57). The urine is scanty, high-coloured, and often contains a small quantity of albumen. In the course of a few days, perhaps by the end of the third or fourth, the attack has reached its height, and the symptoms begin to decline. The rash gradually fades, the temperature falls, the evening rises being smaller and the morning remissions more marked ; the tongue cleans, the fauces are less injected, and the appetite returns. By the end of the first week the temperature has reached normal ; any feverishness

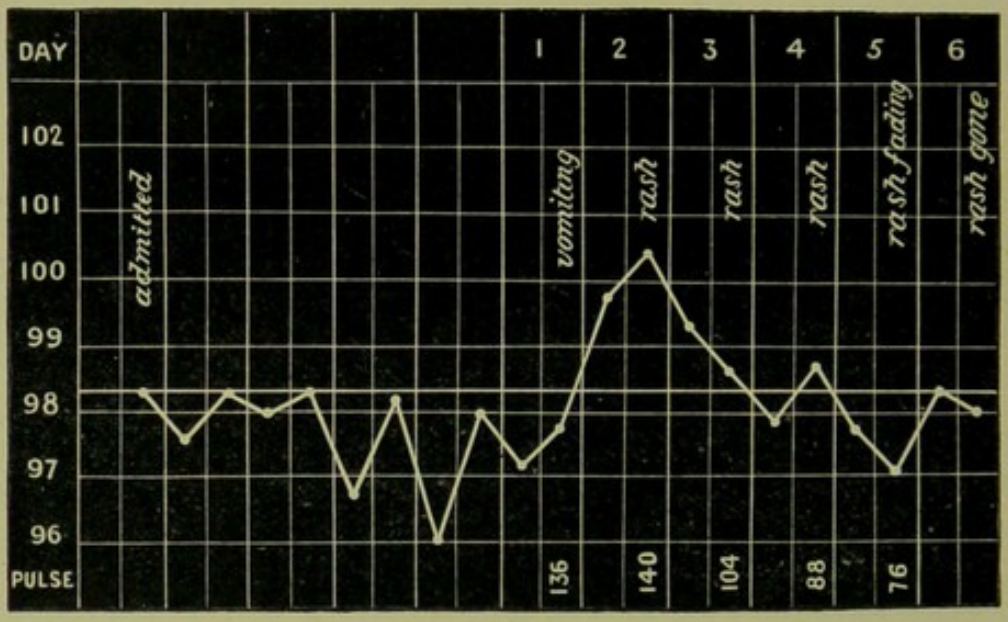

Fig. 58.—Temperature Chart of a Mild Scarlet Fever. B. W., aged 3 years. Attack contracted in scarlet fever ward.

which continues after this suggests some complication, the commonest being an ulcerating or sloughy process going on in the throat, inflammation of glands, and otitis. It must, however, be added, that attacks of scarlet fever are extremely unequal, and no two cases are exactly alike.

Mild Scarlet Fever.—In some cases the premonitory symptoms are absent or the fever is only slight and easily overlooked, and the first thing to call attention to the attack is the rash. It not unfrequently happens, even in hospitals where the children are under observation, that the discovery of a rash is the first thing noted. The child may seem to be in its usual health, make no complaint of sore throat, and appear to take its meals well, with an evening rise and a morning remission of temperature, and yet be suffering from a mild attack of scarlet fever (fig. 58). The rash in such cases is rarely well marked, but if it is diffuse and punctiform and remains visible for twenty-four to forty-eight hours, the attack is unmistakably one of scarlet fever. There is usually slight tonsillitis. We have seen a few cases that

undoubtedly suffered from scarlet fever and infected others, but who never had a temperature above 99° Fahr., but had a fairly typical rash. The most difficult cases to diagnose are those where there is sore throat without rash, inasmuch as there is nothing characteristic about a scarlatinal tonsillitis.

The disease of late years has tended to occur in a milder form than was prevalent twenty or thirty years ago.

Malignant Scarlet Fever.—In some cases death occurs very rapidly, perhaps within twenty-four hours, though this is rare. The most rapid case which has come under our notice was that of a girl of 20 months.

Scarlet Fever rapidly fatal.—She was noticed not to take her dinner well, and vomited after her tea; her temperature, which had been normal in the morning, had risen

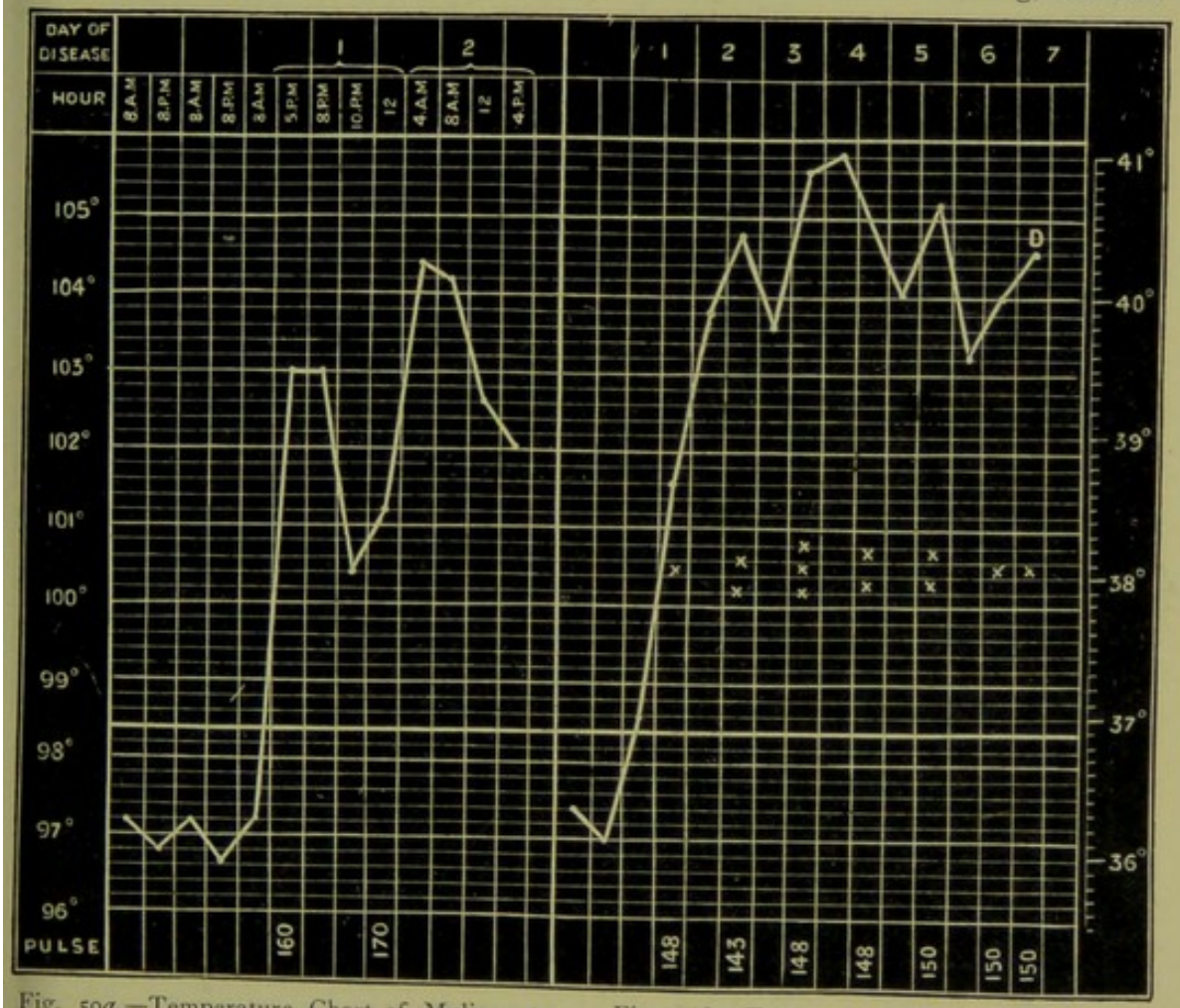

Fig. 59*a*.—Temperature Chart of Malignant Scarlet Fever. Death in twenty-four hours.

Fig. 59*b*.—Temperature Chart of Malignant Scarlet Fever. Death seventh day. *, Rash.

to 103° by 5.30 (fig. 59*a*); at 7 P.M. the pulse was 160, the tonsils were enlarged, and there was a very faint rash over the body; she was removed in the evening to the fever ward. Next morning the rash had disappeared, the tonsils were enlarged, with a patch of exudation on one of them, her pulse and respirations were rapid, but she did not seem extremely ill. She gradually became worse, the face cyanosed, respiration gasping, and pulse failing; she died soon after 5 P.M., twenty-four hours after the initial symptom of vomiting.

At the *post-mortem* one tonsil was sloughing and soft. Death in this case, as in most rapidly fatal cases, took place through the heart failing under the influence of the poison; the patients may not appear for a few hours in

actual danger, then symptoms of cyanosis and collapse set in, quickly followed by a fatal result. In the great majority of acute cases death does not take place till the fourth or the seventh day (fig. 59*b*); in these the temperature is high, perhaps 105° or 106°, there is much diarrhœa, often extreme restlessness, followed by coma; the tonsils are much swollen and covered with foul secretion, there is much nasal discharge, the glandular swelling and cellulitis are great, the neck being hard and tense to the touch; the skin is of a dull lurid colour, the extremities cold, and the heart gradually fails. If life is prolonged for a few days the tonsils and soft palate slough and the lungs become the seat of septic pneumonia. In another class of cases in which life is prolonged to the end of the second or third week a condition of **septicæmia** is set up. The tonsils ulcerate, sloughy patches appear on the fauces, the glands become enlarged and brawny, the nasal mucous membrane discharges a purulent secretion, and the conjunctivæ become affected; the temperature is remittent but continues high, the urine albuminous; pus wells out from both ears, the child gradually wastes, and dies in the course of ten or fourteen days. At the *post-mortem* there are found extensive sloughing about the fauces, pleuro-pneumonia, and large hæmorrhagic kidneys with minute abscesses. In some cases the temperature remains high during the second or third week without any local lesion being discoverable to account for it. In all such cases the lungs should be carefully examined, and the possibility of some septic inflammation going on in the kidneys should be borne in mind.

Prognosis.—A guarded prognosis must always be given in the case of young children, the throat complications in these being generally serious. The tonsils are apt to slough, and they have so little power to get rid of the foul secretion which rapidly forms in the pharynx and nose that they are extremely liable to pneumonia from extension from the pharynx and glandular inflammation. Diarrhœa is always a serious symptom; when present at the onset it points to a sharp attack; in the later stages it is also of evil augury, and if a marked symptom it usually presages a fatal result. Drowsiness at the onset and during the course of the attack is an unfavourable symptom, as it usually accompanies a high degree of fever and a severe course. In all cases where the temperature is maintained during the second or third week the prognosis must be exceedingly guarded, and the possibility of a fatal nephritis supervening must be borne in mind.

Complications and Sequelæ.—Many of these have already been referred to:

(1) The **tonsils** may become deeply excavated, the soft palate may slough, a small hole appearing through the velum, to be followed perhaps by an almost entire destruction of the soft parts; in the rare cases where recovery follows, cicatrisation and deformity of the soft palate are the result. The inflammation may spread to the epiglottis and larynx, and croupy symptoms become so urgent that tracheotomy is required. The fauces and larynx may become the seat of false membrane. In rare cases the ulcerating process in the throat may reach and enter the internal carotid or jugular vein and death follow from hæmorrhage.

(2) The **nasal and conjunctival mucous membrane** may be the seat of inflammation or a fibrinous exudation. A chronic discharge from the nose and a consequent eczematous condition of the upper lip may be left after the fever.

(3) **Otitis.**—The inflammation may spread along the Eustachian tube to the middle ear, and pus be formed in the tympanic cavity, which finds its exit by perforation of the membrane. This may happen during the fever or during convalescence. We have known it occur as early as the fourth day, in other cases when convalescence is well established. Suppuration in the tympanum is one of the common causes of a continued elevated temperature after the disappearance of the rash ; the child may suffer very little pain, and the presence of pus in the external meatus or staining the linen may be the first thing to call attention to this complication. At other times the child will put its hand to its ear and frequently shake its head, as if to get rid of some source of irritation. Pyæmia and abscesses in the lungs may follow if thrombosis of the lateral sinus occurs.

(4) The **cervical glands** frequently become enlarged and suppurate, either during the course of the fever or when the child is convalescent. In some cases, more especially in weakly children, much sloughing may go on about the neck, deep ragged ulcers being formed, exposing the large vessels ; fatal hæmorrhage may occur from the latter.

(5) **Broncho-** or **pleuro-pneumonia** occurs very frequently during the second week, and is due to extension downwards of the lesion from the throat. Pneumonia followed by empyema may take place during convalescence.

(6) **Synovitis and Rheumatism.**—The joints are apt to become swollen and tender at the end of the first or beginning of the second week ; those most frequently affected are the wrists and small joints of the hand, whilst sometimes the synovial sheaths of the tendons at the back and in the palms of the hands are attacked. The knees, ankles, soles of the feet, elbows, and joints of the cervical vertebræ may be affected. Movement of the affected joints causes pain, and they are mostly swollen, red, and tender. The affection is rarely severe, being fugitive, and seldom returning to the same joint. The knees sometimes remain swollen for some weeks from effusion into the joints. The cases complicated with synovitis are usually severe, though exceptions occur. Peri-endocarditis occurs much less frequently than in the ordinary form of rheumatism. Synovitis sometimes occurs in association with nephritis during the second week. Attacks of true rheumatism are apt to occur during convalescence, but such are more common in young adults than in children ; these attacks differ in no particular from ordinary rheumatism, the heart being frequently involved. An attack of scarlet fever during convalescence from rheumatism not infrequently causes a relapse.

Between the years 1880 and 1897, inclusive, 103 cases of synovitis occurred in the 2,840 patients treated at Pendlebury for scarlet fever (3·5 per cent.). The following table shows the frequency of this complication in boys and girls at various ages.

	Boys			Girls		
Age in years	Cases of S.F.	Cases of Synovitis	Per cent.	Cases of S.F.	Cases of Synovitis	Per cent.
0–2	70	1	1·4	82	3	3·6
2–5	481	14	2·9	489	11	2·2
5–10	628	21	3·3	686	39	5·6
10–14	174	2	1·1	230	12	5·2
Total	1353	38	2·8	1487	65	4·3

It will thus be seen that joint affections in scarlet fever are more common in girls than in boys, in the proportion of 3 to 2 relatively. According to the course of the affection this complication of scarlet fever may be divided into *regular*, *irregular*, and *complicated synovitis*.

Regular Synovitis.—Seventy of the 103 cases of synovitis ran a regular course, passing off in 53 instances in from two to six days, and only lasting beyond ten days in 4 cases. In 41 of these regular cases the synovitis came on before the end of the first week, and in 62 before the eleventh day of the scarlet fever. The joints involved varied greatly, but in 22 instances the hands and wrists only were affected, and in 28 other cases these same joints, along with others, were tender and swollen. The frequency with which the other joints were affected, either alone or as part of a multiple synovitis, was knees 19, ankles 13, elbows 10, shoulders 8, feet 6. Pain and stiffness were felt in the back and neck by 9 patients.

The condition of the sounds of the heart in these regular cases was noted as normal 53 times. A temporary apex systolic bruit developed in 15 cases, from the fifth to the twelfth day of the fever, and persisted varying lengths of time from two days to nine weeks, but usually for about seven to ten days. In two instances a bruit was present when the case left the hospital. As a rule no exacerbation of temperature was noticed to be coincident with the onset of the synovitis. In 50 cases the scarlet fever pyrexia was prolonged beyond ten days, though it did not often rise above 102. All these regular cases recovered.

Irregular Synovitis.—In addition to the above cases of regular synovitis there were 14 (10 girls and 4 boys) which ran a more or less irregular course, though all recovered eventually. In 6 cases the joints were not affected until after the eighteenth day of the fever, and in 3 instances the pains were in the limbs and not limited to the joints. In 6 cases the synovitis persisted for periods ranging between twelve and sixty-one days, and the pyrexia in the majority of the cases was prolonged to between fourteen and 130 days. Three cases were considered to be true rheumatism. A temporary systolic murmur developed in 5, and a permanent bruit in 3 of these cases.

Complicated Synovitis.—The remaining 19 of the 103 cases were complicated by serious affections which terminated fatally in 11 instances. Thirteen cases were below five years of age, and of these 8 died. The complications which ended fatally were pyæmia 3, septicæmia 2, cellulitis 1, malignant scarlet fever 1, scarlet fever anginosa 1, meningitis 1, and nephritis 2; those which recovered were nephritis with suppuration in foot 1, purpura hæmorrhagica 1, pneumonia and empyema 1, acute epiphysitis of the right femur 1, and synovial suppuration 4. Pus developed in one or other joint in 12 of the cases.

(7) **Pyæmia and suppuration in the joints** occasionally occurs; any joint may be affected. Such cases are mostly fatal, though not invariably so.

(8) **Pericarditis** or **endocarditis** may occur without joint pain or nephritis being present.

(9) **Nephritis.**—No complication of scarlet fever can vie in importance or interest with nephritis; and this condition often gives rise to much anxiety

in an otherwise mild and favourable case. The 'initial' albuminuria which frequently accompanies the febrile state in the first week of the disease is not of much importance, as it is usually temporary and not due to any important lesion of the kidneys, and quickly disappears as the fever subsides towards the end of the first week. Apart from this febrile albuminuria, there are two forms of nephritis which, it is important to bear in mind, are distinct from one another, though they have frequently been confounded, and much confusion has arisen in consequence. They may be distinguished as (*a*) Septic nephritis, (*b*) Post-scarlatinal nephritis.

(*a*) **Septic Nephritis.**—In the severe forms of fever complicated with sloughing tonsils and soft palate and much glandular swelling the urine is albuminous, frequently highly so ; but it rarely contains blood in appreciable quantities or casts ; there are indeed no renal symptoms, or if there are they are so masked by the general condition of septicæmia that it is difficult or impossible to differentiate them. There is no dropsy or uræmic phenomena. If the patient survive till the end of the second or third week, a more or less typical pyæmic kidney is found at the *post-mortem*. The kidneys are enlarged, frequently very much so ; they are flabby, of a cream colour on the surface, with minute hæmorrhages and usually minute abscesses. On section the cortex is of the same cream colour mottled with injected vessels and points of fluid or inspissated pus. This condition of kidney forms part of a general condition of pyæmia, and is chiefly of interest in demonstrating that the kidneys suffer during the course of the disease itself, and consequently in cases which recover are in a condition which predisposes to inflammatory affections during convalescence.

(*b*) **Post-scarlatinal Nephritis.**—This is the form which is liable to supervene during the third or fourth week, and which is known generally by the name of scarlatinal nephritis. There can be little doubt that the kidneys are actively engaged during the course of the fever itself, and for the succeeding week or two, in carrying off the toxines formed during the fever, and are in an irritable condition and prone to take on inflammatory action, in the same way as the bronchial tubes and lungs are left in an irritable condition after measles and are apt to suffer from inflammatory attacks : and while it is possible in both cases that nephritis and pneumonia may supervene in spite of the greatest care, yet any chill or exposure to cold is extremely likely to produce or determine such an attack. The number of those who suffer varies in different epidemics, and also according to the season and the care which is taken of them during convalescence. Taking an average of several years, we find about 6 per cent. of our hospital patients have suffered from post-scarlatinal nephritis. Patients who have had the primary fever both in a severe and mild form may be attacked ; in the former class of cases, especially where there has been no period of apyrexia, it is mostly fatal ; in the latter class—at least in hospital—it is rarely so fatal. The prognosis is usually bad in those cases where the temperature continues elevated during the second week, in consequence of severe pharyngeal or glandular inflammation, and which contract nephritis in the third week, the latter complication supervening on the throat lesions. From the fourteenth to the twenty-sixth day is the commonest time for nephritis to supervene, but as it usually begins insidiously, traces of albumen being present for a

few days before blood and larger quantities of albumen appear, it is often impossible to determine the exact date of the commencement of the attack. In well-marked cases it is noticed by the attendants that the child which, since the subsidence of the fever, has been practically well, becomes restless, feverish at night, thirsty, has a quick perhaps hard pulse, and passes small quantities of dark-coloured urine. If particular attention has been paid to the urine, it will probably have been found that it has been diminishing in quantity, and has contained small quantities of albumen for a few days prior to the dark urine being passed. Sometimes puffiness about the face precedes the appearance of albumen in the urine. The urine may be dark red, but usually it is 'smoky,' and on allowing it to stand in a tall glass deposits a dark flocculent precipitate, not unlike the flocculi in beef tea. This precipitate consists of blood corpuscles, epithelium and fibrinous cylinders which have

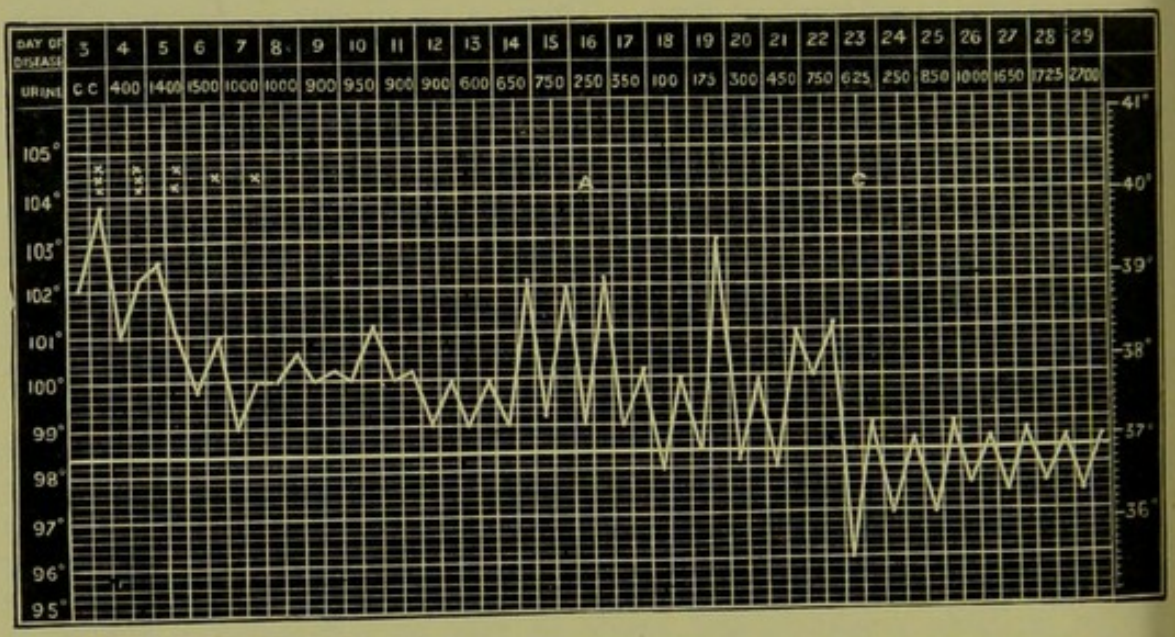

Fig. 60.—Temperature Chart of Post-scarlatinal Nephritis. *, Rash; A, albumen; C, uræmic convulsions. Recovery.

been formed in the tubules and consequently may contain corpuscles and epithelium. The supernatant liquid contains a variable amount of albumen, sometimes becoming almost solid on being boiled; more often a half to a sixth of its volume of coagulated albumen precipitates by boiling. It may contain no blood. For a few days the urine continues dark and albuminous and of high specific gravity (1020–1025), and diminished in quantity, perhaps only a few ounces per diem; the face becomes pale and puffy, there may be œdema of the feet and scrotum, and more or less vomiting; then, perhaps, at the end of a week an improvement takes place, large quantities of urine are passed with diminished quantities of blood and albumen, and the child becomes again convalescent, though the urine may contain some albumen for weeks or even months, and the anæmia may continue for a like period. On the other hand, in a minority of cases the nephritis is prolonged and symptoms of **uræmia** may supervene, the pulse becomes slow, the temperature subnormal, the tongue dry and brown. Often

there is frequent vomiting, sometimes diarrhœa (see fig. 60); hæmorrhages may take place from various surfaces, especially the nose; there may be amaurosis, muscular twitchings, and perhaps general convulsions.

In all cases of nephritis particular care should be taken to examine the heart, inasmuch as a fatal result is more often brought about in consequence of cardiac failure than directly through uræmic convulsions. One of the effects of nephritis is to raise the tension in the blood-vessels, and this, if continued for any considerable time, is followed by **dilatation of the heart,** the tension in the arterial system in combination with malnutrition being responsible for this result. Another not uncommon result is **endocarditis** or **pericarditis,** and possibly **embolism.** The possibility of **death occurring suddenly** during the course of an acute or subacute nephritis must always be borne in mind; the patient may appear to be doing fairly well, perhaps sitting up in bed and playing with his toys, when an attack of dyspnœa comes on, the face becomes livid or pallid, the pulse disappears, and death quickly takes place. Sometimes attacks of dyspnœa may precede by a day or two the fatal event. Such cases have been often described as being fatal in consequence of œdema of the lungs, the dilatation of the heart having been overlooked; œdema of the lungs is present, but it is secondary to the cardiac failure. The pathology of such cases is tolerably clear; acute nephritis, running a very rapid course in consequence of the kidneys being almost completely choked, usually terminates with uræmic phenomena; if it runs a slower course, the tension in the blood-vessels throws additional work upon the heart, the left ventricle struggles with the increased work thrown upon it, the blood becomes impoverished and nutrition impaired, the cavities of the heart dilate, and finally that organ gives way, often suddenly at the last. The amount of dilatation present should be carefully noted by the position of the apex beat, and the increase of impaired resonance.

Pneumonia, pleurisy, and **peritonitis** may occur in the course of nephritis, and pleuro-pneumonia, ending in gangrene, may take place. In a few cases the attack is exceedingly acute, the temperature being high, 104° to 105°, the tongue dry and brown, the urine containing much blood and albumen, and death rapidly taking place. In such cases there is usually coincident pneumonia. In a large number of cases the attacks are mild, a small quantity of albumen, perhaps without any blood, making its appearance during the third week, the face becoming puffy and the child anæmic, the albumen disappearing in the course of a week or two, and the child after a prolonged convalescence slowly regaining its health.

Total suppression of urine is not common, a few ounces daily being usually passed; in one of our cases only three ounces of pale albuminous urine was passed in the four and a half days which preceded death; there were no convulsions. Life is rarely prolonged beyond the fifth day if there is total suppression. Death takes place in many cases without convulsions; in others convulsions may supervene and recovery follow; the convulsions are not dependent only upon retained urinary products, but also upon the stability of the nervous centres, which differs markedly in different children.

Diagnosis.—The diagnosis of mild cases of scarlet fever often presents extraordinary difficulty, and yet the importance of making a diagnosis is

often great. In hospital or dispensary practice cases have mostly to be treated as infectious or non-infectious ; as there is often no opportunity of taking a middle course, they must be sent into a fever ward with the risk of contracting the disease if the diagnosis is at fault, or of infecting others if treated with non-infectious cases. In private practice among the wealthier classes it may be possible to isolate all suspicious cases, but such are always a source of anxiety. It cannot be too forcibly impressed that diagnosis in some instances is impossible, and that errors will occasionally be made by the most experienced, though at the same time it must be acknowledged that mistakes are more frequently made through carelessness than from any want of knowledge. The most characteristic phenomenon is of course the rash, and if this is well marked, being diffuse and punctiform, and lasting at least twenty-four to forty-eight hours, even in the absence of tonsillitis or a high temperature, there can hardly be a doubt about the diagnosis. Mild cases of scarlet fever may occur with a temperature never rising above 99° F. A measles rash can hardly be taken for it, except in those cases where the rash is patchy about the limbs, but in these it is usually diffuse and characteristic on the trunk. A scarlet fever rash, however faint, usually lasts for twenty-four hours at least, in this respect differing from erythematous rashes, which may be present in the evening and gone before morning. It is always well when called to see a rash by artificial light to wait for daylight to give a definite opinion. It is important to bear in mind that a rash more or less resembling scarlet fever occurs in some cases of pyæmia and septicæmia, also in diphtheria (which, when it occurs, is septic), influenza, and rubella. A red rash is sometimes caused by belladonna, arsenic, and quinine ; also in some cases of enemas of soap and water and after the injection of antitoxin for diphtheria. To distinguish between scarlatinal and simple tonsillitis is mostly impossible in the absence of a rash ; the 'strawberry' tongue is generally absent in cases unattended with a rash. Cases of tonsillitis where the nasal mucous membrane becomes involved, or where there is excessive exudation on the fauces or sloughing of the soft palate, if diphtheria can be excluded, are probably scarlatinal. If the lymphatic glands at the angle of the jaw become enlarged and tender, scarlet fever is probable. Acute nephritis occurring after an anomalous rash or sore throat makes it practically certain that the primary attack was scarlet fever.

Much importance has been attached in the past to desquamation as a means of diagnosis. Now while a typical case of scarlet fever desquamates freely, the epidermis separating in flakes from the skin of the neck, trunk, fingers, toes, &c., some of the milder cases hardly desquamate at all, the skin only becomes slightly roughened ; while on the other hand cases of pneumonia, enteric or any febrile disease will desquamate more or less. The absence of desquamation does not prove that there has been no scarlet fever, and the presence of more or less desquamation by no means proves that there has been scarlet fever. The presence of desquamation taken in conjunction with a history of a sore throat, or associated with nephritis, will materially help the diagnosis. Unfortunately, at the present time no bacterial diagnosis is available.

Morbid Anatomy.—In the bodies of those dying during the first few days of the disease, no gross lesions except those in connection with the throat

can be detected. One or both tonsils are ragged, perhaps sloughy, the glands are enlarged, perhaps beginning to suppurate, the internal organs are gorged with blood, there are minute hæmorrhages on their surfaces. The heart, liver, and kidneys are pale, the Peyer's glands are swollen, and the mucous membrane of the intestines injected. If the child has survived a week or more, usually septic changes are present; the lungs are in a condition of pneumonia more or less advanced, which is secondary to the sloughy throat and the glandular inflammation and cellulitis in the neck; marked changes are also found in the kidneys if the child has survived two or three weeks. In typical cases these are much enlarged, flabby, pale on the surface, with minute hæmorrhages and injected capillaries; on section minute abscesses may often be seen at the base of the pyramids. On microscopical examination large tracts of kidney substance will be found infiltrated with leucocytes, and micrococci (*Streptococci pyogenes*) will be detected in the capillaries. If death has been the result of post-scarlatinal nephritis, in the early stages the kidneys will be gorged with blood and deeply stained in consequence of the tubules being choked with casts and the capillaries distended to their utmost. In a later stage the kidneys are enlarged and pale, dripping urine on section, and on close examination it will be noted that the Malpighian bodies are enlarged and pale, standing out prominently like grains of sand dusted on to the cortex. On microscopical examination it will be found that the glomeruli are enlarged in consequence of containing an increase in the number of their nuclei, in some cases fibrinous thrombi, and in a later stage being surrounded by a fibro-cellular growth which completely strangulates them and produces complete obstruction. When nephritis is present the cavities of the heart are found dilated; sometimes there is peri-endocarditis, peritonitis, or pneumonia.

No specific micro-organism has been isolated with certainty in cases of scarlet fever. Various observers have isolated a diplococcus from the fauces of patients with scarlet fever, and Class, of Chicago, claims to have inoculated pigs by means of this organism and produced a disease resembling scarlet fever. It is certain that in scarlet fever there is a mixed infection of streptococci of various varieties.

Treatment.—As soon as scarlet fever is suspected, means must be adopted to prevent the spread of the disease in the household by isolating the patient as far as it is possible to do so. It is obviously impossible to effect this in the smaller class of houses, and indeed even in large and well-appointed houses nothing like perfect isolation can be carried out, the removal of the patient to a fever hospital being in all cases the wisest course when it can be managed. To diminish risks of infection as far as it is possible, a room on the upper story should be secured, or, still better, the whole of the top landing should be devoted to the patient and those of the household who are in attendance on him. Every article in the room which can be spared, especially curtains, carpets, and other woollen goods, should be removed, only retaining such as are required for immediate use. The bedding should consist of a horsehair mattress and warm but light coverings. The sick-room should be large and airy, the more cubic space the better, provided it can be kept at a moderate temperature, and all draughts avoided. The attendants on the sick should not mix with the other members of the household, but devote

themselves entirely to the work of the sick-room. If there are children in the house who have not had scarlet fever, the question will arise what is best to be done with them. In the first place, it is clear that they must not attend school or mix with other children ; the question of sending them away must depend upon various circumstances. Remaining at home unquestionably involves a risk, and at any time so long as the house remains infected they may be attacked. Sending them away involves the risk of their being incubating at the time, and of conveying the infection to another household. The best course, if it can be taken, is to send them away to some household where there are no children, and whence they can be brought back if they are attacked after removal. To send them away to distant seaside lodgings could not be sanctioned under any circumstances ; it is better to run the risk of infection at home, than have them sicken away from home among strangers, and become the source of an outbreak elsewhere.

As soon as the diagnosis of scarlet fever is made the child should be put to bed, and remain there as long as there is fever, or, still better, for three weeks, though this, in mild cases especially, is difficult to enforce in private practice. In hospital practice three weeks in bed is the ordinary rule ; the object of this being to obviate the risk of catching cold, and it is better to be over-cautious in this respect. The diet for the first few weeks should consist largely of fluids ; it is most important that the digestive organs should not be over-taxed and that the excretory apparatus, especially the kidneys, should be active, inasmuch as the waste products are increased during fever, and the poison also passes out of the body in this way. During the febrile period, milk and barley water or milk and soda water is the best food that can be given ; feverish children rarely care for beef tea, and all jellies and meat extracts are unnecessary. One or two pints of milk suitably diluted during the twenty-four hours will be quite sufficient ; if more is attempted, sickness may not unlikely be produced. Daily sponging with tepid or cold water, to which some Condy's Fluid or other deodorant is added, is of much service. Hot baths are useful during convalescence, but the bath must be brought to the patient's bedside. Whilst desquamation is proceeding, after the spongings or warm baths the skin should be gently anointed with glycerine and starch, weak carbolic oil, or ung. lanolini with carbolic acid or eucalyptus.

We have no belief whatever in the possibility of rendering the patient entirely free from infection by anointing the skin. We believe the infection of the disease is given out from the nose and throat rather than by the skin.

The application of topical remedies to the throat and nasal mucous membrane is frequently a matter of great difficulty in children, and much adroitness and firmness will be often required. In mild cases where there is only a slight congestion and swelling of the tonsils, no local treatment need be attempted, except perhaps the sucking of pieces of ice or iced milk. In older children the throat spray may be used if the patient is sufficiently docile, but young children are almost sure to offer a certain amount of resistance when their throat is being attended to, and under these circumstances spraying is useless, as the spray is rarely properly directed. Here mopping by means of a large paint brush or lint secured at the end of a piece of stick will have to be resorted to. Irrigating the mouth and fauces

is useful in clearing away the mucus and septic matters which are apt to accumulate. If there is free discharge of purulent matters from the nose, gentle irrigation is of undoubted value, and we think no harm can be done as some have stated.

In selecting an antiseptic which is to be used freely as in irrigating or spraying, it is well to remember that some of it may be swallowed, and consequently it should not be very poisonous, while for mopping or painting a caustic or more active poison may be used. In severe cases the frequent cleansing of the throat is a matter of great importance and one upon which we are inclined to lay much stress ; it is, however, often attended with exhausting struggles for the patient, and can only be done by properly trained nurses, the friends rarely having the necessary skill or firmness. The actual antiseptic selected is of less importance than the manner of using it, the object being to prevent the mucus and products of decomposition from accumulating in the fauces and being drawn into the air passages or being absorbed. For syringing the nose and fauces, a warm solution of boric acid (1 in 20), a weak solution of iodine (2 drachms of the tincture of iodine to 10 ounces), or solution of liq. sodæ chlorinatæ (1 to 20), answer as well as any, and are not disagreeable. For mopping, a saturated solution of boroglyceride in glycerine, a saturated solution of salicylic acid in sp. vini rect., or glyc. acid. carbolici (1 in 10) may be used with advantage ; it is well to clear away the mucus and purulent discharge before mopping the fauces.

There is but little reason to believe that the course of the fever is much influenced by internal remedies ; in mild cases a saline such as citrate of potash is useful, giving it in doses of 2 to 5 grs. every four or six hours ; chlorate of potash is of doubtful value. In more severe cases the treatment must be adapted to the symptoms, stimulants being usually required on account of the depression which is so often present. Carbonate of ammonia, digitalis, cinchona bark, separately or in combination, are the most useful drugs. Diarrhœa, if excessive, must be kept in check by opium enemata ; if moderate, it had better be left alone. Sleeplessness, headache, delirium, are best relieved by an ice bag to the head and full doses of bromide. We do not believe that biniodide of mercury or other mercurial salt is of the slightest use in modifying the severity of the attack. It has failed entirely in our hands. (F. 46, 47.)

When the temperature continues high, being 104° to 105°, quinine in 1 to 3 gr. doses, and repeated packs, so as to get the skin to act, have appeared to us the most useful form of treatment. The child should be wrapped up in a sheet wrung out of water at 60° and rolled up in a blanket for an hour. This must be repeated if the temperature continues high. Cold spongings are also useful. In the early stages especially, graduated baths are of great value in reducing temperature and soothing the patient. The patient should be put into a bath of 90° and the temperature of the bath gradually reduced by the addition of cold water. In the later stages, especially when there is blueness about the lips and the heart flagging, more care is necessary, and we have seen serious depression produced by a too long use of a cold bath. Phenacetin and antipyrin are not suitable for serious cases, on account of the depression they are apt to produce.

The injection of anti-streptococcic serum has been resorted to by Marmorek in cases of scarlet fever of the septic type, *i.e.* sloughing throat and glandular enlargement, and more recently by Aronson. The dose of Aronson's serum is 50–80 cc., but it cannot be said that any very satisfactory results have been obtained.

Moser prepares an anti-streptococcic serum which has been used by Escherich in Vienna with good results, in doses of 200 cc. injected subcutaneously. It is chiefly given in the severe or malignant cases, and it is claimed for it that in a few hours the temperature falls to normal without any collapse occurring. The serum is prepared at the Vienna Serum Institute, by injecting into horses a bouillon culture made from the blood of fatal cases of scarlet fever. These injections are repeated week by week for many months before a satisfactory serum is obtained. (Moser, 'Jahrbuch für Kinderheilkunde,' 1903.) A polyvalent anti-streptococcic serum is prepared by Dowson at the Wellcome Research Laboratories, which has been used by Knyvett Gordon with some success.

It must, however, be admitted that the treatment of the severer forms of scarlet fever is disappointing and often disheartening ; in spite of the most devoted nursing, stimulants freely given, antipyretics, liquid nourishment of all kinds, antiseptics to the fauces, they go from bad to worse, apparently uninfluenced by all that has been done for them. On the other hand, it sometimes happens that cases which at first are most unpromising are apparently saved by careful nursing and appropriate treatment, and this fact should encourage every effort. In rare instances sloughing fauces will mend, pneumonias clear up, temperatures which have been high for two or even three weeks gradually fall, and complete recovery ensue.

The otitis which so commonly occurs is usually suppurative from the first ; the tympanic membrane quickly gives way and a free discharge follows. Earache should be treated by the instillation of warm camphorated oil to which a drop or two of laudanum has been added, and hot fomentations may be applied externally. A single drop of glyc. acid. carbolici (B.P.), carefully dropped into the ear so as to reach the membrane, usually gives relief. If, on examination with the speculum, pus is seen bulging the membrane, an incision should be made ; but nature usually anticipates the surgeon in this matter, and so quickly that the operation is seldom necessary, except in those cases where the membrane fails to give way early. The pus which forms in scarlet fever appears to penetrate the membrane more quickly than the pus formed in non-febrile cases. When a discharge exists, care should be taken to keep the ear syringed out, and some antiseptic powder, such as iodoform and boric acid, blown in. The after-treatment of chronic otitis need not be gone into here.

The preventive treatment of post-scarlatinal nephritis consists in the greatest care being taken during the second and third weeks to avoid cold and to keep the skin acting, and to avoid a stimulating diet and any overfeeding. The child should be sponged daily or bathed, provided there is no risk of chill ; the diet should be chiefly fluid, milk, light puddings and sops, and the bowels should be acted upon if necessary by laxatives or salines such as tartrate of soda or Glauber's salts. On the appearance of albumen a smart purge of senna or jalap should be given, and the child dressed in a

flannel night shirt and placed between the blankets, salines such as citrate of potash, liq. ammon. acet., or tartrate of soda, being given. The diet should consist entirely of barley water and of milk, or at any rate of fluids. Hot packs, a blanket wrung out of hot water being used, or hot vapour baths given by means of Allen's apparatus, or warm baths, are always useful in acting on the skin and drawing away the blood from the kidneys, and so relieving the inflammatory congestion present. The smaller the quantity of urine passed the more vigorous should be the packs or baths. Ten grains of jaborandi leaves, made into an infusion with hot water, or one-tenth of a grain of nitrate of pilocarpine subcutaneously, may be given before the packs once or twice a day. Children bear pilocarpine well, but its use requires care on account of the cardiac depression it is apt to produce. Poultices to the loins should be applied between the packs. Dry cupping seems sometimes to be useful and may be tried. If the kidneys fail to act, and no urine or only a small quantity is secreted, large enemata of warm water will sometimes give relief, urine being passed as the enema is being expelled.

During the course of a nephritis the condition of the heart must be carefully watched, as also must any tendency to muscular twitchings about the face or hands. Any attacks of dyspnœa or evidence of cardiac dilatation must be met by the administration of digitalis, two to five drops every two hours. Solution of nitro-glycerine in drop doses, inhalation of chloroform, or nitrate of amyl may be tried if convulsions supervene.

Quarantine.—Six weeks at least—better two months—reckoning from the first day of the fever should elapse before a child convalescent from scarlet fever can be allowed to rejoin his companions or go to seaside lodgings; and not then if the desquamation is incomplete or there is a discharge from his nose or ears. In so important a matter as discharging a convalescent scarlet fever patient, it is wise to err on the side of caution.

Experience shows that the scarlatinal infection sticks to the patient with extraordinary tenacity, as the number of 'return' cases to infectious hospitals show. Putting aside the question of desquamation (which has probably been too exclusively regarded) and also of purulent discharge of ears, it seems certain that the infection clings to scarlatinal patients for a considerable period, and this in spite of many carbolic baths and much head washing. It seems likely that the scarlet fever micro-organisms remain in the convalescent's nose and throat long after he is apparently well, and if he mixes with his fellows he may infect them. It is not wise to send a patient direct from the sick-room or hospital ward to mix with others. Wherever it is possible there should be a convalescent ward, and the patient should spend many hours in the open air before being looked upon as safe.

The question of length of quarantine in scarlet fever is one which has given rise to a considerable difference of opinion. It is certain there is a good deal yet to be learned about the organism of scarlet fever, and the conditions under which the fever prevails as an epidemic. It appears that at times children convalescent from scarlet fever who have been well looked after and tended, who are free from nasal or aural discharge, are after the lapse of six or eight weeks the means of infecting others. On the other hand, Dr. Jos. Priestly records that in consequence of an outbreak of

small-pox at Leicester, 120 children in various stages of convalescence from scarlet fever were sent to their homes, and no secondary cases occurred at any of these homes! In spite, however, of such an experience, it is wise to give ample quarantine after scarlet fever, and not allow children convalescent from this disease to be sent to the seaside or to school before two months have elapsed, and they are quite free from nasal or aural discharge.

Measles

Measles is an acute infectious disorder characterised by coryza, cough, and fever in the prodromal stage, followed by a peculiar papular eruption on the face and body.

Measles, like whooping cough, prevails in widespread epidemics, though its epidemics are of shorter duration; but sporadic cases are always occurring in large centres of population. This epidemic prevalence occurs in large cities every eighteen months or two years, though the epidemics differ very much in their extent and fatality.

When once the disease enters a household, or indeed a city street or alley, hardly any of the inhabitants escape except perhaps the young infants, and those protected by a previous attack; the chief sufferers are young children. When introduced into the ward of a children's hospital the majority of those who are not protected will probably be attacked. Infants under six months appear less susceptible than children over that age; though infants are occasionally born with the rash of measles on them.[1] Communities removed from frequent contact with civilisation, and where there has been no epidemic prevalent for some time previously, invariably suffer severely when the poison of measles is introduced, adults being affected as well as children. The most notable instance of this in recent times is the epidemic of measles in the Fiji Islands in 1875, which raged for four months, 40,000 natives dying out of a population of 150,000,[2] equal to upwards of one in every four of the population, whereas in London in 1886, which may be taken as an average year, the deaths from measles were five in every 10,000 living (at all ages). The same virulence of an epidemic may be seen in a lesser degree in populations, more especially among children, in villages or isolated places where there has been no epidemic for some time previously. The susceptibility to measles is exceedingly great in unprotected subjects; thus Biedert,[3] in a small epidemic in an isolated village, found only 14 per cent. of the children who were unprotected escaped after being exposed to the infection. In the Faroe Islands under similar conditions in two epidemics only 4·5 per cent. and 1 per cent. escaped.[4] The same experience obtains in schools and in the wards of children's hospitals, where, if a child has been admitted incubating and remains till the rash appears, an epidemic follows, which it is difficult to stop until nearly all of the unprotected have been attacked. The epidemics are independent of season, and occur in winter as in summer.

[1] Helm, *Medical Chronicle*, May 1890.
[2] Corney, quoted by Collie.
[3] *Jahrbuch für Kinderheilkunde*, vol. xxiv. p. 94.
[4] Madsen, *Panum*.

The disease, like most other specific fevers, spreads by contagion, but the nature of this has not been satisfactorily determined, though micro-organisms have been obtained from the breath and secretions of patients suffering from measles by A. Ransome, Braidwood and Vacher, and Canon and Pielicke. We have frequently made cultivations of pus cocci from the blood of patients with measles, and such can also be detected by staining a dried drop of blood.

The poison is apparently given off in the breath and secretions, and may be conveyed to a distance by its adhering to the clothes or person of a nurse or others coming in contact with the sick. The infection, however, appears to be more diffusible or more readily destroyed than the poison of smallpox or varicella, as rarely if ever in our experience is it introduced into a ward, except by those who were admitted incubating, it being unlike variola

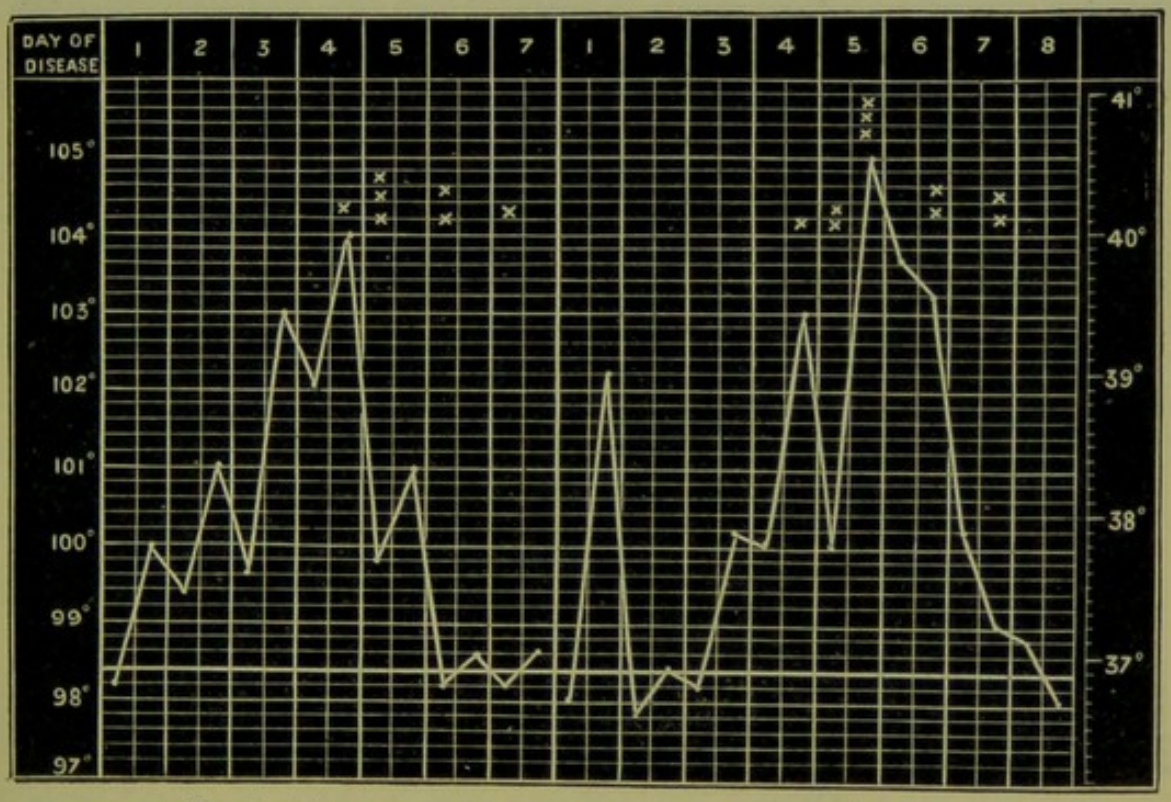

Fig. 61.—Temperature Charts of cases of Measles. *, Rash present.

or varicella poison in this respect, infection in the latter case appearing to be brought in by visitors. The infection is known to be given out from the patient very early in the attack—that is, from the first appearance of definite symptoms, as coryza and fever—but there is good reason to believe that Mr. Vacher is right in believing that measles is infectious during the incubative stage, as well as during the febrile and eruptive stages. Several instances which point strongly to this conclusion have come under our notice.

The mortality differs enormously according to the circumstances under which the attacks develop and also in different epidemics. In healthy children among the well-to-do class the mortality is small ; in the tuberculous and wasted children to be found in workhouses, hospitals, and among the

lower classes the mortality is enormous, no disease more certainly being attended with a fatal result.

J. Comby records that in the Hospice des Enfants Assistés, during the years 1882–1886, 1,575 cases of measles were treated, with a mortality of 46·2 per cent. At the Hospital des Enfantes Malades, 2,585 cases were treated, with a mortality of 40·15 per cent. Where a number of measles cases are crowded together pneumonia of a malignant type is apt to be rife. In dispensary practice the mortality is much less ; Heubner records in Leipsic 600 cases were treated in 15 years with a mortality of 6·5 per cent. Furbinger in Jena, a mortality of 8 per cent. 5,769 cases of measles were treated in the patients' homes in

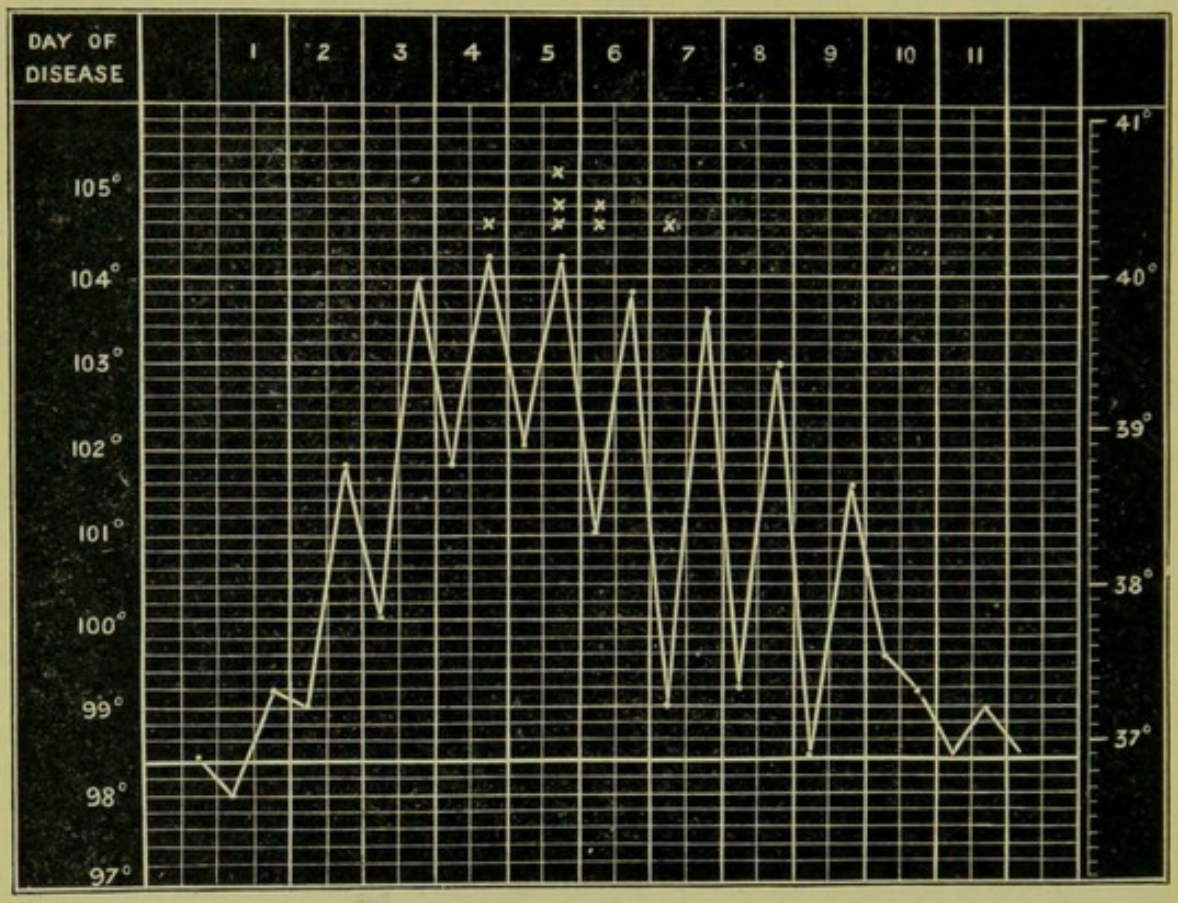

Fig. 62.—Temperature Chart of a case of Measles complicated with Broncho-pneumonia. *, Rash.

connection with the Dispensary of the Manchester Children's Hospital between the years 1886 and 1904, with 440 deaths, making a mortality of 7·8 per cent.

Second attacks of true measles are not uncommon. We know one family in which one boy has had a severe attack of measles four times, a boy and girl three times each, and one girl twice ; all these attacks were severe. In many cases where there is said to have been a recurrence of measles, one of the attacks has no doubt been rubella.

Incubation.—When inoculated this appears to be seven or eight days, when contracted in the usual way it is mostly ten to twelve days, the rash appearing on the fourteenth or sixteenth day. During this period the child is mostly in its usual health, though there may be an evening rise of temperature.

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Symptoms. Prodromal Stage.—The early symptoms are those of a feverish cold. The child sneezes, waters at the eyes, there is catarrh of the nasal membrane, with usually a hard, hacking, or perhaps croupy cough. Sometimes the symptoms are those of a catarrhal laryngitis or bronchitis. The palpebral conjunctivæ are suffused and of a pink colour from congestion of the capillary vessels. In mild cases there may be very little congestion of the conjunctiva or catarrh. The child is feverish, often acutely ill, the temperature rising in the evening a degree or two and usually falling again in the morning; this continues, though becoming increasingly marked, till the rash is fully developed. Sometimes there is a marked remission on the second or third day (see fig. 61). An examination of the fauces will show that the tonsils, hard and soft palate, are reddened, and often distinct papules or red points surrounded by a zone of congestion are visible; in the slighter cases these papules are absent. This papular rash is present some twenty-four to forty-eight hours before the rash appears on the face and trunk. Koplik has pointed out that at this stage—that is a day or two before the appearance of the external rash—small irregular spots of a bright red colour may be seen on the mucous membrane of the cheeks and inside of the lips. In a good light a 'bluish white speck' may be seen in the centre of each spot. Some observers have noted the presence of Koplik's spots in at least 75 per cent. of their cases of measles during the prodromal stage. We hardly think from our own experience they are as commonly seen as this. It is certain they may be overlooked, especially when far back and situated opposite the posterior molar tooth. Comby has called attention to stomatitis as an early symptom of measles; the gums and mucous membrane of the cheeks are red and covered in places with a thin opaque exudation. Tonsillitis is present in some cases, and earache is common in the early stages.

Eruptive Stage.—The characteristic eruption usually makes its appearance at the end of the fourth day, on the forehead, face, neck, and fauces. The child's appearance at this time is so characteristic that in well-marked cases a glance is sufficient to establish the diagnosis. The face is flushed, the eyes red and watering, there is a short cough, the forehead, nose, and cheeks are covered with crops of dusky red papules, surrounded by a zone of erythema which contrasts with the normal skin between the groups. The papules can be distinctly seen and felt, and though not 'shotty' to the touch, yet they have often a distinct feeling of hardness. The rash on the face is usually both patchy and discrete, the patches being made up of confluent papules, the latter of small groups or single papules arranged at times in small crescents or semicircles. In the course of a day or two the rest of the body is more or less covered with the rash; it is apt to be confluent with much erythematous redness on the dependent surfaces, the extensor surfaces of the arm and thigh, the back and buttocks, and more discrete or spotty on the chest and rest of the body. By the fifth or sixth day the eruption is at its height, and, beginning to fade first on the face and later on the body and limbs, is followed, especially on the face, by a fine desquamation. By the seventh or eighth day the rash has completely disappeared, leaving at most only an indefinite mottling or staining over the body. The temperature, which has probably reached 103° to 105° by the sixth day, quickly falls to normal or thereabouts, and the

headache and discomfort are gone and the child seems greatly relieved. In severe cases in weakly children the crisis may be accompanied by much exhaustion, but this rarely happens. The temperature remaining high indicates some complication such as bronchitis or pneumonia (see fig. 62).

Mild or Ill-defined Measles.—Very often all the symptoms are milder than those just described, but at the same time are perfectly characteristic. On the other hand, the attack may be so slight as to be recognised with difficulty. There may be almost an entire absence of symptoms in the prodromal stage, or a temperature only reaching 100° or 101°, the coryza and catarrh being insignificant, while the rash is represented by ill-defined and characterless papules about the neck, back of the hands, and thighs. In other cases probably the catarrh and laryngeal symptoms are well marked, the child evidently suffering from a laryngitis ; this is followed by an indefinite mottling about the neck and hands as the laryngeal symptoms abate.

Severe and Complicated Measles.—Epidemics of measles differ greatly in the severity of the individual attacks. Most of the fatal attacks are characterised by high fever, dry brown tongue, delirium, and convulsions due to an intense hyperæmia of the internal organs, more especially the lungs and brain. The heart's action is depressed, the rash ill-defined, the skin dusky, and in some cases markedly petechial. In such cases death may take place on the third or fourth day, or improvement may commence at the end of a week. In the majority of cases measles threatens life through the tendency to **inflammation of the lungs.** The lung symptoms may be prominent from the first, or the presence of pneumonia may delay convalescence, or supervene when the acute symptoms have passed away. In the former case the symptoms are those of acute broncho-pneumonia, the temperature continues high, perhaps 105° or 106°, there is marked dyspnœa, sibilant sounds are heard over the whole chest, the air does not enter the bases freely ; the rash is scanty, perhaps only an ill-defined mottling ; delirium followed by coma comes on ; the eyelids become glued together with thick semi-purulent secretion, sordes appear on the mouth, the tongue is brown and dry, and unless improvement takes place the child sinks.

Instead of broncho-pneumonia, the symptoms may indicate acute capillary bronchitis with emphysema and collapse of lung. The dyspnœa may become urgent and threaten life by asphyxia, or the pneumonia may be of the croupous type with or without pleurisy.

Catarrhal or Membranous Laryngitis is not uncommon in the pre-eruptive stage, or as the eruption is receding. Tracheotomy may be required if the obstruction to respiration becomes sufficient to threaten life, but it must be borne in mind that an amelioration of symptoms generally takes place when the rash appears. In those cases attended with membranous exudation the laryngitis generally follows rather than precedes the eruption. **Ophthalmia** frequently occurs in anæmic and unhealthy children ; corneitis and corneal ulcers may also be met with. **Glandular enlargements** may develop, the deep cervical gland being especially involved, as in scarlet fever ; abscesses are not common. **Otitis** is very common during convalescence, suppuration taking place in the middle ear and the membrane becoming perforated. **Diarrhœa** is not an uncommon complication or sequela, especially during the hot weather, though by no means

exclusively so ; it is apt to become dysenteric in character, mucus, blood, and hard lumpy fæces being passed, with prolapse of the bowel. The health often remains impaired for a considerable time after an attack of measles ; it is during this stage that **Acute Tuberculosis** and **Cancrum oris** may arise. The tuberculosis very frequently appears to take its rise from enlarged and cheesy bronchial glands.

Convulsions may occur at the commencement of the prodromal stage, or a few days later, marking the onset of pneumonia. In some few cases we have seen the convulsions followed by hemiplegia. In one case coming under our notice the convulsions were severe and followed by coma for some days ; there was no paralysis, but some brain damage was done, as the child (aged 4 years) did not speak for some months afterwards and his intellect was impaired. We have also seen attacks of anterior poliomyelitis in the course of an attack of measles, and in one case an obscure ill-defined general paralysis which finally recovered. Dawson Williams, Bruce and Barlow have described cases of myelitis following measles.

Diagnosis.—A typical case of measles with the rash well out can hardly present any great difficulty in diagnosis. But inasmuch as measles is infectious some days before the appearance of the rash, it is of importance to make an early diagnosis. In the premonitory stage the fever may be slight, perhaps only a degree or two, and some redness of the conjunctiva, but other signs may be absent. In any suspected case an examination of the mouth must be made in order to detect the presence of papules on the soft palate and Koplik's spots on the mucous membrane of the cheeks and lips. In some cases a scarlet rash which may be mistaken for scarlet fever appears before the measly rash. The disease most likely to be mistaken for measles is rubella, the latter disease closely resembling mild measles. (See Rubella.) A measly rash is sometimes present in cases of septicæmia, where there is suppuration as in empyema. Care must be taken not to mistake the patchy rash sometimes present in scarlet fever for measles. An examination of the tonsils will usually prevent such a mistake, though some of these cases are difficult to diagnose.

The laryngitis which in some cases occurs in the catarrhal stage may be mistaken for diphtheritic croup, and such cases have not infrequently been admitted to a diphtheria ward, the mistake only being discovered on the appearance of the rash of measles a day or two later.

It is possible to confound measles with smallpox, though this difficulty is more likely to arise in the case of adults than children. According to Collie there are two kinds of smallpox which it is possible to confound with measles, viz. the commencement of a confluent case and the commencement of a hæmorrhagic case. The papules in smallpox are much harder and more shotty, and, moreover, in a confluent case, the headache, lumbar pain, and general symptoms would be more severe. Hæmorrhagic measles is very rare, and, according to the same author, would be difficult to diagnose from 'black smallpox' ; the quantity and quality of the vaccination marks should be taken into account.

Morbid Anatomy.—There is not much to be said under this head, inasmuch as there are no *post-mortem* appearances characteristic of measles, the principal lesion found being catarrhal pneumonia ; the whole of the internal

organs are gorged with blood, and minute hæmorrhages are present on their surfaces. The mucous membrane of the bronchi is intensely congested, the surface of the pleura roughened and perhaps covered with lymph, one or both bases are solid from catarrhal pneumonia; in such cases the pneumonia resembles that found in septicæmia. In some instances croupous pneumonia involving a lobe or portion of a lobe may be present, or there may be patches of croupous pneumonia. At other times there is intense bronchitis, with patches of catarrhal pneumonia and emphysema. In all cases of pneumonia following measles which we have examined microscopically we have found fibrinous exudation in the air vesicles, in spite of the pneumonia being apparently of the catarrhal variety. A fibrinous exudation is sometimes found on the mucous membrane of the large bowel.

The following *post-mortem* record taken from one of our note books illustrates a malignant case :—

Measles, malignant case; death.—Child of eleven months; death on fourth day. On removing lungs it is noted that the upper lobes are emphysematous on their surfaces; in the lower lobes emphysema alternates with collapse; on section there is intense injection of the trachea and bronchi, yellow mucus exudes from the minute bronchi; the lungs are intensely congested, there are patches of broncho-pneumonia in the lower lobes.

Treatment.—No very active treatment is needed during an attack of ordinary severity, but much may be done to promote the patient's comfort and to prevent any complications. He should, of course, be confined to bed as soon as measles is suspected, the temperature of the room being maintained at 65° F., and if the cough is hard and irritating a steam kettle should be called into requisition to keep the atmosphere moist. The diet should consist of milk diluted with barley water or seltzer; in mild cases sops or light puddings may be allowed. Demulcent drinks, such as barley water, lemonade, black currant or tamarind drinks or jellies, are useful in allaying the irritating cough. Frequent spongings with warm water containing a weak solution of tar or 'sanitas' relieve the itching and help to bring out the rash. During the pre-eruptive stage, when there are high fever, restlessness, cough, and frequent pulse, small doses of tr. aconiti, one or two drops every two hours —carefully watching the effect, especially after five or six doses have been given—will usually be attended with relief. Jelly containing codeia or small doses of Dover's powder may be given to relieve the cough. Great care should be exercised during convalescence to prevent catching cold, especially in those who are liable to bronchial catarrh, as the bronchial mucous membrane remains for some time in an irritable condition, and exposure to cold is exceedingly likely to give rise to bronchitis or diarrhœa.

In cases of greater severity, especially those in small children which are accompanied by a scanty rash, congestion of the internal organs, high temperature, and broncho-pneumonia, active treatment is required. It is necessary to get the skin to act efficiently and thus relieve the congested internal organs; to this end tepid sponging, hot packs, or mustard baths may be employed. For children under two years of age the mustard bath is the most suitable; the child being placed for three minutes in a bath of 100° F., one table-spoonful of mustard to the gallon of water being about the proper strength. The child must be quickly dried and put between blankets; the

bath may be repeated in a couple of hours if necessary. The stimulating effect of the bath upon the skin is often of great service. Linseed poultices to the chest are to be avoided in the case of young children, unless the attendants are trained nurses ; hot fomentations or bran poultices are preferable in dispensary practice and in the hands of the unskilled, as being less heavy.

In older children the hot pack is to be preferred to baths. In the early stages small doses of antimony, pot. ant. tart. $\frac{1}{100}$–$\frac{1}{40}$ of a grain, with some tartarated soda or citrate of ammonia, should be given every three or four hours, but omitted if there is nausea. Aconite may be useful, but it must be carefully watched, on account of the depression it is apt to produce if pushed too far. Alcohol in the form of whisky or brandy should be given if the pulse is small and rapid and the tongue dry and brown. If the cough becomes loose and there is excessive secretion from the bronchi, ammonia, digitalis, and alcohol in combination should be given. The eyes, nose, and mouth in severe cases require attention ; they should be bathed or mopped out with warm water ; if there are any aphthous patches in the mouth some borax in dilute glycerine should be applied. During convalescence no medicine answers better than dilute nitric acid and bark or F. 36 and 37.

It cannot be stated with too great emphasis, that to overcrowd a measles ward means a high mortality. To admit cases of measles to a ward containing patients suffering from pneumonia or any septic complication is not justifiable. The success attending the treatment of measles-pneumonia in the open air, as practised in the fever hospitals of Edinburgh and Glasgow, clearly shows how essential fresh air is in the treatment of such conditions.

Quarantine.—How long should quarantine be maintained in a case of measles ? This is not an easy question to answer, though it is certain that the infection is not given off from the patient for so long a period as is the case in scarlet fever. In uncomplicated cases hot baths may be given as the rash begins to disappear ; they are useful to cleanse the skin and render the patient more comfortable. It is well for the patient to keep his bed for ten days and his room for three weeks ; then, if he is quite well in every respect, there can be little danger in his mixing with his fellows. When a case of measles occurs in a house, it is necessary for the other children who have not had it to stop going to school or mixing with other children, as it is probable they will have contracted the disease ; and as measles is infectious in its early stages—if not during the incubation period—they may readily be the means of giving it to others. For the same reason it is unwise to send them away from home, though care should be taken that they do not come in contact with the patient at home. The bedding should be stoved and the room occupied by the patient disinfected at the conclusion of the illness.

Rubella

Rubella[1] is an infectious fever closely resembling but distinct from measles ; it is for the most part a milder disorder than measles, and does

[1] We adopt the term 'rubella' as first suggested, we believe, by W. Squire. 'Epidemic roseola,' which has been proposed, introduces the ambiguous term of 'roseola.'

not protect from it. In some epidemics it closely resembles mild scarlet fever.

Etiology.—The resemblance between these two diseases is unquestionably a close one, and there is little doubt that not infrequently epidemics of rubella—or at any rate sporadic cases—are mistaken for measles. It has, however, been clearly shown by those who have had the opportunity of watching successive epidemics of infectious diseases in schools and asylums, where the same individuals have been attacked, that rubella does not protect from either measles or scarlet fever, nor do attacks of the two latter afford any immunity from attacks of rubella. The resemblance, and yet the difference, between the two diseases was well put by the late Dr. West when he said 'they resemble each other somewhat as varicella and variola—alike, but not the same—not twin sisters indeed, but half-sisters at any rate. That they should be confounded in practice is not surprising, especially when we remember that measles is sometimes an extremely slight disease and the rash by no means characteristic. In mild attacks of measles the coryza is usually slight or absent, and the rash little else than ill-defined mottling.

Rubella occurs in epidemics, sometimes being prevalent and widespread, as it was in this country during 1880; at other times sporadic cases crop up and there appears but little tendency for the disease to spread. As a result, rubella has earned a different character as regards contagiousness from different writers who have observed it, some maintaining that its contagiousness is almost *nil*, and others that it is extremely contagious. The truth is that susceptibility to its influence seems to vary strangely at different times and in different places in a way which it is difficult to account for. Thus in one locality there may be an epidemic prevalent; an individual goes to another while incubating, he suffers from an ordinary attack and the disease does not spread, though he comes in contact with many individuals. There is little doubt, however, that rubella has been confounded with some of the non-specific, non-contagious forms of roseola or rose rash. Age does not seem greatly to influence predisposition, infants, children, and adults suffering alike; indeed, in some epidemics adults suffer more in proportion to their numbers. Thus in an epidemic in the Children's Hospital observed by Dr. Hutton and ourselves, out of twenty-seven cases, eight were those of lady probationers or 'sisters,' and nineteen of children; so that the adults suffered far more largely in proportion to their numbers, though there can be no doubt that the nurses came in contact with those suffering from the disease much more than the children. Considering how much rarer a disease rubella is than measles, it would appear that a smaller number of individuals who are unprotected by a previous attack are susceptible to its influence than is the case with measles.

The relationship of rubella to measles and scarlet fever is an interesting question, and while very few believe it to be a hybrid disease, the attack resulting from the reception by the patient of both scarlatinal and measles poisons, yet, considering the close resemblance which it bears to measles, there is nothing inherently improbable in the idea that the resemblance is something more than coincidental, that the poisons may have been derived from one another or from the same stock at some distant epoch, and have

become modified by being cultivated under different conditions. It is interesting to note that some observers assert that the character of an epidemic becomes modified in the direction of either measles or scarlet fever if either of these is prevailing at the same time.

Incubation.—There has been some uncertainty about the length of the incubation period. The common period is from two to three weeks, as observed both by W. Squire and Lewis Smith. In three cases coming under our own observation the time appeared to be sixteen, seventeen, and eighteen days respectively.

Premonitory Stage.—In children, as a rule, no prodromal symptoms are observed, the rash being the first thing to be noticed. In adults, who are able to describe their feelings, complaint is made of weariness, headache, and backache for twenty-four hours before the appearance of the rash. There may be vomiting, coryza, slight sore throat, or a tingling sensation of the skin of the face. Another noteworthy symptom sometimes present is the enlargement of the superficial lymphatic glands situated along the posterior edge of the sterno-mastoid, or the submaxillary and occipital glands are tender as well as slightly enlarged, and give rise to a certain amount of stiffness of the neck. On the other hand, it is by no means uncommon even in adults that the discovery of a rash is the first thing to call attention to the attack.

Exanthematous Stage.—The rash usually appears first on the face, and consists of indistinct, ill-defined papules, forming irregular patches of a rose-red colour, which shade away into the colour of the skin ; there may be simply erythematous blotches. The patches of confluent papules vary much in size and shape, many perhaps consisting of only a few papules grouped together ; sometimes, on the contrary, the whole face is of a red colour. The rash is usually also abundant on the neck, chest, back, buttocks, and flexor surfaces of the arms and thighs ; in these situations it is usually less confluent and patchy than on the face, the rash consisting of groups of papules or of single papules. Occasionally the confluence of the papules and the erythema which surrounds them gives rise to the suspicion of scarlet fever, especially to that form in which the rash is patchy on the limbs, the rash being more or less typical of rubella in one part of the body and resembling scarlet fever in another. Rubella rashes undoubtedly vary considerably, especially in the confluence of the papules ; as a rule, the colour is of a rose-red when it first comes out, being of a brighter colour than measles ; the papules do not so constantly arrange themselves in crescents, and they are less distinct than the measles papules. The rash is usually most intense on the second day, but remains visible for three or four days ; by the end of this time it has mostly faded, often leaving more or less staining of the skin and a light branny desquamation. The rash frequently gives rise to much itching. Sometimes the axillary and inguinal glands become enlarged.

The course of the attack may be feverless, though usually there is a slight rise of temperature, the highest being on the second day, 99° to 100° ; in rare cases it reaches 102° or 103°. The temperature becomes normal as the rash disappears.

Hyperæmia of the conjunctiva and fauces exists in many cases, but it is rarely as marked a feature of the attack as it is in measles. Sometimes a dryness and soreness of the throat in swallowing is complained of, with more or less catarrhal tonsillitis.

While such may be taken as a typical attack, it must be acknowledged that the attacks of this exanthem vary greatly in intensity, and the rash may be too ill defined to admit of a positive diagnosis. In some rare cases, such as those described by Dr. Cheadle, the course of the disease is that of a serious illness, with marked implication of the larynx and bronchi, the cough being incessant and crouplike. In two of these broncho-pneumonia supervened, in several others earache was a prominent symptom. On the other hand, cases may occur of the mildest form, so wanting in character both as regards rash and coryza, that they may be looked upon as of a doubtful nature and perhaps forgotten, and only when they are succeeded by more typical cases does their character become clear.

Complications and Sequelæ.—There are usually none ; in the more severe cases catarrhal disorders, such as coryza, tonsillitis, and broncho-pneumonia may complicate and succeed the attack. The prognosis is favourable ; the disease is probably never fatal in healthy children ; in epidemics in hospitals, where it attacks children already suffering from and much reduced by pulmonary affections, it has appeared to be the immediate cause of a fatal result. Even in healthy children the health may remain below par for some time afterwards.

—	Rubella	Measles	Scarlet Fever
Incubation.	14 to 21 days.	8 to 12 days.	2 to 5 days.
Premonitory fev.	1 day.	3 to 4 days.	1 day.
Prodromal symptoms.	Often none. Sometimes enlarged glands, weariness and slight coryza.	Sneezing, coryza, headache, cough.	Vomiting, headache, sore throat.
Tonsillitis.	Slight tonsillitis.	Usually none.	Tonsillitis well marked.
Rash.	Appears on the first or second day. Consists of indistinct papules of a rose-red colour confluent on the face, usually discrete on the limbs, buttocks, and thighs. Often fades from the face before it is fully developed elsewhere. Often much itching.	Appears on the fourth or fifth day. Consists of confluent papules of a dusky-red colour on the face, and groups of papules often in a crescentic form on the trunk and limbs.	A diffuse punctiform red rash comes over neck, trunk, and limbs—may be patches on the extremities.
Desquamation.	Desquamation absent or only very fine branny scales.	Desquamation absent or only in fine scales.	Desquamation usually free.
Temperature.	Often normal throughout, rarely above 100° F.	Fever always present, sometimes high, reaches its maximum when the rash is fully out, then falls.	Fever always present, mostly high, disappears as the rash fades.

Diagnosis.—Rubella may at times be mistaken for some of the anomalous erythematous or roseolous rashes from which children suffer from various causes, especially indigestible food ; but there is usually no fever. In single cases diagnosis may be difficult, but the fact that rubella prevails in epidemics often assists in making a diagnosis. The diagnosis between measles and rubella in an individual case is at times impossible ; often it is difficult, inasmuch as it must be admitted that there is no one characteristic symptom of rubella, and moreover the rash differs in different cases. The differences between typical cases of rubella, measles, and scarlet fever are shown in the table on p. 296.

Treatment.—Every case of rubella and every suspicious case should be carefully isolated, and confined to one room, if not to bed. The diet should consist largely of fluids and slops. A simple saline such as citrate of potash may be given, and other symptoms must be treated as they arise.

Quarantine.—The patient should be isolated for at least three weeks ; better if four weeks elapse before he is allowed to rejoin his companions.

'The Fourth Disease'

It is universally admitted that there is a mild febrile disease accompanied by a diffuse red rash which closely resembles mild scarlet fever, and may readily be mistaken for it. There is no general agreement of opinion as to whether this febrile disorder is merely a variety of rubella or whether it is a separate disease which 'mimics' scarlet fever, as rubella does measles or varicella does variola. Some observers have reported epidemics of rubella in which the majority of cases have been of the more common measly type, while a few cases have closely simulated mild scarlet fever. On the other hand, Dr. Dukes has observed epidemics of the latter type, and he believes that it is not a variety of rubella, but 'breeds true,' and he has provisionally called it 'the fourth disease.'

Our own experience of epidemics has been that these two diseases or varieties of disease have occurred separately and not together. Some years ago we were much puzzled by finding that a number of what were apparently mild cases of scarlet fever, when admitted to a scarlet fever ward, developed scarlet fever a few days after admission. Shortly after we noted a number of patients coming to the out-patient department with diffuse red rashes, who were not ill, but who had been brought on account of the rash. It soon became apparent that there was an extensive epidemic of a disease closely resembling mild scarlet fever, but not protecting from it. We have seen several such outbreaks. Dr. Dukes has described several epidemics in a public school ; the initial symptom in some of the cases was vomiting, the fauces were reddened, and the conjunctiva injected. The cervical lymphatic glands were often enlarged and tender, more especially the post sterno-mastoid group. The rash lasts a few days, and is succeeded by fine desquamation ; the temperature is rarely more than 98°–100° F.

It must be admitted that an epidemic of a disease answering to the above description would do duty for mild scarlet fever, and indeed would not be distinguished from it with certainty. In any epidemic of scarlet fever there

would probably be typical cases with tonsillitis, high temperature, copious rash, &c., which would settle the diagnosis, though others might be mild. Should nephritis follow an attack, it would almost certainly suggest that the febrile attack had been scarlet fever.

The whole question is still far from settled, and is surrounded with difficulty.

Dr. Dukes observed cases in which the incubation varied from 9 to 21 days ; our own impression is that in the 'fourth disease' it is somewhat less —namely, 7 to 9 days.

CHAPTER XV

THE SPECIFIC FEVERS—*continued*

Diphtheria

DIPHTHERIA is an infectious disorder which is characterised by the formation of a fibrinous exudation on mucous surfaces or abraded skin, due to the growth of a specific bacillus ; it is usually accompanied by fever and albuminuria, and frequently followed by paresis of various muscles. At the very threshold of the subject it may be as well to attempt to clear the ground by asking—Are we to consider all fibrinous exudations which have the characters of a 'false membrane' as evidence of the presence of diphtheria? Is diphtheria always accompanied by a 'false membrane'? Both these questions must be answered in the negative. Recent observations clearly show that other micro-organisms besides the D-bacillus are capable of producing fibrinous exudations on the fauces, and, moreover, the D-bacillus has been demonstrated in the secretions taken from non-membranous sore throats. Still, we must admit that membranous exudations are usually diphtheritic, and that diphtheria is not often present in the absence of 'false membrane.' It is quite certain, however, that the D-bacillus may be found in normal throats.

That diphtheria is a highly contagious disorder is made certain by very definite evidence ; it is a matter of common experience that the disease passes from patient to nurse, from one patient to another in the wards of a hospital, and from a sick child to its playmates or parents in private houses. It is certain also that the infection can be conveyed from the sick to the healthy by means of a third person, the bacilli travelling on the clothes, on the hands, or in the secretions of the mouth of the latter. The occurrence of diphtheria in the families of medical men attending cases of diphtheria is a proof of this. Direct inoculation has taken place accidentally by means of small pieces of membrane or the secretions entering the mouth, as in sucking a tracheotomy wound ; false membrane has formed within twenty-four hours of an operation at the seat of the wound. The disease is often spread in schools and families by individuals, who are not ill enough to be in bed, going about while suffering from mild and unrecognised diphtheria. There is little doubt also that the disease has been transferred from animals to man through direct contact or by means of milk from cows suffering from the disease. The D-bacillus may retain its vitality for many months outside the body, and may be carried any distance in clothes, bed-linen, or on surgical instruments. It is a popular notion that there is a close connection

between diphtheria and sewer gas, and sanitary faults in houses are frequently credited with being the cause of outbreaks of diphtheria ; it is quite possible that sewer gas may give rise to a non-specific sore throat which may form a suitable soil for the development of the D-bacillus.

Diphtheria occurs in epidemics, but it is also endemic in some cities and rural districts. It is constantly present in large cities as Berlin, Paris, and New York, and in some rural districts in this country. In its distribution and in the varying character of its epidemics it is one of the most mysterious diseases with which we are acquainted, and there is much about it which requires continued investigation. In this country until recently it has been more common in the rural than in the urban districts, though it appears at the present time to be more common in our large towns than formerly. It is especially prevalent in the south-eastern and eastern rural districts, while some others appear to escape almost entirely. It makes its appearance at times in isolated farmhouses, or villages remote from other habitations, and this circumstance has suggested the idea that possibly the infective particles have been conveyed thither by means of the wind (Airy). It has occurred in Central Africa far away from any source of infection. But in connection with these singular cases we must remember that the D-bacillus retains its vitality for many months under suitable conditions, and may be conveyed any distance on clothes or other articles, and thus infect persons long distances away from the original source of the infection.

No age is exempt from its attacks, but children between the ages of two and eight years are most often attacked, and children of these ages more readily succumb than do older children. The disposition to diphtheria seems to run in families, members of the same family being attacked in quick succession or at variable intervals.

The parts which are most often attacked are the fauces, nasal mucous membrane, larynx and trachea, glans penis and vulva ; less often some wound or eczematous skin. The bacillus enters the mouth in either air or food, and if conditions are favourable for its development the growth of the bacillus commences, and membrane forms on the tonsils and soft palate. In what these favourable conditions consist it is difficult to say. Certainly a slight sore throat or laryngeal catarrh often precedes an attack of diphtheria, and it is very probable that any injury to the epithelium or a catarrhal state may afford a suitable soil for the development of the bacillus. We have known instances in which nasal diphtheria has supervened in a case of chronic ozæna, while other children exposed to infection at the same time were not attacked. The fatality of different epidemics varies strangely ; sometimes whole families are swept away, as in the epidemic described by Trousseau in Sologne ; thus in one farm, where the residents numbered eighteen, only two, the father and a servant girl, survived. The infection seems to vary in intensity, at times and under certain conditions becoming attenuated, at other times resuming its virulency. The mortality has been reduced by at least one half since the introduction of antitoxin. Thus the mortality from diphtheria in the hospitals of the Metropolitan Asylums Board was 30·4 per cent. in 1893 and 29·2 per cent. in 1894 ; it gradually fell after the introduction of antitoxin in 1895 to 15·5 per cent. in 1898 (Goodall).

Morbid Anatomy and Pathology.—The membranous exudation which is present in diphtheria is of a whitish-grey colour, and when first formed is firmly adherent to the tissues beneath it. It is in some cases rather yellowish than white ; in malignant cases it is frequently brown from being stained by broken-down blood. In a few days more or less the membrane becomes loosened from its attachment and can be removed by means of a brush ; if forcibly removed it leaves a raw surface, which quickly becomes again covered with membrane. Speaking generally, membrane adheres more firmly and is less easily detached from the mucous membrane of the tonsils and soft palate than from the larynx and trachea.

If a thin section of a piece of membrane adhering to the soft palate be stained with methyl blue, and examined with a moderately high power, it will be seen that the membrane consists of a fine network of fibrin with epithelial cells and leucocytes in the meshes ; beneath the membrane the papillæ and connective tissue of the deeper layers of the mucous membrane are infiltrated with leucocytes. Loeffler's D-bacilli are usually in little balls or masses embedded in the superficial layers of the false membrane ; in some cases they may be seen in the deeper part of the membrane or beneath it. Unlike the anthrax bacillus, the D-bacillus remains local, and does not penetrate into the tissues or enter the blood. The D-bacillus is a non-motile little rod about the length of the tubercle bacillus, but thicker, so that when several are joined together they look at first sight not unlike streptococci. When fully developed the ends of the bacilli are darker and thicker than their central portions ; sometimes only one end is enlarged. Two are often joined together. They vary considerably in shape and size, according to their age and the conditions under which they have grown ; thus the 'long bacillus' and the 'short bacillus' are sometimes spoken of ; it would be unsafe to say that the presence of the short variety means a mild attack of the disease.

Recently, chiefly by French authors (Roux, Yersin, Barbier, Sevestre), the micro-organisms which are found associated with the diphtheritic bacilli have been carefully studied. The most important association is with streptococci, the strepto-diphtheria of French authors ; these cases correspond with the septic cases of scarlet fever, to which, indeed, they have a close resemblance. The presence of streptococci in considerable numbers notably increases the virulence of the attack. Staphylococci (aureus and albus) are frequently associated with the D-bacilli ; the attack is usually more benign than when streptococci are present. Pneumococci (Frankel), Coli-bacilli, Proteus bacilli may also be present, the latter in gangrenous diphtheria. The chemistry of the membranes and the poisons formed in the exudations and in the blood have been studied by Roux and Yersin, and more recently by Sidney Martin. The latter observer has established the fact that during the growth of the bacilli toxins are formed which act as virulent poisons on the system. Similar poisons are formed when the bacilli are cultivated in blood serum or in gelatine. Roux and Yersin have shown that if the nutrient fluids in which the bacilli have grown are, after the bacilli have been separated by filtration, injected subcutaneously into guinea pigs, death takes place with symptoms of toxæmia in twenty-four hours. If small doses were employed and injected into rabbits, and a fatal result did not take place, a paralysis was often left.

The poison appears to give rise to degeneration of the tissues ; there are changes in the liver cells, the muscular fibres of the heart and other organs, and the smaller motor and sensory nerves. In the peripheral nerves the white substance of Schwann undergoes degeneration, and in places disappears ; the axis cylinder is also affected, but in less degree. It is this peripheral degeneration of the nerves which is the cause of the paralysis so often noted after an attack of diphtheria. The blood is profoundly altered, and its coagulability interfered with ; hence the hæmorrhages and purpuric condition seen in malignant cases of diphtheria. The cause of the albuminuria is uncertain ; it may be caused by the altered state of the blood, or be due to the fatty degeneration which the renal epithelium undergoes ; the amount of albumen present is in most cases a correct index of the severity of the attack.

From the above facts it would appear that the D-bacillus is the primary infective agent, and that during its growth it gives rise to the fibrinous exudation ; at the same time a ferment is formed resembling pepsine which is capable of digesting proteids. This proteid digestion goes on both in the membranous exudation and also in the blood, albumoses being formed, which play the part of virulent poisons, giving rise to rapid tissue degeneration and serious changes in the blood.

The relation between the diphtheria of man and that of the domestic animals is interesting and important. Some of our domestic animals appear to suffer not infrequently from diphtheria, and may be the means of giving rise to epidemics of human diphtheria. The observations of Klein [1] have shown that diphtheria may be communicated to cows by subcutaneous injections of cultivations of bacilli from the membrane taken from cases of human diphtheria. A soft tender swelling forms at the seat of the injection, and in some cases at least a number of pimples appear on the udders, which pass through the stages of pustules and ulcers. The cows suffer more or less from fever, and an extensive loss of hair takes place. During the eruptive stage the milk of some of the cows was found to contain numerous diphtheria bacilli. In at least two epidemics of diphtheria in which the milk coming from a certain dairy was suspected of being the cause, it was found on examination of the cows that they were suffering from an eruptive disorder on their udders similar to that produced in those cows which had been inoculated. Diphtheria has been produced by Klein in cats by feeding them with cultures of the D-bacillus in milk, and epidemics of diphtheria have been observed in cats. Guinea pigs are the most susceptible of all the domestic animals. Fowls suffer from membranous croup which closely resembles, but is not identical with, human diphtheria.

Pharyngeal Diphtheria.—The tonsils, uvula, and pillars of the fauces are the favourite sites for the false membrane in diphtheria, and in by far the greater number of cases occurring in practice these parts are affected in the first instance. The attack, unlike scarlet fever, usually begins insidiously. The friends notice that the child is ailing, it does not care for its toys, it is peevish and fretful, and towards evening is feverish. Perhaps there is some glandular enlargement at the angles of the jaw, or a discharge from the

[1] Twentieth Annual Report of the Local Government Board.

nose, or the child is heavy and drowsy. In older children there is usually some complaint of sore throat or difficulty in swallowing ; the child feels cold and shivery, and sits over the fire trying to keep itself warm. An examination of the fauces, if made within a few hours of the first symptoms, may show nothing very distinctive ; there may be some swelling and excessive redness, with some whitish or yellowish exudation in points or patches, but it may be quite impossible to decide whether the case is one of diphtheria, scarlet fever, or other form of tonsillitis. Usually, however, within twenty-four hours of the commencement of the illness, patches of membranous exudation may be seen on the inner surfaces of the tonsils or soft palate ; these are whitish or grey and opaque, adhering firmly to the surface so that they cannot be removed by brushing. If removed by forceps, a raw bleeding surface is left ; a piece of membrane when removed is seen to be tough and firm, differing from the soft cheesy material which is present in scarlet fever or tonsillitis.

The temperature is rarely high, being mostly 101° to 103° F. ; the evening temperature being, as a rule, a degree or two higher than the morning temperature. In a day or two, if not from the first, membranous exudation may be seen on the uvula or the pillars of the fauces, though the tonsils may be from first to last the only part affected. The nasal mucous membrane is apt to join in the inflammatory process ; a semi-purulent, often bloody, discharge makes its appearance at the nostrils ; the child makes a snoring noise when asleep, on account of the obstruction caused by the swelling of the mucous membrane and the excessive secretion. An examination of the urine during the first day or two may be negative as far as albumen is concerned, but if a daily examination be made, in the great majority of cases albumen varying in amount from a trace to one-half will be found.

During the next few days fresh patches of membrane make their appearance on the fauces, the older ones becoming loosened, then detached, by the process of sloughing which goes on. In the meantime the glandular enlargement and tenderness become more marked, and the neck is stiff and all movements are painful. The patient becomes weak, anæmic, and easily exhausted ; there is often marked fœtor of the breath.

In favourable cases, after the first few days or a week no new membrane forms, while the old patches disappear, the swelling of the glands and tonsils becomes less, and the temperature gradually falls. The albumen also gradually diminishes in quantity and finally disappears. The child remains weak for a long time, convalescence being only slowly established. On the other hand, in unfavourable cases, instead of an improvement taking place at the end of the first week, the symptoms both local and general become more pronounced ; the amount of urine increases, the pulse is weaker and perhaps intermittent, the anæmia is profound, the breath very offensive, and oozing of blood takes place from the mouth and nose. The patient gradually becomes exhausted and refuses his food. During the last hours of life there may be total suppression of urine, drowsiness, and extreme depression of the heart's action.

Mild cases may occur in which both the local and general symptoms are slight. There may be membranous or yellow-coloured patches on the tonsils, the nasal mucous membrane remaining free and the glandular enlargement absent, and perhaps only a trace of albumen in the urine. Such patients

may be seen running about with but little appearance of illness ; the local lesions may disappear in a few days. It is important to remember that in such cases paralysis may follow, or a fatal result may come about through cardiac failure.

Malignant Diphtheria.—Of severe and malignant cases of diphtheria there are several types. The attack may begin insidiously with a day or two of slight illness, and then alarming symptoms of cardiac failure may set in without there having been any excessive local lesion. In other cases the attack is stormy from the very first, perhaps accompanied by vomiting, and closely resembling scarlet fever in its mode of attack (strepto-diphtheria or septic-diphtheria). Within a few hours of the onset there is extensive swelling at the angles of the jaws, with a feeling of stony hardness, a fœtid, sanguineous discharge issues from the nostrils, and it is difficult to get a view of the throat in consequence of the swelling and difficulty in opening the mouth. The tonsils are so swollen as to meet, the uvula and soft palate œdematous and covered with more or less sloughy-looking membrane. The temperature is usually high, being 103° to 104° F., and the pulse and heart's action exceedingly feeble. In the course of a day or two, sometimes less, the cellulitis extends, the cheeks and face become œdematous, and the skin pits as low as the clavicle, or even over the sternum and chest walls ; the patient becomes drowsy and cyanotic, and there may be an erythematous rash, especially about the neck and chest. Purpuric rashes are common in malignant cases. Death usually occurs in a few days. Such cases resemble malignant scarlet fever, and it may be difficult or impossible to distinguish between them in the absence of a characteristic rash.

In some cases there is a marked tendency to hæmorrhage, blood oozing from the fauces, nose, and gums. There may be hæmaturia, or hæmatemesis. In one case of 'wound diphtheria' of the penis which we saw, there was severe hæmorrhage from the kidneys. Such cases appear to be invariably fatal.

Nasal Diphtheria.—In pharyngeal diphtheria the inflammatory process is apt to spread to the nasal mucous membrane, especially in severe cases. In some cases, however, the nasal mucous membrane is the first seat of the exudation, and it may never spread to the tonsils, though it is usually to be found to involve the back of the soft palate and the pharynx. In nasal diphtheria no membrane may be distinguished during life ; there may be only a purulent discharge with blood, the presence of which in the nasal passages obstructs respiration, giving rise to a bubbling or sniffling sound, especially during sleep. In nasal diphtheria the general symptoms are usually quite as severe as in faucial diphtheria, and a guarded prognosis must always be given. In cases in which the soft palate, tonsils, and nasal mucous membrane are involved, the general symptoms, including the depression and also the albuminuria, are well marked. In connection with this form of diphtheria we must bear in mind there is a form of membranous exudation occurring on the nasal mucous membrane in measles and as a primary disease which is not diphtheria, but which runs a much more favourable course, and in some cases at least the membrane formed is thinner and less adherent than it is in diphtheria. The term 'Rhinitis fibrinosa' has been applied to these cases. In all cases in which a child is feverish with a

discharge from the nostrils we should be exceedingly suspicious of diphtheria, especially if an epidemic prevails at the time. The inflammation may spread from the nose to the conjunctiva, and membrane may form on the palpebral conjunctiva and much purulent discharge may exude, while the eyelids may be much swollen. Membranous conjunctivitis is not usually diphtheritic, but due to pneumococci (Frankel); the local disturbance may be severe, while the constitutional symptoms are slight.

Laryngeal Diphtheria.—The larynx may be the seat of the local manifestations of diphtheria in the first instance, or may become involved secondarily to the fauces or other part. The child may in the first place suffer from sore throat and feverishness for several days, and then a metallic cough and some dyspnœa will suggest the onset of laryngeal complications. Less often some other part is the first to be involved; thus we have known a patch of membrane to make its appearance at the seat of an eczema, and then a few days afterwards a diphtheritic laryngitis supervene. The symptoms present in laryngeal diphtheria will be found described (p. 354). We must constantly bear in mind that the obstruction to the air passages caused by the presence of membrane in the larynx or trachea may modify or overwhelm the symptoms of the disease, but we must not overlook the tendency to heart failure or the depression, as well as the possibility of uræmia or paralysis supervening.

Wound Diphtheria.—Diphtheritic membrane may be present on the lip, tongue, vulva, and glans penis. The diphtheria bacillus is, however, apparently unable to flourish on normal skin; but when the cuticle is abraded, as after blistering or in eczematous conditions when a moist raw surface is present, the bacillus readily flourishes. Granulations also afford a congenial soil. The bacillus may be inoculated during an operation—as, for instance, in excision of the tonsils; we have seen a case in which membrane formed within twenty-four hours of an operation for hypospadias at the seat of operation, a fatal result occurring in a few days. We have several times seen membrane form on granulations at the external wound in empyemata. In one of these cases a fatal result followed. In tracheotomy for diphtheria the wound and skin around the wound are apt to become the seat of a fibrinous deposit, the inoculation taking place by the sputa coughed through the tube. In newly born infants the granulating surface left after the sloughing of the cord may become the seat of a diphtheritic inflammation.

Complications and Sequelæ.—These, though less numerous than those occurring after scarlet fever, are hardly less important. There is the extension of the inflammatory process from the fauces to the neighbouring parts already referred to—viz. to the larynx, nose, middle ear, and lymphatic glands; the latter may suppurate besides these. The most noteworthy are the following: 1st, albuminuria and uræmia; 2nd, pneumonia; 3rd, disturbed innervation of the heart; 4th, paralysis.

1. **Albuminuria** can hardly be said to be a complication of diphtheria, inasmuch as it is almost constantly present at some time or other of the course in faucial, nasal, and laryngeal diphtheria. It is, however, frequently absent in mild cases of wound diphtheria. In some epidemics, according to some observers, albuminuria is much commoner than in others. Our experience certainly has been that albumen is rarely absent from the urine in cases

of true diphtheria. The albumen usually makes its appearance from the third to the eighth day. The urine is mostly normal in colour and in amount, but a few blood corpuscles and epithelial casts may be found on microscopical examination in many cases. In some malignant cases hæmaturia may be present. The amount of albumen present forms a rough indication of the severity of the case ; at least after the disease has existed for a few days. The albuminuria is due to the changes effected in the blood or in the renal epithelium of the kidney by the albumoses or toxalbumens present in the blood, and the amount of albumen in the urine represents to some extent the amount of poisoning going on. Suppression of urine and uræmia occur at times, though the symptoms present are not so distinctive as in scarlet fever, as death mostly takes place before the symptoms become well marked. Persistent vomiting with a falling temperature should always suggest uræmia ; the urine may become scanty and loaded with albumen, and perhaps cease to be secreted twenty-four or forty-eight hours before death. Œdema, muscular twitchings, or uræmic convulsions are rare. In cases which recover traces of albumen may remain for months, but chronic kidney disease as a result of diphtheria is uncommon.

2. In severe cases of diphtheria, **pneumonia** in the catarrhal form is common, and is the result of an extension of the inflammation from the fauces or larynx to the lungs. It is found in nearly all cases of fatal laryngeal diphtheria. It is often hæmorrhagic.

3. In all severe cases at the height of the attack the pulse is feeble and for the most part rapid, and dilatation frequently occurs ; or it happens at this time that the heart's action becomes irregular, intermittent, or abnormally slow. A pulse-rate of 40–50 is significant of approaching heart failure. This condition is, however, more common during convalescence, or at least when the membrane is disappearing and the patient apparently improving. There is often dyspnœa on the slightest exertion, an intermittent cantering action of the heart, and frequently vomiting. **Sudden cardiac syncope** is apt to take place. This may occur from any unwonted mental disturbance or from some slight exertion, such as getting out of bed or sitting up to use the chamber vessel. With an irregular action of the heart there is often dyspnœa ; frequent vomiting and slow pulse during convalescence from diphtheria are symptoms of great gravity ; fatal syncope may occur without any evidence of dilatation.

4. A peculiar form of **paralysis** is apt to follow not only diphtheria, but also other febrile disorders, as influenza, measles, and erysipelas ; it is, however, very much more common after diphtheria, about one-fourth of the total number of cases being affected. The paralysis comes on in the majority of cases during convalescence, between the third and fifth weeks, but it may make its appearance much later than this. It may follow either mild or severe cases. Its usual course is first to attack the soft palate, the symptoms being a return of fluids through the nose, perhaps only a few drops, and a nasal twang in speaking ; an examination of the soft palate shows that its movements are less free than usual. In many cases a slight paresis of the soft palate, which may pass off in the course of a week or two, is the only evidence of post-diphtheritic paralysis. In other cases the paresis is much more decided ; when the patient attempts to swallow any fluid, much

of it returns through the anterior nares, and some may perhaps enter the glottis, giving rise to a fit of choking. Other parts may become affected—the pharyngeal muscles and œsophagus, so that deglutition is performed with difficulty and the patient has to be fed through a soft catheter. The pupils may become dilated and unequal from paresis of the circular fibres of the iris, there is impairment of vision, from the ciliaris muscle being affected. There may be squint from one or more of the ocular muscles being involved, the commonest form being paresis of the external recti, and consequently converging strabismus. The paresis may extend to any or all of the voluntary muscles, so that the patient is unable to stand or sit up in bed or even raise his head. Further, the respiratory muscles, the intercostals, and diaphragm may be affected, in most instances speedily producing a fatal result. The movements of respiration are laboured, the patient cannot give a forcible cough or cry or speak loudly. It must be borne in mind that in post-diphtheritic paralysis there is rarely complete paralysis, but rather a partial loss of power, combined with numbness and sensations as of prickings with 'pins and needles.' Both rectum and bladder may also become paralysed, but this is not common. Facial paralysis is rare; we have only seen one or two instances. It is important to bear in mind that paresis may follow very mild cases, so that the patient may be seen for the first time when suffering from the paresis and make no mention of sore throat. Such cases, especially if there be no paresis of the soft palate, may be very puzzling, and, if there be weakness of the legs and staggering gait, may be mistaken for tumour of the cerebellum or ataxy. The knee reflex is absent in such patients, and it may be many months before it makes its reappearance. The cardiac failure, as also the vomiting, is no doubt due to a lesion of the vagus or the vagus centre. The prognosis in diphtheritic paralysis is good except where the respiratory muscles are affected, and in the absence of cardiac complications.

Of 125 consecutive cases of paralysis analysed by C. W. Goodall, in 102 the palate was affected, in 56 the ciliary muscles, in 52 the lower extremities, in 26 the external ocular muscles, in 21 the upper extremities, in 14 the larynx, and in 10 the diaphragm; in 19 a difficulty in swallowing occurred.

Diagnosis.—The diagnosis of diphtheria in a typical case does not present much difficulty, especially if an epidemic is prevailing. The false membrane on the fauces, and the presence of albumen in the urine, render the diagnosis of diphtheria practically certain. But there may be a fibrinous exudation on the fauces with more or less fever; no urine can perhaps be obtained, or, if obtained, it may contain no albumen, and we may be in doubt about the diagnosis. There may be a membranous exudation on the tongue, lip, nasal mucous membrane, or conjunctiva, with no marked constitutional symptoms, and we may be in doubt as to the nature of the case. In such cases clinical distinctions may entirely fail us, it being uncertain if the case in question is one of mild diphtheria or not. We have to depend for a diagnosis on the detection of the D-bacillus in the membrane or secretions. If we can by microscopical examination or by cultivation in blood serum demonstrate the presence of Loeffler's D-bacillus in the membrane, the diagnosis is certain; if, on the other hand, only streptococci or staphylococci are present,

the case is not one of diphtheria. In cases of 'croup' or ozæna an examination of the secretions, which may be non-membranous, may often decide the diagnosis in favour of diphtheria. The disease of the throat most likely to be confounded with diphtheria is croupous or membranous tonsillitis ; usually, however, in this disease there is no tendency to spread to the nasal mucous membrane or the larynx, and there is less often glandular enlargement. The onset is more sudden ; the urine is free from albumen. It is unnecessary, perhaps, to add a word of caution not to exclude diphtheria without very good reason. No albumen may be present in the urine at the time of examination, but be present later ; there may be a complete absence of constitutional symptoms, and yet diphtheria be present. A mild case of diphtheria in a household may be followed by a malignant one. Diphtheria is distinguished from scarlet fever by the absence of the rash, though an erythematous blush is present in a few cases. In malignant strepto-scarlet fever the rash may be absent, and the glandular swelling and sloughy condition of the throat closely resemble diphtheria ; there may also be a fibrinous exudation as well as albuminuria. Diagnosis is often impossible. The punctiform rash, however, is rarely absent in scarlet fever.

Prognosis.—Diphtheria is one of the most fatal diseases with which we have to deal ; but the mortality differs widely in different epidemics. The most fatal form is undoubtedly the laryngeal ; but the mortality has been considerably reduced by the use of antitoxin. Strepto-diphtheria in its worst forms is exceedingly fatal. Of especially bad augury are large quantities of albumen in the urine, much glandular enlargement, excessive nasal discharge, a fœtid state of the fauces, vomiting, and suppression of urine. A sudden fall of the temperature to subnormal, and an intermittent pulse, are also extremely bad symptoms. Recovery from a severe attack in which there is great depression and much albumen in the urine is exceptional, especially in a child under six years of age. Suppression of urine in diphtheria is nearly always fatal ; though in one case seen by us, in which the boy had suppression of urine and nasal hæmorrhage, recovery finally took place. A fall of temperature in scarlet fever in the absence of nephritis is a good sign ; it is by no means so in diphtheria, especially if vomiting be present and an increasing quantity of albumen.

The mortality of cases of diphtheritic paresis is very high in those cases in which the diaphragm and intercostals are affected. Cases in which the paresis is confined to the limbs, soft palate, and muscles of the eye mostly recover. Those patients who live five or six weeks after the onset of the paralysis mostly do well.

Treatment.—The indications for treatment are the following : 1st. To isolate the patient in the most airy room obtainable. 2nd. To inject antitoxin. 3rd. To apply antiseptics to the fauces or affected parts to prevent decomposition and fœtor. 4th. To support the strength of the patient, and to treat symptoms as they arise.

1st. The patient may be isolated by sending him away to a hospital for infectious diseases, and this is often the best and simplest plan, but it is not always possible. If the patient is to remain at home, the largest room available on the top landing should be selected, or, still better, two rooms adjoining one another, so that the patient can be moved from one to the

other, thus allowing the unused one to be ventilated. The supply of a large quantity of fresh air to the patient is of the first importance. *All other children in the house should be sent away, bearing in mind, however, that they may be incubating the disease, so that they should not be sent where there are other children, or to a distance where they cannot be brought back again in case they fall sick.* Arrangements should be made for disinfecting all the excretions and bed linen of the patient.

2nd. The most important therapeutical procedure in connection with diphtheria is to inject antitoxic serum. No time should be lost as soon as ever the diagnosis is made, as statistics clearly prove that it is within the first two or three days that the antitoxin exerts the greatest control over the disease. It is wise to use fresh serum, as after a year or less the serum appears to lose strength rapidly by keeping. The dose for a child above two years of age is 2,000 to 3,000 units during the first two or three days of the disease, and repeated in twelve hours if necessary: 5,000 to 10,000 units may be given if the case is not seen till the fourth or fifth day or later. The best place is the skin of the flank; the skin in this situation is less sensitive than it is on the abdomen. The surface must be thoroughly washed with soap and hot water, a suitable syringe, such as Roux's, sterilised by boiling, a fold of skin nipped between the fingers, and the serum injected into the subcutaneous tissues. The injection is sometimes followed by a rise of temperature, but in twenty-four hours the temperature falls, the membrane tends to separate, and the patient feels better and is brighter. It is the pure diphtheria cases in which the effect is most marked, while the septic or streptodiphtheritic, in which there is much sloughing of the throat and cellulitis, are but slightly influenced or not at all. In cases of diphtheria which have lasted a week or more, the improvement is small; we have seen such cases die within a few hours of the injection without the slightest improvement being manifested. It is certain that the injection of serum cannot cure the mischief which has already been done by the disease, and in malignant cases irreparable and fatal mischief may occur within twenty-four hours of the commencement of the attack. It is less common now than it was to find erythematous rashes, urticaria, and arthritis following the injection. We have never seen a case in which the antitoxin was followed by any alarming symptoms when used early in the attack; when used in severe cases, and late in the disease, it is only too likely that if death quickly follows after the injection the fatal result may be attributed to it. Experience teaches that, in children under two years of age, the serum treatment is just as useful as it is in older children. The experience of physicians, both in America and in Europe, is greatly in favour of the serum treatment, and there can be little doubt that the mortality of the disease has been lowered by its use. It is difficult to express this accurately in statistics, as it is well known that epidemics of diphtheria differ extremely in severity, and the mortality with the serum treatment differs largely according as to whether it has been used within the first day or so, or late in the attack. Then, as we have already remarked, the serum injection has little effect on septic cases, and these in some epidemics form the majority of the cases. The prophylactic dose for children is 600 units, the serum being used for this purpose in hospitals, schools, and households more frequently on the Continent and in America than

it is in this country. If children are to remain in a household in which a case of diphtheria is being nursed we should certainly advise their being injected.

3rd. During the last few years it has been recognised that our means of destroying specific organisms present in the throat and naso-pharynx are extremely limited. The action of antiseptics contained in sprays or local applications is too temporary to effect much, and can hardly reach bacilli which are embedded in membranous exudation or are subepithelial. The most we can effect is to keep the throat and fauces sweet and clean. It is evident also that we have in the serum treatment a far more powerful means at our command to control the disease than by any local applications. In many cases, especially in young children, the prolonged fight rendered necessary in order to cleanse the naso-pharynx is extremely exhausting to the patient. Warm boric acid, if it can be applied effectually, is useful in cleansing the throat by removing mucus and fœtid secretions. The insufflation of powders such as precipitated sulphur, boric acid and iodoform, may generally be managed without difficulty. In many cases, on account of the fractiousness of the patient, we must be satisfied with vaporising carbolic acid in the sick room by means of heat or by a Siegel's steam spray placed near the patient's face. For wound diphtheria dry applications, as finely powdered calomel, are much more efficient than lotions or ointments. With regard to the medicinal treatment of diphtheria, we prefer to use the old-fashioned tr. ferri perchlor. in three to five minim doses every four hours. It may be given in lemonade, soda water, or in any way in which the patient will take it. We do not think that either chlorate of potash or bichloride of mercury is the least use, and in large doses they are dangerous. For the treatment of the paresis, hypodermic injections of strychnine and inhalation of oxygen should be employed, if the heart or respiratory muscles show any sign of weakness. Digitalis, caffeine, coca wine, alcohol, should be given from the first if there is much depression of the system, and in the worst cases alcohol in the form of brandy or port wine must be given with a free hand. J. D. Rolleston recommends adrenal chloride in cardiac failure, beginning with five-minim doses of the solution (Parker, Davis & Co.) every four hours. It must be begun early to be of much use.

4th. The diet supplied to the patient must consist of the most concentrated form of nourishment possible, as in most cases there is great difficulty in getting him to take food on account of the discomfort and pain in swallowing ; beef juice, peptonised meat preparations, milk, and nutrient suppositories may be needed. If there is swelling or cellulitis, the neck should be painted with glycerine and belladonna and covered with cotton-wool. If the glands suppurate, incision and proper drainage must be resorted to. The greatest care must be exercised during convalescence to supply the patient with suitable food and fresh air, and to prevent any exertion on his part. Paresis of the soft palate, general paralysis, and failure of the heart may come on at any time within a month or five weeks of the commencement, even in mild cases, and the practitioner should constantly be on his guard, and warn the friends against allowing any excitement or unwonted exertion. During convalescence quinine, strychnine, and iron should be given. The continuous current and massage is of use in the paralysis which follows. Change to the

seaside after five or six weeks, reckoned from the commencement of the attack, will prove of great benefit.

Quarantine.—This should be maintained for four weeks in mild cases, and six weeks or more in the more severe attacks. It is important during convalescence to spray or irrigate the patient's throat and fauces with weak carbolic or boric acid solution in the hope of getting rid of any remaining bacteria, and to allow the patient to be in the open air as much as he can. If possible a bacterial examination of the secretions of the patient's fauces should be made before letting him loose on society.

Disinfection.—A temperature of 60° C. in a moist atmosphere is sufficient to destroy the D-bacillus. For disinfection the simplest way is to boil the linen removed from the patient, and treat his clothes, as far as possible, in the same way. The furniture of the rooms in which he has been should be scrubbed with hot water and carbolic soap, and the floors and walls should be treated in like manner. Wearing apparel which cannot be boiled had best be destroyed.

Membranous non-diphtheritic Tonsillitis

Practitioners have long been familiar with a form of sore throat which mostly occurs in epidemics, which in many ways resembles diphtheria, but for the most part runs a milder course, and is not followed by the serious lesions which so often follow diphtheria. Such cases have gone by the name of diphtheritic sore throat or 'croupous angina.' Recent observations have shown that the D-bacillus is not the only micro-organism which is capable of giving rise to fibrinous exudations, but, at the same time, no other micro-organism is apparently able to produce the depression, albuminuria, and paralysis which so often accompany true diphtheria. Given suitable conditions, several kinds of cocci, especially the *Streptococcus* and *Staphylococcus pyogenes*, the *colon bacillus*, and the *pneumococcus* of Frankel, are able to produce an inflammatory sore throat with more or less fibrinous exudation; there is also, according to Klein, a 'pseudo-diphtheria bacillus' closely resembling the true bacillus in its histological characters, but incapable of generating during its growth the toxic albumens produced by the true bacillus. We are, however, inclined to agree with those who look upon the pseudo-diphtheria bacillus as the true diphtheria bacillus which has lost its virulence. Cases of pseudo-diphtheria may be mild with only slight fever, but, on the other hand, they may commence with vomiting, high fever, rigors, and the tonsils may be swollen and covered with a membranous exudation. The mortality is not high, being very much less than in diphtheria, but fatal cases do occur, sometimes from pneumonia. The clinical course of such cases may be very much like what has already been described under acute tonsillitis. Fibrinous exudation may occur in other places, as on the nasal mucous membrane, tongue, lip, vulva, conjunctiva, in connection with measles or other diseases, caused by septic cocci as well as by the D-bacillus.

The one important point in connection with these cases is necessarily the diagnosis. If we can certainly exclude diphtheria, the relief to all concerned will be great. Clinically this may be impossible, and a diagnosis may only be made by demonstrating the absence or presence of the D-bacillus in the

exudation or secretions. But difficulties may occur here as long as the question as to the existence of a pseudo-diphtheria bacillus, and its diagnostic characters, is unsettled. It must be remembered that the failure to find the D-bacilli in the secretions of a sore throat is only negative evidence. The local treatment of pseudo-diphtheria is much the same as that for diphtheria, antiseptics being employed to destroy the cocci and to keep the fauces and mouth sweet. Carbolic acid, salicylic acid, peroxide of hydrogen, and chlorine water are among the most suitable. On the skin, starch and salicylic acid powder answer very well. All such cases should be isolated; indeed, every case of tonsillitis occurring in children should be regarded with suspicion, and the child kept away from its fellows during both the febrile and convalescent stages.

Epidemic Influenza. 'La Grippe'

During the last few years the British Isles, in common with the continents of Europe and America, have been visited by epidemics of a peculiar zymotic disease, which has received various names, but is best known in this country as 'epidemic influenza.' These epidemics have been widespread, affecting a number of people at the same time, have come to an end in a few months, and then reappeared in the following year. Epidemic influenza is very infectious, its incubation is short, and, unlike most zymotic diseases, one attack does not protect from attacks in subsequent epidemics. Relapses are common. In some epidemics in past times children appear to have escaped to a large extent, having been apparently less susceptible than adults. This does not seem to have been so in the recent epidemics, for individuals of all ages have been promiscuously attacked, children having been affected in common with adults, though the mortality among the former has not been so high as among the latter, especially in the pneumonic form. In some epidemics children have apparently escaped till late in the epidemic. The incubation is usually a short one, often not more than a few hours, though it may be longer. Certainly instances occur in which a very few hours after the arrival in a household of an infected individual some members of the household are attacked. The disease appears mostly to spread by direct contagion, and the difficulty of controlling an epidemic arises from the fact that a number of mild cases occur which do not confine the patient to his bed or to the house, so that while going about his business as usual he readily disseminates the disease. R. Pfeiffer has successfully cultivated the influenza bacillus on blood-agar—that is, an agar medium containing hæmoglobin. The bacillus occurs in large quantities in the mucus coughed up.

The difficulty in describing the symptoms consists in the absence of any very characteristic ones, and in the multiplicity of symptoms which may be present. Moreover, the type of attack appears to alter from time to time and in different localities. The diagnosis has, in point of fact, often to be made by a process of exclusion, aided greatly by the knowledge that an epidemic of the disease is prevailing at the time, and that perhaps other members of the household have recently suffered. As a result of the difficulty of diagnosis, there cannot be a doubt that many cases in which the diagnosis

was doubtful have been described as influenza, inasmuch as the disease was prevailing at the time ; and thus it has come to pass that much confusion has arisen, and much that has nothing to do with influenza has been included in the descriptions of this Protean disease. We are far from denying that influenza may not be the cause of diverse forms of inflammatory lesions ; we know the so-called pneumonia diplococcus is able to excite not only a pneumonia, but also an otitis and meningitis, and it is by no means impossible that the influenza micro-organism may at one time excite a pneumonia and at another time an enteritis or meningitis. The cases in which the greatest difficulty in diagnosis occur are in infants and young children. It is so tempting to attribute an indefinite febrile attack in an infant to teething or dyspepsia, and so difficult to be certain that the attack is due to influenza, unless another case crops up in the same household to give us the clue. In infants we have not the advantage of the patient's account of himself that we have in adults, so that the diagnosis is often only come to with difficulty. One of the commonest forms of the disease in infants and young children is the simple febrile type. Practically the only prominent symptom is fever. The infant is noticed to be hot, there is a temperature of 102° or 103° F., the pulse and respirations are accelerated, it is heavy and drowsy, and then, after a few days or a day or two, the temperature falls, and the infant is practically well again. In many cases the course is protracted, the temperature going up every evening for a week or more before it finally settles down to normal again. In more severe cases the fever suddenly runs up to 104° or 105° (it may be with a convulsion or vomiting), then for days or weeks there may be fever of a remittent or intermittent type, without there being any pneumonia or tubercle or enteric fever to account for the temperature. Finally, a good recovery is made. These cases are often very puzzling, especially the protracted ones, and we may call in question our original diagnosis of influenza, and begin to fear there may be an acute tuberculosis in progress : in all such cases it is, of course, necessary repeatedly to examine the lungs, and to bear in mind the possibility of an erratic enteric fever being present ; there cannot be a doubt, however, that in young children a fever of the intermittent type, lasting two or three weeks or more, may be due to the influenza bacillus. Convulsions and vomiting are among the frequent symptoms in infants and young children, possibly suggesting an acute meningitis ; the vomiting is often exceedingly troublesome, but the worst cases of this type occur in older children. In others there may be bronchitis and pneumonia of a depressing and fatal character. We have not seen many fatal cases in infants apart from pneumonia, but in one case that we know of death occurred in two days as the result of an attack which was accompanied by high fever and depression. The infant was ten months old and its mother was suffering from influenza at the time.

In older children the attacks approach more nearly the types of attacks witnessed in adults. But as a general rule the neuralgic pains are less marked, as also are the rigors and backache. The attack is sudden, the temperature running up to 103° or more, there is severe headache, vomiting, chilliness, and often sore throat. The conjunctivæ are injected and the child has a heavy look. Earache is often a marked symptom. After twenty-four

to forty-eight hours of more or less high fever, the temperature falls to normal or it runs a lower course. Some cough remains for a few days, and often marked depression ; but this, in our experience, is not so severe as in adults. An examination of the fauces will often show them to be injected, and the tonsils enlarged and covered with yellow points ; there may be some glandular enlargement secondary to the tonsillitis. To add to the difficulties of diagnosis, these cases sometimes have a red rash closely resembling scarlet fever. In some cases which we have seen, we had no doubt that they were influenza and not scarlet fever—this conclusion being arrived at rather from the fact that influenza was epidemic and there were cases in the same household and neighbourhood, than from being able to decide from the symptoms and examination of the patient. Kramsytyk records an epidemic of influenza in Warsaw, accompanied by a red rash ; on the other hand, Filippow records sixteen cases in which influenza was complicated by scarlet fever. There may be an attack of the simple febrile type, already described as affecting younger children. A persistent, irritating cough, almost like whooping cough, is not infrequent.

One of the most serious forms which the disease can take is that in which vomiting is a prominent symptom. In some of these cases the fever is high, perhaps 104° or 105° F., there may be delirium or an excited state of the nervous system, the conjunctivæ are injected, and the child restless and sleepless. Such a case will often suggest an acute meningitis. The vomiting is often continuous, and gradually exhaustion comes on. In one fatal case of this character which we saw the temperature was not high, not exceeding 102° F., and this for a time made the diagnosis of influenza doubtful. In the worst cases the vomiting continues unrelieved, and the child dies of exhaustion or in a convulsion. At the *post-mortem* no gross lesion is found, but there is usually venous congestion and marked injection of the venous capillaries. Another serious complication is pneumonia ; this may be either of the croupous or broncho-pneumonic type. The course is often protracted, and the mortality is higher than in the ordinary forms of pneumonia. Empyema is not an uncommon result. Less commonly there is a catarrh of the small or large bowel, giving rise to troublesome diarrhœa and colic. We have seen several cases of acute ileo-colitis which occurred during an epidemic of influenza, but we could not for certain say they were due to this cause. We have seen cases that certainly resembled enteric fever. Meningitis has been described as occurring in some attacks (G. W. Earle). Dr. Mumford tells us he has seen children with influenza becoming drowsy, closely simulating the semi-comatose state of tuberculous meningitis, but ending in recovery. We have seen a similar case which we certainly thought was meningitis, but she recovered in a few days without a bad symptom. Severe otitis is not uncommon. Relapses are common, and the possibility of their occurrence will always have to be borne in mind. We have known death to take place in a relapse. As a rule, the depression which so commonly follows an attack of influenza in an adult is much less marked in the case of children.

Sequelæ.—Chronic otitis is apt to be left by influenza. Various nervous sequelæ may occur, more especially in adults. We have seen cases in which an irregular and intermittent action of the heart was left by attacks of influenza in children. Recovery seems always to take place.

Treatment.—The patient should be isolated, and confined to bed in a well-warmed room. As long as the fever lasts his diet should consist of fluids, such as beef tea and warm milk. As a routine method of treatment we generally prescribe a mixture containing salicylate of soda, antipyrin, and spirits of chloroform. (F. 50, 51.) If the fever is high, vigorous antipyretic measures may be required; to this end warm or tepid baths, with doses of phenacetin or antipyrin, may be given. Other symptoms must be treated as they arise. The most difficult cases to treat are those in which the vomiting is a constant symptom. In these cases antipyrin in an effervescing mixture, iced champagne, and small quantities of raw beef juice may be tried. In the continued fever quinine may be given.

Enteric Fever

As a general rule it may be said that children and young people are more susceptible to enteric fever than are adults, and they usually suffer from it in a milder and less complicated form. It is not common in children under three years of age, though it undoubtedly does occur even in infants, and may be fatal; it is not easy to say at what period of life it is most common, as statistics of fever hospitals are apt to be fallacious, since the milder cases are certain to be nursed at home, and children suffering from the disease in a mild form will in a great many cases never enter a hospital at all. According to Collie, ten years to twenty years of age is the commonest time for an attack; five years to ten years of age ranking next. The mortality at all ages from enteric fever, according to Murchison, is 15 to 20 per cent. In children, according to Barthez and Rilliet and Gerhardt, 10 per cent. In our own hospital 592 cases have been treated, with 48 deaths, giving a mortality of 8 per cent. It is obvious that too much reliance must not be placed upon these figures, as in the different hospitals a different proportion of severe cases may be admitted, or the mild and abortive cases may or may not be reckoned as attacks. Infants suffering from enteric rarely find their way into hospital.

Enteric fever spreads by direct contact with the sick, by means of emanations from both fresh and stale fæces, possibly also by the breath, by inhalations of sewer gas given off from drains into which the excretions of enteric patients have been thrown, and by the taking of drink or food which has become contaminated by the bacillus of Eberth. There is reason to believe that infection may be carried from the sick to the healthy on the fingers or clothes of a third person. The evidence that enteric fever is directly contagious, the disease being contracted by coming in contact with a patient, is too strong to be explained away—notably the evidence produced by Collie at the Homerton Fever Hospital; and in our own hospital in past times nurses used to contract the fever from patients; and we have known it to happen that patients in the same ward with cases of enteric fever, who have never been out of bed, have contracted the fever, doubtless by the bacillus having been brought to them by one of the attendants. It appears to spread in this way in the crowded homes of the poor, where one member, mostly one of the children, contracts the disease, and remains at home, being nursed in a room where others sleep; then in the course of two or three

weeks other members are attacked. Indeed no disease is more certain to spread in the crowded dwellings of the poor than enteric fever. The inhalation of dust may be the means of communicating the disease. Probably also flies may act as carriers.

Incubation.—Usually fourteen to twenty-one days.

Symptoms and Course.—In every epidemic cases may be met with which are so mild that they can only be recognised as enteric as they occur in the same house with other undoubted cases. In such cases the temperature may be from first to last intermittent, being perhaps 102° or 103° in the evening, and falling nearly to normal the following morning ; evidently these cases were included by the older writers under the term 'infantile remittent fever.' Other cases, which begin like an ordinary attack, abort by the end

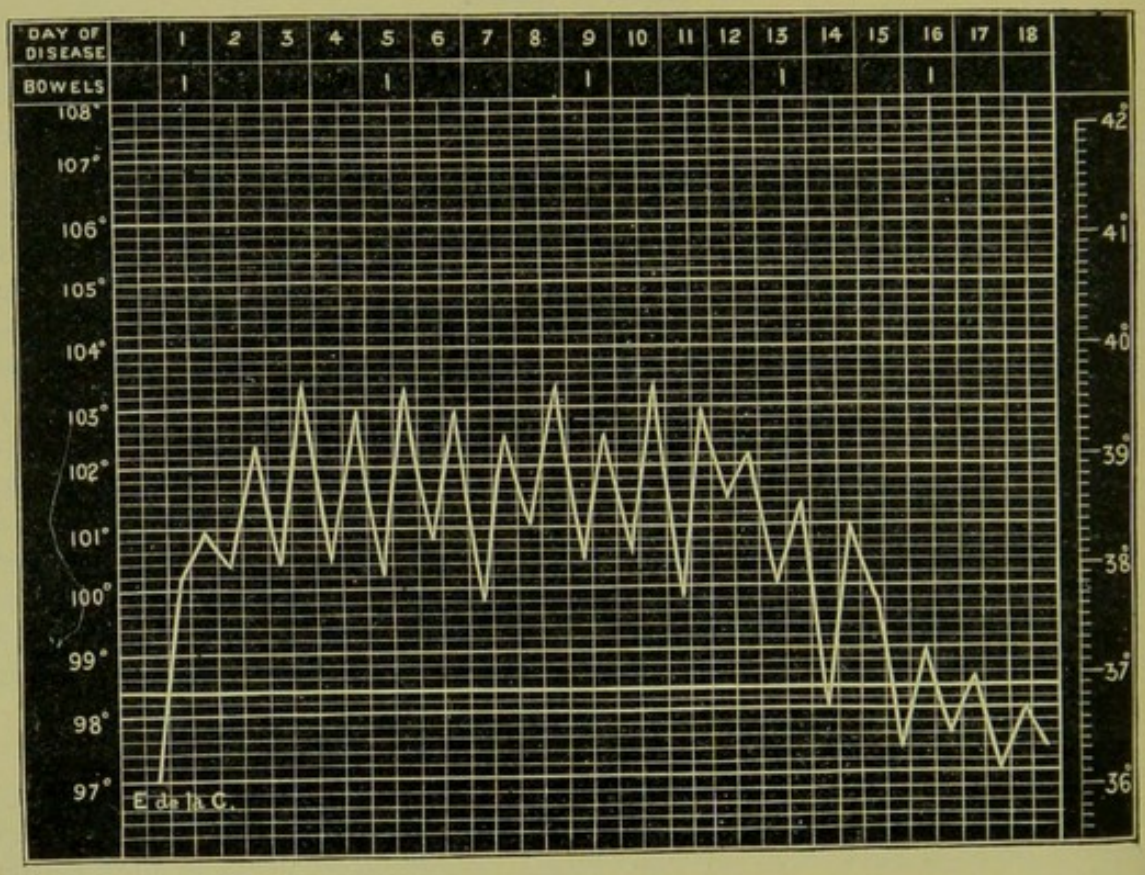

Fig. 63.—Temperature Chart of a case of Mild Enteric Fever in a boy aged 9 years.

of the second week, and are at once convalescent without going through the ordinary three weeks' course. In other cases the morning remission is much more marked, being perhaps three or four degrees lower than the evening, and this tendency is especially shown after the middle of the second week. In these mild cases the patient does not appear ill ; in the morning the child will be seen sitting up in bed playing with his toys ; and but for a heavy look about the eyes and a glance at the temperature chart over the bed, it would be difficult to persuade oneself that he was suffering from any febrile disease. Such patients are often brought to the out-patient rooms of dispensaries, and are not considered by their parents as anything but 'out of sorts.' There is rarely diarrhœa in the milder cases. On the other hand, cases of great

severity may be met with in children, the fever may run high and last for many weeks, or fatal complications may supervene, or death may take place early in the disease from the intensity of the poison, as in the case of a child of three years coming under our notice who died as early as the eighth day.

Initial Symptoms.—These mostly come on gradually, though exceptionally there is a somewhat sudden onset ; the fact that the onset in any case has been abrupt does not certainly negative the diagnosis of typhoid fever. Frontal headache is nearly always complained of, with a feeling of chilliness which induces the patient to sit over the fire ; there is usually 'rambling' at night, less often abdominal pain, diarrhœa, and epistaxis.

Temperature.—In an attack of ordinary severity the evening temperature reaches 104° by the fourth evening, continuing to reach this point or thereabouts once daily for about ten days, the diurnal remissions usually being 1° to 2° ; the remissions then become more marked, amounting to 2° or 3°, the fever gradually subsiding by lysis, and of an intermittent type, remaining normal after the twenty-first day (see fig. 64), though perhaps touching normal a day or two before. The highest temperature of the twenty-four hours is usually at 4 or 5 P.M. ; later in the attack it is postponed, and reaches its highest point at 8 P.M. or midnight. In mild attacks there is a marked tendency to remit 2° or 3° or more early in the attack, and to abort at the end of the second week, in a way which is rare in adults.

Hyperpyrexia is the exception in children ; in a few cases a temperature of 105° or even 106° may be reached, but the usual maximum temperature during twenty-four hours in the first ten days is 103° to 104°.

The temperature curve of a relapse differs very much in different cases ; it is usually of a remittent type. It is hardly necessary to insist that the temperature should always be carefully taken during enteric fever, as it affords the best index we possess of the severity of the disease or the patient's progress to recovery.

Tongue and Mouth.—During the first week there is usually nothing characteristic about the tongue ; it is coated with a thin white fur, but is clean and moist at the edges ; there is often a glazed clean strip down the centre. It may remain moist and furred throughout, while later, especially in cases of moderate severity, the tongue is covered with a brown fur, dry, with a brownish glazed central strip. Later the tongue becomes clean, red and glazed ; sometimes there are superficial ulcerations on the surface. Sordes very readily collect on the teeth, and the mouth becomes fœtid if not cleansed.

Abdomen.—The abdomen does not become distended till the end of the first week ; during this time the distension gradually becomes more and more marked from the accumulation of gases in the small intestines ; at the same time a certain amount of pain on deep pressure may be elicited and gurgling detected in the iliac fossæ. By the end of the third week, if the temperature has become normal, the abdomen becomes less rounded, and gradually returns to the normal condition. In mild cases the abdomen may be normal from first to last.

Spleen.—The spleen usually enlarges during the first week ; the earliest day on which we have felt it to be enlarged was in one case on the sixth day.

It continues enlarged and somewhat soft during the pyrexia; according to Jacobi, if the spleen remains enlarged after the temperature has fallen, a relapse is to be feared. In some cases there is no enlargement to be felt during life, and the *post-mortem* has revealed a spleen of normal size.

Bowels.—Typical 'pea-soup' stools are the exception in children; certainly diarrhœa is not usually a prominent symptom. The bowels may be constipated or normal, they may be simply loose, or there may be the watery pea-soup stools characteristic of the disease. As a rule it is the severe cases which have troublesome diarrhœa, but cases may be severe with high temperature and prolonged course without diarrhœa being present. During convalescence constipation is apt to be troublesome, on account of the atony of the bowel left by the disease.

Cerebral Symptoms.—Slight delirium at night with a tendency to talk and chatter nonsense is common: acute delirium like that present in typhus or acute pneumonia is rare. After a severe attack the mind sometimes remains weak, a condition of dementia existing for some weeks; sometimes aphasia is left; more often the loss of speech is due to mental weakness. The prognosis is good, the mind recovering as the system gathers strength.

Eruption.—The characteristic rose spots are present in about 75 per cent. of the cases. The spots may be detected by the end of the first week, rarely earlier; fresh spots appear daily till towards the middle of the third week; they may go on longer, into the fourth or even fifth week. They often reappear during a relapse. Their numbers vary from two or three to many hundred, so that the child has a freckled appearance.

Urine.—If the temperature is high and continuous, albumen in slight quantity is mostly present. The urine is high-coloured and concentrated. During the second and third week the urine gives usually Ehrlich's diazo-reaction. It is often negative in mild cases.

Blood.—Widal's test has taken a prominent place in the diagnosis of enteric fever during the last few years. It depends upon the property which the blood serum of a patient suffering from enteric fever has of producing the phenomenon known as *agglutination.* Blood is obtained from a sterilised finger, collected in a capillary pipette and transmitted to a laboratory. The result may be doubtful during the first week, but is positive by the seventh day.

Enteric Fever in Infants.—It has long been recognised that the diagnosis of enteric fever in infants and young children is a matter of considerable difficulty. An infant will have an intermittent temperature for a couple of weeks or more, with no other definite symptoms, and there may be no cases of enteric known in the neighbourhood; the attack is attributed to enteric, but there is a feeling of some doubt in the mind of the medical attendant. The diagnosis in these cases is the result of exclusion, or rather was so before Widal established the value of the blood reaction test. Even the *post-mortem* examination has, in some cases at least, left the diagnosis of enteric in doubt, as in infants and young children swollen Peyer's patches and ulceration may be due to enteritis rather than to enteric fever. The younger the subject, the more nearly the lesions of enteritis resemble those of enteric (Miele).

It is difficult to say if the comparative rarity of enteric in infants is due to some immunity or to the fact that they have less chance of being infected by Eberth's bacillus than older children or adults. That they do suffer from enteric at times is founded on certain evidence. Gerhardt's case is one of the youngest on record, viz., an infant 30 days old, who was born while the mother was suffering from this fever (see *infra*). Marfan has observed enteric fever in three cases, aged respectively 9 months, 15 months, and 18 months. Miele has given a careful description ('Revue d'hygiène et de médecine infantiles,' 1902) of four cases of enteric, aged 2 years, 16 months, 9½ months, and 6 months; in all the cases Widal's reaction was positive. They all recovered. Heubner has also described cases of enteric in infants of 7 months and 10 months respectively. Speaking generally, the fever is intermittent in type, running a course of two or three weeks more or less, and frequently accompanied by bronchitis or broncho-pneumonia. The

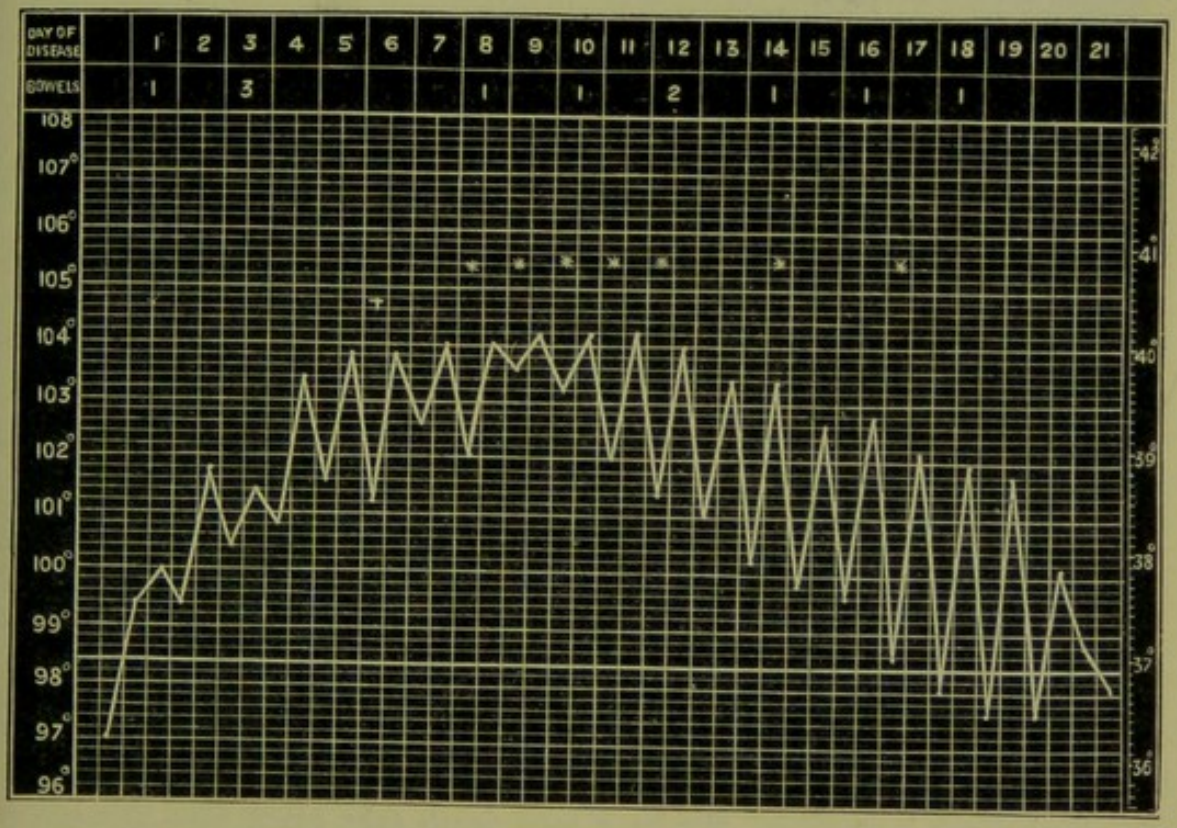

Fig. 64.—Temperature Chart of a case of Enteric Fever in a girl aged 9 years.
* Rose spots; † spleen felt.

eruption is often absent, the spleen is enlarged, vomiting is frequent, diarrhœa rare. There is marked loss of flesh. Widal's reaction is positive at the end of the first week, it has been noted as late as the sixteenth and eighteenth day (Miele); there is no albuminuria, the diazo-reaction of Ehrlich is mostly distinct. The abdomen is for the most part distended as in the case of older children and adults. Other complications are not usually present, but fatal hæmorrhage from the bowel has been recorded in an infant of 23 months.

Are typhoid bacilli transmitted from the mother to the fœtus? Hicks and Trench collected ten cases in which the bacilli were found in the fœtal organs or blood, having passed from the blood of pregnant women suffering from

typhoid fever into the fœtal blood. Positive reactions (Widal's test) have also been noted in the fœtal blood.[1]

Complications.—The same complications that occur in adults are found also in children. There is the same tendency to **relapse,** there may even be more than one. Not infrequently the relapse is more severe than the primary attack; death from perforative peritonitis may take place in a relapse. The interpyrexial period is very variable. Thus in a severe case the temperature touched normal on the twenty-first day, was then intermittent till the thirtieth, then normal till the thirty-fourth, then a relapse occurred, the temperature varying from 102° to 104°, till it reached normal again on the fifty-third day; recovery followed. In another case the primary fever ended on the nineteenth day, a relapse occurred on the thirtieth, lasting till the fiftieth. In another the primary fever ended on the twentieth, the relapse occurred on the twenty-eighth, and lasted till the forty-second. In another the primary fever ceased on the twenty-fifth, and a relapse occurred lasting from the twenty-seventh to the forty-sixth.

Epistaxis is not uncommon as an early symptom, and is of no importance. Small quantities of blood in the stools are common during the second and third week, and if small in quantity need not be a cause of alarm. Smart **hæmorrhage from the bowels** is rare, though serious when large in amount, yet we have not seen a fatal case result from it in a child. We have seen severe hæmorrhage in three cases, all, however, ending in recovery. In one case, a girl of 11 years, there was a fall of temperature on the twenty-seventh day, from 103·2° to 98·8°, followed by a hæmorrhage of 10 oz. of blood per rectum; another hæmorrhage occurred on the thirty-first day, and again on the thirty-second day some 12 oz. were passed; she eventually recovered. In another case, in a boy of 12 years, who was admitted after having been ill a month, the same evening there was a large hæmorrhage per rectum, sufficient to blanch his lips, and for the time he was nearly pulseless; he finally recovered.

Bronchitis and **pneumonia** come on in many of the severe cases; they occur quite independently of a chill or from taking cold; they are due rather to stasis of blood in the lungs, mostly at the bases, and possibly also to the local working of the specific bacillus of enteric fever. Diminished resonance with râles and rhonchi are detected at one or both bases if pneumonia is present. The temperature is usually high, and the pulse and respiration are increased. We have seen death take place from this cause on the nineteenth, twentieth, twenty-first, twenty-third, and thirty-fifth days. The pneumonic lung is of a purplish colour, has a solid airless feel, and is often more or less collapsed on section; the cut surface is not granular like croupous pneumonia, but smooth and dark red. The lung is airless and sinks in water.

Pyæmia, with secondary abscesses in the lungs and elsewhere, the result of septic embolism from the ulcers in the intestines, occasionally occurs. In four of such cases dying in the Children's Hospital, the course of the disease was acute, with hyperpyrexia and an intermittent temperature towards the close; one died on the nineteenth day with suppuration in the parotid, the

[1] 'Typhoid fever and pregnancy, with special reference to fœtal infection,' Hicks and Trench.—*Lancet,* June 3, 1905.

others on the twenty-fifth, twenty-ninth, and thirty-seventh days respectively. At the *post-mortem* pyæmic abscesses, due to infarcts, and pneumonia were found.

The most dreaded complication in enteric fever is **perforation of the intestine** followed by **peritonitis**, in consequence of an ulcer penetrating through the wall of the intestine. This complication is fatal with very few exceptions, though it is difficult to say if it always is, as cases with symptoms of peritonitis sometimes recover, and it is not unreasonable to suppose that at times no extravasation may take place, the affected portion

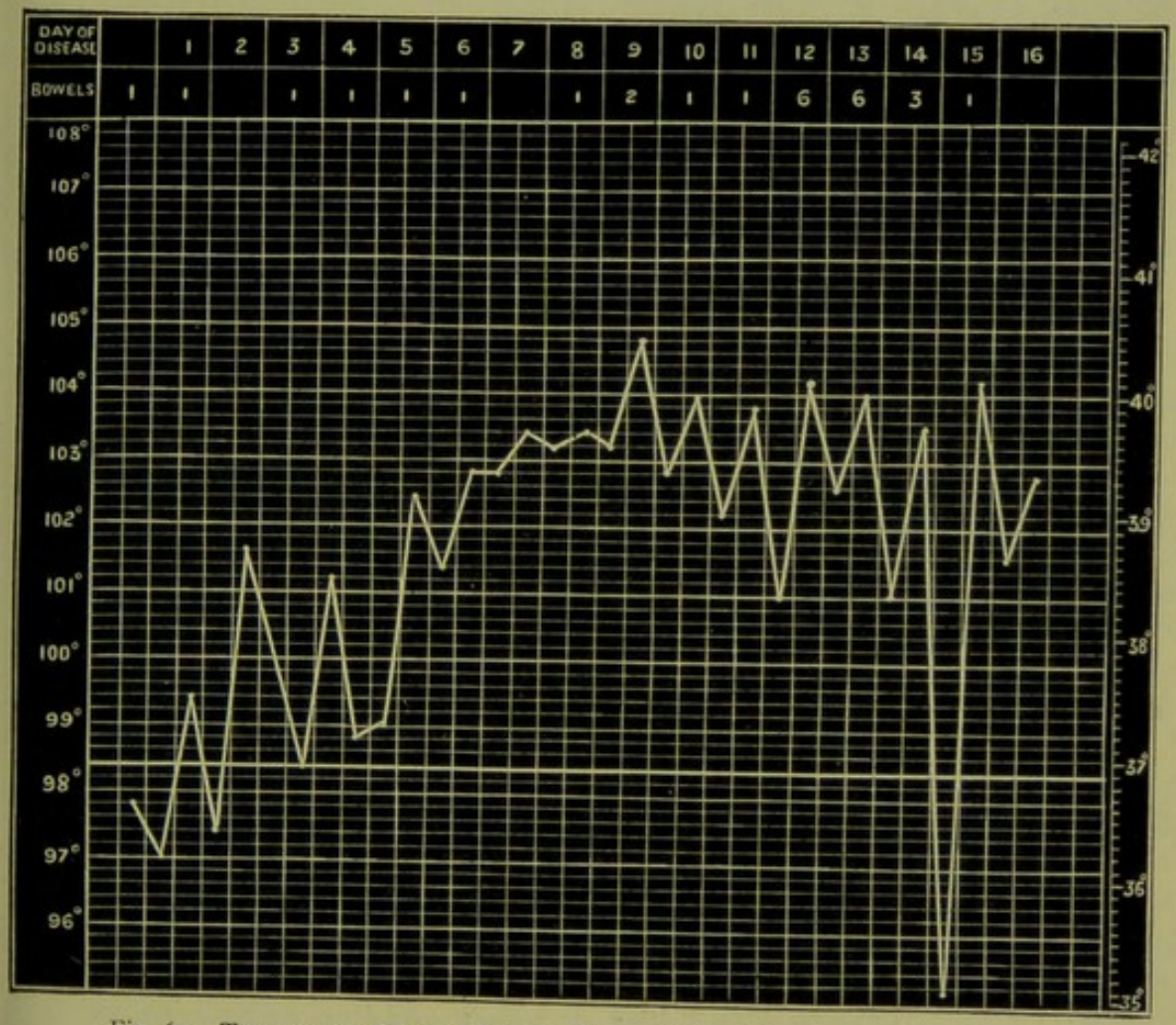

Fig. 65.—Temperature Chart of Enteric Fever; Peritonitis; death sixteenth day in a girl of 9 years.

having become glued by means of lymph to another piece of intestine. In four of our cases death occurred on the sixteenth, twenty-second, thirtieth and forty-eighth days respectively. In the case in which death occurred on the sixteenth day, it was not certain if it was the sixteenth day of the primary fever or of a relapse, as there was a history of indefinite illness before admission. The temperature on admission was normal, though there was some rhonchus and râles were heard in the chest; the disease ran an acute course (fig. 65) for fifteen days, when suddenly there was collapse, the temperature falling abruptly, with vomiting and abdominal pain; the temperature rose again to 104°, death occurring next day. A perforation in the ileum, three

inches from the cæcum, was found, with extravasated fæces and general peritonitis. In all the cases there was abdominal pain and collapse a day or two before death. In the case in which death occurred on the forty-eighth day, the girl had been ill three weeks before admission, and the attack treated in the hospital may have been a relapse. There was hyperpyrexia and intermittent fever.

Some cases of enteric begin with tonsillitis and **membranous exudation** on the tonsils ; occasionally sloughing tonsillitis supervenes in the course of the attack ; this was so in one fatal case, in another a membranous laryngitis occurred causing death on the twenty-first day. **Otitis** may occur, and occasionally a fatal result follows from thrombosis of the lateral sinus and pyæmia.

Tuberculosis may complicate the course of enteric fever, or it may follow as a sequela. In one case a child died of pneumonia on the twenty-first day ; tubercles were present on the pleura and in the lung. In another case a girl recovered from enteric, the temperature becoming normal on the twenty-sixth day ; it remained normal for a few days ; she continued to improve for a month, though the temperature went up occasionally at night. Then hectic fever came on, with vomiting, and she died comatose three weeks after ; the *post-mortem* showed tuberculous meningitis and a few tubercles in the lungs.

Diagnosis.—During the first week the diagnosis of enteric is difficult, often impossible ; and especially in children typhoid may be confounded with the feverishness which so often accompanies dyspepsia and intestinal catarrh. Children are frequently brought to the out-patients' rooms of children's hospitals with indefinite symptoms and feverishness ; a tentative diagnosis of enteric is made, but in a few days the symptoms disappear and the child is practically well again. Such attacks may be more severe, and it may be impossible to say whether the patient has had an abortive enteric attack or not, unless there are undoubted enteric cases in the household. In all doubtful cases, in the early stages, the temperature should be carefully taken every four hours and a careful examination made for rose spots and enlargement of the spleen. The diagnosis in small children and infants is extremely difficult, on account of the many causes, such as patchy catarrhal pneumonia, intestinal catarrh, influenza, and tuberculosis, which may give rise to an intermittent or remittent fever ; it must have occurred to almost every medical man in practice to have seen babies or young children with an intermittent fever lasting two or three weeks or more, with rounded abdomen, but no distinct enlargement of the spleen, rose spots, or diarrhœa. Here diagnosis may be impossible without the aid of serum-diagnosis. It is possible that these continued febrile attacks are due to some other form of bacillus, as the colon bacillus, when Widal's blood reaction test is negative. The diazo-reaction of the urine is of value if positive.

Acute Miliary Tuberculosis and enteric may be very similar, and for a week or two the diagnosis may have to be held in abeyance. Careful temperature-taking every four hours will often greatly aid the diagnosis. In acute tuberculosis the fever is mostly intermittent, the diurnal ranges being perhaps 3° to 5° ; there are no true spots, rarely diarrhœa ; miliary tubercles may occasionally be detected in the choroid, crepitation may be heard in the

lungs, or there may be some want of resonance at one apex ; the abdomen is not usually rounded. **Tuberculous Meningitis** in the early stages may simulate enteric. A child who is seen for the first time, recovering from typhoid fever, being anæmic, wasted, and having perhaps some cough with rhonchi heard on examining the chest, and possibly bedsores, might readily be thought to be suffering from **Chronic Tuberculosis.** If there is diarrhœa and abdominal tenderness, the two diseases at this stage may be still more alike. A careful examination of the lungs would generally distinguish between the two, as in chronic tuberculosis some consolidation at the apices or elsewhere would usually be found. **Pyæmia** may resemble enteric fever, especially in those cases where the pyæmia is secondary to some bone disease without any external wound. A case of pyæmia secondary to Pott's disease of the spine, with abscesses in the lungs, which came under our care was thought for a few days to be enteric fever ; but the daily ranges of temperature are more extreme, the type more markedly intermittent, in pyæmia than typhoid. A rounded distended abdomen, with a pimply rash, may certainly occur in other diseases than enteric, though when true rose spots are present they are characteristic. (See chapters on BONES AND JOINTS.)

Morbid Anatomy.—The solitary glands and Peyer's patches are swollen in catarrh of the bowel, enteritis, also in scarlet fever and septicæmia, as well as in enteric fever. Ulceration occurs in the later stages of enteritis, ileo-colitis, and tuberculosis, as well as in typhoid. In a typical case of typhoid there is usually no difficulty in making a *post-mortem* diagnosis, as the swollen condition and ulceration of Peyer's patches, enlargement of the spleen and absence of tubercle are sufficiently characteristic. If death takes place early in the disease, there may be more difficulty. Eberth's typhoid bacillus is with difficulty distinguished from other bacilli in the fæces, but if present in spleen pulp or juice, then its diagnostic value is much greater.

Treatment.—The management rather than the medicinal treatment of typhoid fever is of the greatest importance. The patient must of course be put to bed in a cool room, and arrangements made for both night and day nursing ; it is needless to emphasise the importance of a trustworthy nurse at night to feed and attend to the patient's wants and soothe him to sleep. Sponging with warm water, to which some Condy's Fluid or Sanitas has been added, should be performed every evening before settling the patient for the night, great care being taken to cleanse the buttocks and anal region, especially if the patient is suffering from diarrhœa, as the stools are apt to be smeared about. To keep the patient's back scrupulously clean is a matter of importance in the prevention of bedsores. The patient's mouth must be carefully attended to, and cleansed, by means of a paint brush or rag, of decomposing food and foul secretions ; the more ill and insensible the patient is, the more important does this become. Condy's Fluid or dilute solution of boro-glyceride may be used for the purpose. The diet should consist of milk diluted with barley water or soda water, and in amount should be suited to the age. During the pyrexial period milk is better taken than beef tea or other savoury foods, which as a matter of fact are quite unnecessary. The more thirsty the patient is, the more must his milk be diluted, lest too much curd remain undigested in the stomach and intestines, and give

rise to flatulence and discomfort ; a pint and a half to a quart of milk daily will be sufficient. An excess may give rise to diarrhœa or accumulate in the large intestine as hardened fæces. In the later stages, when the tongue is cleaning, beef tea is usually taken well, and forms a pleasant change of diet. Where milk does not agree, or when the diarrhœa is troublesome, peptonised milk or Benger's Food should be given. It is well to continue the fluid diet till a full week after the temperature has become normal. Our usual practice is to allow sops in the milk or beef tea on the thirtieth day, at once discontinuing it if the temperature rises. In mild or medium cases alcohol is unnecessary. No medicine is required ; a simple saline may be given. The treatment of hyperpyrexia must depend upon the effect which it has upon the patient, though in any case, if the temperature rises to 104°, sponging the head, trunk, and limbs with water at 60° should be resorted to, or the cold pack may be given, provided there is no immediate risk of peritonitis. If the temperature is not kept in check by these means, but the fever is not making the patient drowsy or delirious, no other means need be taken except perhaps applying an icebag to the head. Other means are however available, such as the administration of phenacetin or quinine, and the graduated bath. Antifebrin and antipyrin are best avoided, as too depressing. In the early stages, with due care, the graduated bath is useful in reducing temperature ; in the later stages it is contra-indicated on account of the disturbance to the patient which it entails. The patient may be placed in the bath at a temperature of 100°, and cold water added so as to reduce it to 70° or 80°, though it is rarely wise to allow the child to remain in longer than five minutes. Excessive diarrhœa should be checked by starch and opium enemata, or Dover's powder by the mouth ; sleeplessness and delirium by a wet pack or small doses of nepenthe, the latter being more useful than bromides, chloral, or urethan ; abdominal pain or tenderness is best treated by nepenthe in free doses by the mouth, and opium fomentations, while the food and liquids taken are reduced to a minimum compatible with safety; pneumonia by stimulating applications such as mustard poultices or turpentine stupe, the latter being used with great care on account of the sores apt to be produced. Any signs of cardiac depression must be combated by alcohol in the form of mist. vini gallici, or champagne, or by caffeine, ammonia, ether, or digitalis.

It is often an anxious question to decide as to whether a laxative should be given when the bowels are constipated, inasmuch as a patient is rendered more comfortable by a free action of the bowels, and the distension and discomfort are lessened. On the other hand, one fears that the peristalsis set up by a purgative or even an enema may do irretrievable damage by converting an ulcer into a perforation or tearing down adhesions of lymph which have formed. At the same time it must be remembered that hard lumps of fæces irritate the bowel and fret and rub the ulcers, and in some of the worst instances of extensive ulcers in fatal cases we have found numerous hard lumps of fæces in the lower part of the ileum and large bowel. Some doses of castor oil during the first ten days are often beneficial if the bowels are confined ; after this time enemata are safer, though they are not free from risk, and should certainly be avoided if there are signs of peritonitis. If severe hæmorrhage from the bowel occur, the greatest care must be taken to give the child only the smallest quantities of food by the mouth and to keep him as quiet as

possible. An ice bag should be placed on the abdomen and a grain of ergotin given subcutaneously and repeated every two or three hours. Opium should be given in small doses if there is much restlessness. Turpentine or terebene in two or three drop doses in mucilage is useful as a stimulant and hæmostatic. For perforation-peritonitis, see p. 133.

Can we *abort* enteric fever by giving laxatives or antiseptics? This is a disputed point, inasmuch as enteric frequently aborts, especially in children, without the help of drugs, and the diagnosis in the early stage is difficult. We certainly believe that the danger of setting up perforation-peritonitis by giving purgatives has rather frightened us unnecessarily into the too sparing use of evacuant remedies such as calomel or castor oil. Small and repeated doses of calomel or castor oil during the first ten days may be safely given, and in many cases with great benefit. We are less inclined to the heroic doses of calomel advocated by some physicians.

During convalescence dyspepsia and constipation are frequently troublesome; flatulence and a rise of temperature are very apt to follow any excess of starchy or any indigestible food, especially in early convalescence. The food should consist of meat essences, of broths, jellies, pounded meat, chicken, and fish, with small quantities of toast or stale bread. Good sherry with a grain or two of pepsine and some liquid malt extract are often very useful. The constipation is usually slow in disappearing; purgatives should be avoided, as the constipation is simply due to wasting of the muscular fibre of the bowel and weakened secretions. In this condition the mineral acids, strychnine, cascara sagrada and bitters are of most use.

Typhus

During an epidemic of typhus children suffer equally with adults, though the mortality is exceedingly small. It is probable that the fact that children usually suffer from the disease in a mild form, and but few die, has given rise to the general belief that children are less susceptible to the typhus poison than are adults. That this is not the case has been shown conclusively by Dr. Buchanan, who, after referring to the slightness of the fever in children, says: 'When inquiry as to age is made to include every case of attack, children and adults are found to be equally susceptible; the actual incidence may even be observed to be strongly upon the young, partly because of their greater numbers and partly because adults are frequently protected by previous attacks.' That many children are attacked with typhus is shown by the statistics of the Homerton Fever Hospital (given by Collie), for out of 711 admissions of typhus to the hospital during the period 1871–1880, 24 were under 5 years of age, 54 from 5 to 9 years, 113 were from 10 to 14 years of age; it is more than probable that the proportion really attacked as compared with adults was much greater, but on account of the mildness of the fever they were nursed at home and not sent to hospital. Only two deaths took place among the 191 children under 14 years of age admitted, while the total mortality was ten times greater, being nearly 20 per cent.

Symptoms and Course.—The symptoms and course do not differ from those seen in adults, with the exception of their usually greater mildness. The attack commences with headache, pains in the limbs, drowsiness, more

or less shivering, sometimes vomiting, rarely diarrhœa. This history closely resembles that often obtained in scarlet fever, and this should be borne in mind, as a hasty conclusion as to the nature of an attack may be a wrong one. If seen for the first time at the end of three or four days, there is a listless expression on the face; it is flushed, the eyes suffused, the conjunctivæ injected; the child may answer questions if spoken to sharply, but is drowsy, semi-delirious, and irritable if interfered with. The tongue is dry, coated with a brown fur, and protruded with difficulty, the lips are black, there are sordes on the teeth, while the gums easily bleed. An examination of the

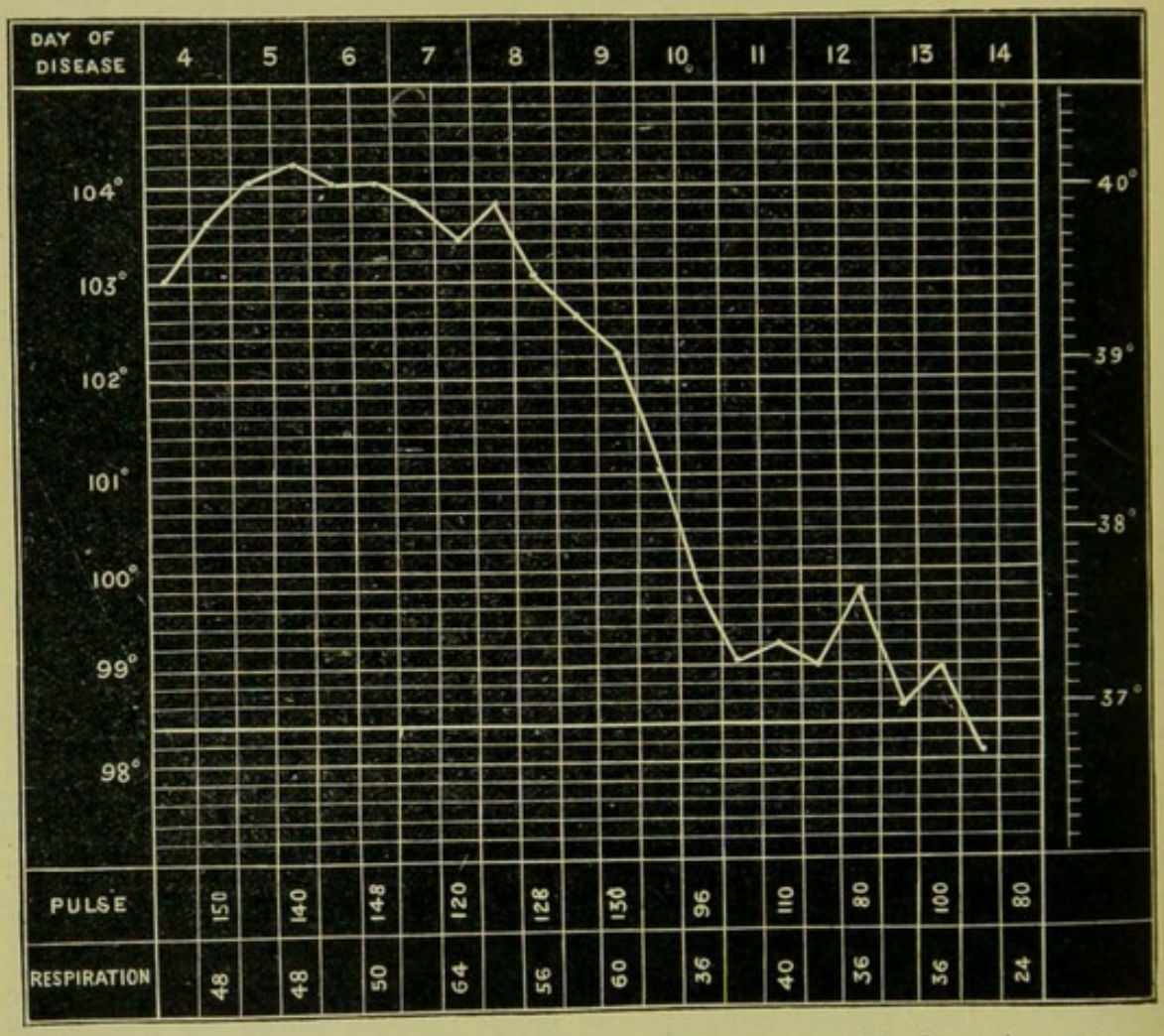

Fig. 66.—Temperature Chart of Typhus Fever, ending in recovery. Eliz. G., aged 7 years.

lungs reveals the presence of rhonchi, perhaps râles, and some loss of resonance at one or both bases. On the fourth or fifth day the rash usually appears; the skin has a dusky congested appearance, with an indistinct mottling, in addition perhaps to petechial points, due to flea bites; for our patients with typhus usually come from the dirtiest and most squalid quarters. Perhaps a dusky mottling is all that can be seen, but in more typical cases the rash is more definite, consisting of rose-coloured spots, or maculæ, larger than typhoid spots, and with more ill-defined margins, scattered over the body. According to Collie, they are first seen on the sub-clavicular regions, along the lower border of the pectoralis major, on the wrists, back of

the hands and epigastrium. We have sometimes noted the rash especially well marked on the dependent parts of the body, sides of the thighs, and arms, and back, extending along the neck on to the cheeks, and present also on the dorsum of the feet. The temperature is usually continuously high, 103° to 104°, the pulse small and weak, perhaps 120 to 130, and there is some cough, and frequently much delirium or wandering at night. The fever may last for two weeks; more frequently the symptoms undergo marked amelioration after the first week, and possibly the temperature declines to normal by the eighth or tenth day, all the symptoms becoming milder and the rash disappearing without becoming petechial, as it often does in adults. The rash may be only visible for a few days or may fade as the fever becomes less. While the above description applies to a typical case in a child, very severe cases may sometimes be met with, though far oftener the symptoms are decidedly milder. The tongue may never be brown, only coated with a white fur; the rash may consist of a dusky mottling only; there may be drowsiness without active delirium. The late Dr. Tomkins observed in some of his cases at Monsall Fever Hospital that there was marked torpor and lethargy during the first few days, so that the child was with difficulty aroused to take food.

Diagnosis.—It is obviously important to recognise typhus, though the attack may be mild, as such cases are of course infectious and may spread the disease. Dr. Tomkins recorded the case of a woman who contracted a fatal attack by sleeping with a child suffering from mild typhus, the cause of the child's illness not having been recognised.

The fact that typhus occurs in epidemics and is apt to prevail in the overcrowded and poverty-stricken quarters of a large city often helps the diagnosis; but occasionally an epidemic breaks out in a school or in the homes of the well-to-do. The onset of the attack may suggest scarlet fever; the high fever, drowsiness, and dusky condition of skin present in a malignant case of the latter disease might render the diagnosis doubtful at first; but the condition of the tonsils would usually clear up a doubt if the characteristic rash of scarlet fever was not present. Nevertheless we have seen a case fatal in two or three days that gave rise to some doubt, and in the absence of a *post-mortem* was never cleared up. The disease most likely to be mistaken for typhus is **acute pneumonia** (Collie); this is in accord with our own experience, as we have seen cases of acute 'cerebral pneumonia,' with physical signs delayed, sent into hospital as typhus; the mistake is likely to occur, as in most cases of typhus some râles or rhonchi are to be heard.

In 'cerebral pneumonia' the lesion is often at the apex of the lung; if seen on or after the fourth day of illness, and there is bronchial breathing or dulness, or some high-pitched resonance over a portion of lung and no rash, the disease is almost certainty acute pneumonia A dusky or mottled skin, brown dry tongue, râles or rhonchi scattered over the whole lungs or bases, would indicate typhus. **Enteric fever** may be mistaken for typhus, especially when acute, but the insidious nature of the onset, the absence of marked delirium or torpor, the tenderness on pressure over the abdomen, and the rose spots usually suffice to make a diagnosis. We have seen some cases of typhus where there was a good deal of general hyperæsthesia and

muscular tenderness, where pressure on the abdomen evoked expressions of pain.

Prognosis.—This is mostly good, but fatal cases sometimes occur, the children succumbing in the first few days of the fever from the intensity of the poison.

Treatment.—That of fever generally. Sponging with Condy's Fluid should be resorted to daily ; the apartment should be large, airy, and warm ; stimulants are required in all but the mild cases ; milk and other liquid nourishment must be given in suitable quantities. Directly convalescence has set in, a more liberal diet may be allowed.

Varicella

Varicella is a specific infectious disease closely resembling modified smallpox, though perfectly distinct from it. There are still a few who believe varicella to be a variety of smallpox, notwithstanding the many facts which point in a contrary direction ; these may be summed up as follows : the two diseases are not mutually protective—children who have recently had smallpox may contract varicella ; during epidemics of one disease the other is not usually prevalent ; smallpox affects all ages, varicella affects children almost entirely ; inoculation with the virus of smallpox produces smallpox, inoculation with the contents of the vesicles of varicella, when successful, produces only chicken-pox.

Varicella occurs in epidemics in schools, workhouses, children's hospitals, and among the poorer classes of society where there are many children in constant contact with one another ; its epidemics, however, are not so widespread as those of measles or whooping cough, nor does it affect so large a proportion of the unprotected. It affects children almost entirely ; thus in 584 cases observed by Baader in Bâle, 98 per cent. were under the age of 10 years, and 65 per cent. below 5 years of age. Adults do, however, occasionally take it. We have several times seen nurses contract the disease from children suffering from it.

Varicella can be communicated from the sick to the healthy by inoculation, by simple contact, or by infection being carried by a third person. Trousseau failed in his attempt to inoculate ; Steiner seems to have been more successful, succeeding in eight cases out of ten. The disease is most usually communicated directly from children suffering from or convalescent from an attack ; it is also certain that the infection can be carried by means of a third person, and remain in an active condition in clothes for many weeks, inasmuch as sporadic cases of the disease will occur in hospital wards in patients who have been in for months, and where no cases had occurred previously in the ward for a long interval.

Symptoms.—The *incubation* period in the inoculated cases reported by Steiner was eight days ; when contracted in the ordinary way it is usually about fourteen days, sometimes a day or two more. We have on several occasions had an opportunity of verifying this. There are usually no *premonitory symptoms* ; the discovery of papules and vesicles on the body is usually the first thing noted by the friends. In a few cases there is a diffuse redness of the body resembling the roseolous rash which sometimes precedes

smallpox, and which has given rise to the suspicion that the case is one of scarlet fever; in one case a measly rash, preceding the vesicular eruption, made it look as if the child was suffering from both measles and varicella, but of this there was no confirmatory evidence. Frequent micturition was observed in one of our cases before the rash appeared. The premonitory fever if present is of short duration, varying from a few hours to twenty-four hours, and in this respect varicella presents a marked contrast to variola. The temperature is not as a rule characteristic, and varies with the acuteness of the attack, mild cases with only a few vesicles being feverless, severe cases with a great number of vesicles being accompanied by a temperature of 104° or more. The most frequent type is the intermittent (fig. 67).

The rise of temperature is accompanied by an accelerated pulse, coated tongue, and restlessness, though in mild cases these may be absent; in a

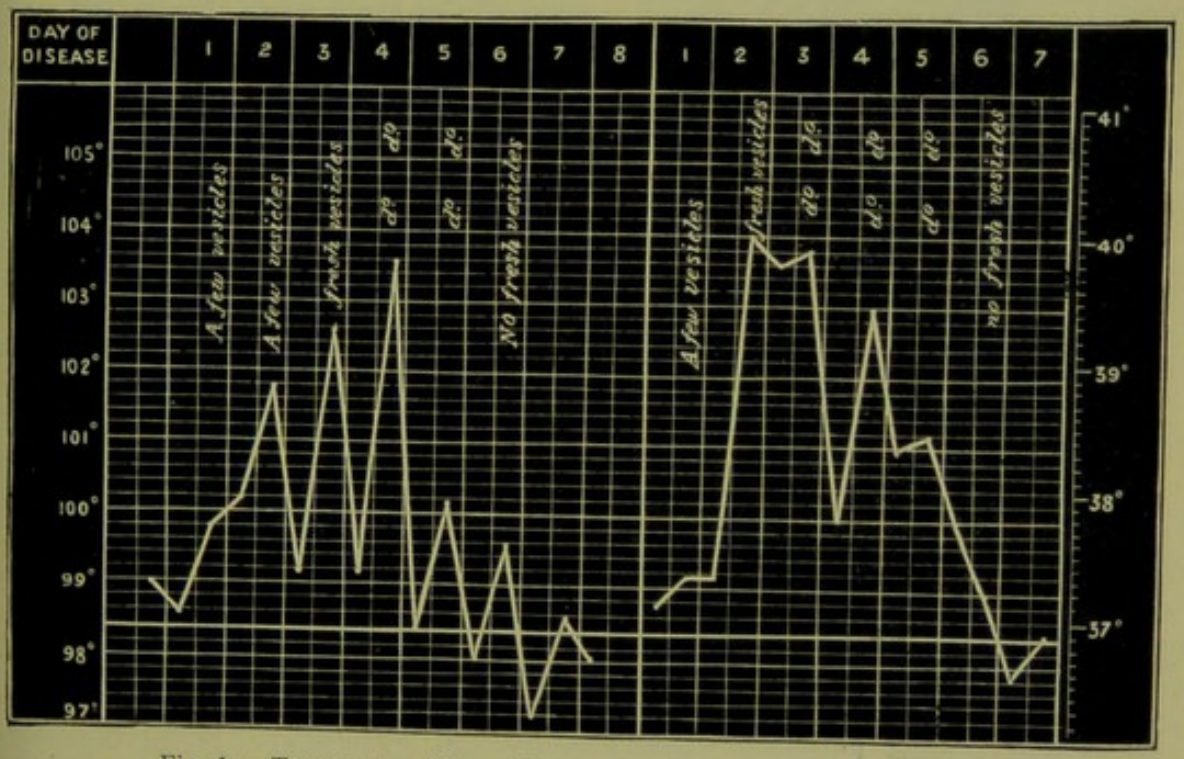

Fig. 67.—Temperature Charts of two cases of Chicken-pox in children of 3½ years and 18 months.

few hours rose spots, resembling the rash of typhoid, appear and quickly become vesicular. Probably at the time the first examination is made there will be both rose papules and minute blebs or vesicles containing clear fluid and surrounded by a zone of redness. By the next day a fresh crop of papules and vesicles will have appeared, the vesicles of the previous day are larger, perhaps some of them have aborted and commenced to dry up. Fresh crops appear on the third, fourth, fifth days, and perhaps later still, so that when the attack is at its height, as it usually is on the third or fourth day, the trunk and extremities are thickly covered with vesicles and scabs, probably also a few pustules where there has been some scratching and the tesicles have burst. The contents of the vesicles are at first quite clear; as they enlarge their contents become more cloudy, but not purulent unless

the vesicle has been injured and part of its contents has escaped. The vesicles are mostly unilocular, their upper surface is convex and collapses as soon as it is pricked, though in some cases a few vesicles may be seen more or less flattened, umbilicated, and multilocular, closely resembling smallpox or vaccination vesicles. The number of vesicles varies greatly; in some cases only a few are present, in others there may be many hundreds. They are never confluent. In the majority of cases the vesicles dry up and scabs are formed at their site; these fall off in the course of a few days, leaving clear and healthy skin beneath. In some of the worst cases this is not so; an ulcer, which may be some weeks in healing, forms beneath the scab and thus a scar is left not unlike those following severe smallpox. The vesicles make their appearance on the trunk, limbs, and scalp; they are generally more sparely present on the face, tongue, and soft palate.

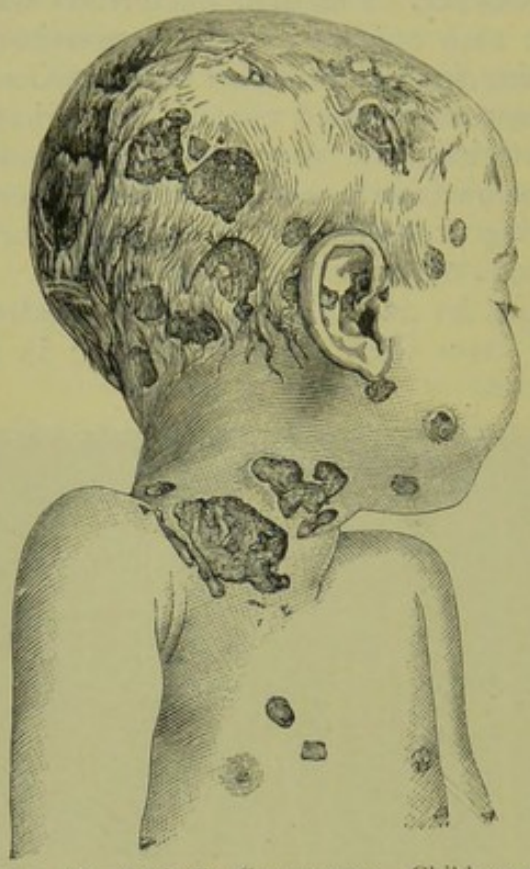

Fig. 68.—Varicella Gangrænosa. Child aged 2 years. From a photograph taken after death. The patient died of tuberculosis; she had had an attack of Varicella two months before death.

The prognosis in varicella is uniformly good, as it is apparently never fatal in a previously healthy child. In weakly and tuberculous children the varicella vesicles are apt to be followed by spreading ulcers, which, joining one another and taking on an unhealthy action, sometimes assist in bringing about a fatal result. Such cases have been described by Mr. Hutchinson under the name of **varicella gangrænosa**; they are not uncommon in the out-patient room (see fig. 68). The gangrenous action is usually associated with tuberculosis, and it is curious that in all fatal cases of this affection—as has been remarked by Dr. J. F. Payne—tubercle has been found *post mortem*. Eustace Smith has known acute tuberculosis to follow varicella, and we have also seen several such cases. Nephritis is an occasional sequela, as first noted by Henoch.

Diagnosis.—The disease with which chicken-pox is most likely to be confounded is mild or modified smallpox, but as a rule no difficulty is experienced. The points of most importance in making a diagnosis are the absence of premonitory symptoms and the character of the rash; the table on p. 331 shows these.

Occasionally a vesicular syphilitic eruption may simulate varicella, though such eruptions are rare in congenital syphilis, and when present take the form of bullæ of various sizes rather than vesicles. In one case which came under our notice, a vesicular syphilide closely resembled varicella, but there was no fever, and some brown staining followed the rash.

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VARICELLA	VARIOLOID, or modified Smallpox
Incubation.—Thirteen to sixteen days.	Twelve days.
Premonitory Fever.—A few hours.	Two or three days.
Premonitory Symptoms.—Mostly *nil.*	May include headache, backache, drowsiness, vomiting, delirium, convulsions.
Rash.—Red spots becoming vesicular in a few hours and drying up in three or four days, leaving crusts; coming out in crops on four or five successive days on the scalp, trunk, limbs, face, and mucous membranes. The vesicles are mostly unilocular.	Red shot-like papules appearing on face, wrists, body, limbs, and soft palate; in the course of a day or two the papules becoming vesicles, and developing into pustules by the eighth day, or they may dry up leaving only scabs.
Temperature.—Intermittent in character.	Sudden rise, reaches its height when the papules are fully out; then comes a speedy fall. The secondary fever is slight or absent in modified cases.

Quarantine.—How long does the infection last in varicella? No case should be considered past the infection stage until all the scabs have cleared away and the skin is quite smooth and normal. This is usually accomplished in three or four weeks. In one case which was admitted to hospital suffering from psoriasis, which had succeeded the eruption of chicken-pox, and where some unhealed ulcers were present, the admission into the ward was followed by an outbreak of the disease some fortnight afterwards. The child admitted had had chicken-pox five weeks before.

Treatment.—Not much treatment is necessary. The child should be isolated, and preferably kept in bed if there is a copious eruption. A light diet should be given, and ointment containing some tarry or carbolic compound will be useful to apply to the scabbing vesicles.

Vaccinia.—*Performance of Vaccination.*—The safest age for vaccinating infants has been in dispute, some preferring to vaccinate within a few weeks of birth and before the monthly nurse leaves, while others much prefer postponing the operation till three or even six months. Inasmuch as unvaccinated children under one year if they contract smallpox almost certainly die, no time should be lost in vaccinating infants if there is any chance of their being exposed to contagion—as, for instance, if smallpox exists in the house or is present in the neighbourhood in epidemic form. On the other hand, if the risk of their being exposed to contagion is small, it is unwise to vaccinate during the first few weeks of life, on account of the disturbance of the general health liable to follow; infants of three months or six months old bear the operation better than infants a few days or weeks old. We prefer the age of six months. It is of importance to postpone vaccination beyond the end of the third month if the infant is not robust, or suffers from diarrhœa, malnutrition, eczema, intertrigo, or if erysipelas is prevailing in the neighbourhood. Revaccination should be performed at or before puberty. If human lymph cannot be obtained from an infant of an undoubtedly healthy family, glycerinated calf lymph should be obtained, and if the latter is used, any objection to the performance of vaccination on the ground of transmitting syphilis and other diseases is obviated. The cuticle should be removed by a few scratches of a needle or lancet at the spot where a drop of lymph has been applied. After vaccination nothing is usually to be seen till

about the third day, when there is some itching and a slight redness surrounding the spot, or there may be a tiny papule. By the seventh or eighth day there is a flattened vesicle at the seat of puncture, containing clear fluid in various loculi. During the next few days a red areola forms round the vesicle and its contents become cloudy ; by the tenth or eleventh day the fluid oozes out and forms a scab on the surface, which, becoming detached, leaves a superficial ulcer, which takes a variable time to heal ; a permanent cicatrix, which is circular, depressed, pale, and pitted, is left. The size and distinctness of the scar will depend upon the ulceration which has followed the pustule ; if the latter dries up without an ulcer forming, there will be hardly any scar left. There is often some febrile disturbance from the fifth to the tenth day.

What are we to regard as the best vesicles for obtaining lymph from? According to Dr. Hugh Thompson,[1] 'they are such as, at the beginning of the eighth day (the day usually chosen for taking lymph, although not always the best), show the punctures made in vaccinating well healed with no scabbing, the vesicles depressed in the centre and elevated at the margin, containing a moderate amount of lymph, not acuminated ; that is, flat in proportion to breadth, and not having lost the inequalities, bosses and foveæ—resulting from some of the connections between the epidermis and corium still remaining intact, the areola incipient or only slightly developed. The lymph which exudes from them, on being pricked, is nearly if not quite limpid, somewhat viscid, moderate in quantity, and does not tend to run down the arm.

'As a general rule it is the finest children—those, at least, who are such in the eyes of the vaccinator: "children of dark complexion, with a thick, clear, smooth skin," as Seaton remarks, indications of a strong vigorous constitution—who furnish the finest vesicles. At the same time care must be taken to see that the child is in perfect health, and especially, by a thorough examination, that it is free of all skin diseases, and more particularly all indications of syphilis, among the most persistent and obvious of which (excepting, of course, manifest syphilides) are chronic coryza, generally from birth ; a depressed nose, open fontanelles, hydrocephalic head, turgid veins of scalp, tumid lymphatic glands. Many of the manifestations of syphilis disappear under treatment, and it is possible they may have thus disappeared without the disease being thoroughly eradicated ; but it is rare that one or more of the above may not be found if searched for. It is superfluous to caution against the smallest admixture of blood.'

Complications and Sequelæ.—These are fortunately few, though numerous and important in the eyes of prejudiced persons, and a lengthy list could be easily compiled if all the evidence collected by such were to hold good. The most important are the following : (1) **Syphilis** (see *infra*). (2) **Erythema** and **Erysipelas.** There may be an unusual amount of redness and hardness surrounding the pustules, as a result of the lymph causing more irritation than it commonly does ; this may spread down the arm, and give rise to some glandular enlargement without there being any erysipelas present. Erysipelas does occasionally occur. The erysipelas coccus may gain entrance

[1] 'Inoculation for Smallpox,' by Hugh Thompson, M.D. ; *Glasgow Medical Journal*, vol. xxvii.

into the wound at the time of vaccination ; in this case symptoms will probably arise within a few days, the incubation period being a few hours to two or three days. It is impossible to say for certain that it may not be longer. In a case which came under our notice the seat of the vaccine punctures began to become inflamed nineteen or twenty hours after vaccination. In such cases the vesicles and pustules often mature earlier than in normal cases, and a vesicle may be present on the second day, with more or less redness around the punctures. The patches of redness and œdema are migratory, as in other forms of erysipelas—that is, they do not necessarily remain in the immediate neighbourhood of the wound, but may affect the face, trunk, or any other part. The mortality of vaccine erysipelas is very high, most of the cases being fatal, death occurring in one to three weeks. It has unfortunately happened that the vaccine has been taken from the infant suffering from or incubating erysipelas, and has communicated erysipelas to infants vaccinated with it. Erysipelas may supervene at any period between vaccination and the healing of the pustules if the infant is exposed to the infection, the cocci becoming accidentally implanted into the wound. (3) **Glandular enlargement.** The axillary and cervical glands may enlarge and suppurate during the maturation of the pustules, or more commonly in the second week. We have seen several cases in infants with chronically enlarged and caseating superficial cervical glands of the left side, which had commenced to enlarge shortly after vaccination, and it appears likely that in infants of a tuberculous or 'strumous' tendency vaccination may be the predisposing cause. Similar chronic axillary adenitis is also occasionally seen produced by vaccination, just as by any other irritation. (4) **Cold abscesses** and boils may form in various parts of the body, as they will at times after all suppurations, especially in tuberculous or 'strumous' children. (5) Various rashes occasionally make their appearance, most towards the end of the week, when the vesicle is maturing. A **roseolous** rash over the body and arms, which is fugitive, disappearing mostly in twenty-four hours ; a **vesicular** rash, consisting of a few pimples becoming vesicular ; a **lichenous** rash ; and patches of **erythema** may be sometimes present. We know of no evidence which directly connects eczema with vaccination ; it is very common during infancy in one form or another, and it is not surprising that vaccination often gets the credit of producing it. An **impetigo** is not uncommon, having been produced by inoculation of the secretion from the pustules by means of the finger nails.

Varioloid or Post-vaccinal Smallpox.—Unvaccinated children suffer from smallpox in as violent a form as do unprotected adults ; indeed, according to Collie, 'smallpox is very fatal in unvaccinated children under five years of age, more than half dying, and nearly all infants under one year.'

Children who have been vaccinated in infancy who take smallpox usually suffer from it in a modified form ; there may be no rash at all, or more often the attack aborts and the vesicles dry up without passing through the pustular stage, the secondary fever being absent or only slight. Sometimes the attacks, according to Collie, are so slight that diagnosis is impossible, except from the fact that they occur after exposure to infection or in association with cases of undoubted smallpox. The premonitory symptoms may

be present—headache, feverishness, backache—which disappear before the rash appears, the attack coming to an end without any papular eruption. It is much more common for the attack to abort immediately after the rash appears, secondary fever or pustulation being absent. The premonitory symptoms may be severe—headache, backache, the temperature rising to 103° or 104° on the third or fourth day, a copious eruption of papules appearing, perhaps being confluent on the face, to be followed by a sharp fall in the temperature of perhaps 4° or 5°. The papules become vesicular and dry up with but slight if any pustulation, and the child is convalescent at once.

The temperature chart (fig. 69) was that of a child aged 10 years who was convalescent from scarlet fever, and who contracted smallpox while in

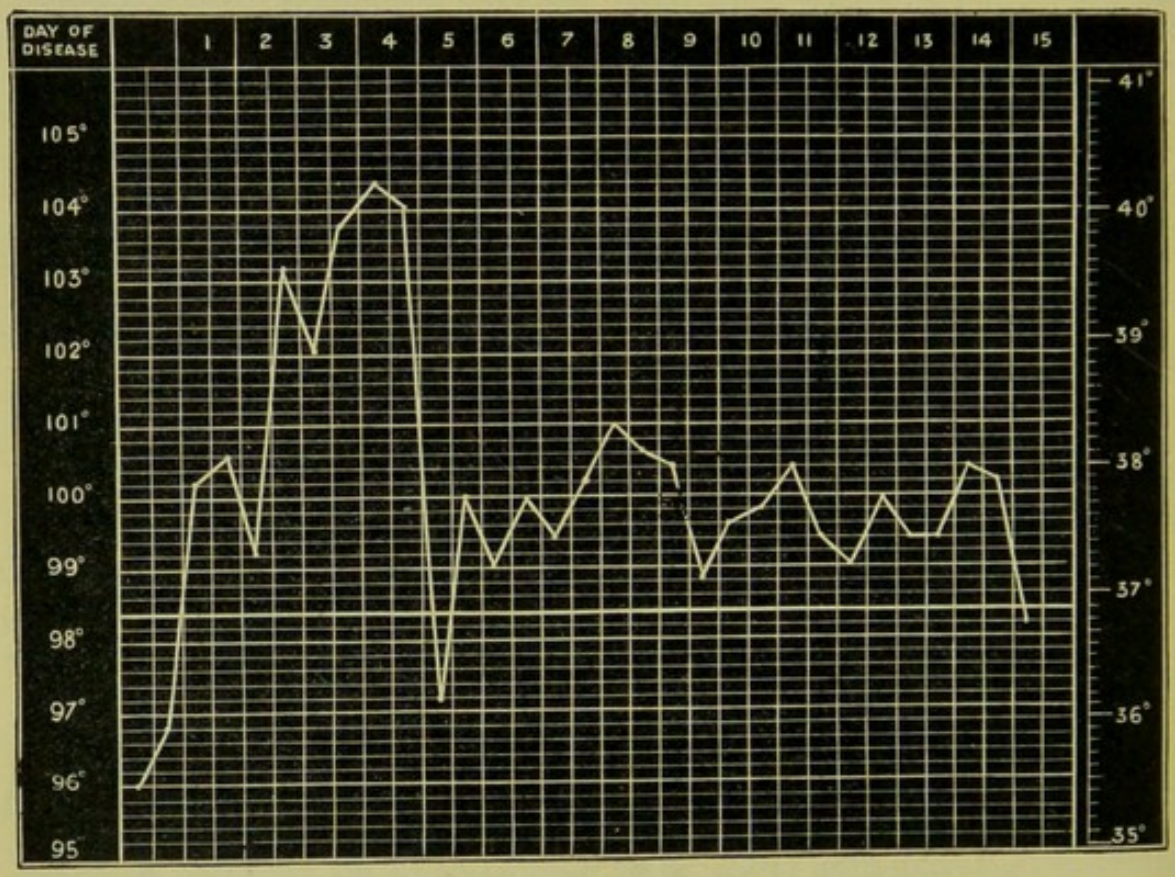

Fig. 69.—Temperature Chart of a case of modified Smallpox in a girl aged 10 years. Papular rash on the third day, becoming vesicular on the fifth.

the scarlet fever ward ; the only source of infection which could be traced was a visit of her mother twelve days before, the latter coming four miles from a district where smallpox was prevailing. There was marked headache but no pain in the back ; on the third day an erythematous rash was seen on the body, which suggested that her illness might be scarlet fever, though she had passed through a typical attack some weeks before ; on the afternoon of the same day a few tiny papules like the rose spots of typhoid were seen on the abdomen and arms, the headache was severe and the eyes suffused. The spleen was enlarged, being felt 1½ inch below the ribs. On the fourth day the face, neck, trunk, and limbs were covered with well-defined papules, many confluent. The same evening the temperature fell

from 104° to 97°. On the fifth day the eruption was copious, some of the papules were beginning to be vesicular; the vesicles quickly began to dry up and scab, no true pustules appearing. The girl made a good recovery and was not permanently pitted.

Diagnosis.—The fact that smallpox is at times a very mild disorder makes it important that it should not be overlooked, inasmuch as a mild case as well as a more severe one may be the means of spreading the disease. Diagnosis is hardly possible in the absence of a papular eruption, or the purpuric spots of the malignant form.

Treatment.—The treatment is that of fevers generally.

Whooping Cough

Etiology, &c.—Whooping cough is an infectious disease which is characterised by a catarrh of the air passages and a peculiar spasmodic cough. It prevails in epidemics which are both widespread and prolonged, though sporadic cases are generally present in large centres of population. There is no disease which is more certainly infectious than whooping cough, in the sense that if those who are unprotected by a previous attack come in contact with those suffering from it they are almost certain to take it. If one member of a household is attacked, all the other members, both children and adults, who are unprotected, take the disease. If it enter a court or alley, it is tolerably certain that all the unprotected inhabitants will suffer. It is almost certain to spread in a similar way in a school or convalescent home. It is, however, a curious fact which we have often noticed, that whooping cough does not appear to spread to any great extent in hospital wards in which the children are in bed and the cubic space great (the same fact has been noticed by Dr. Sturges and Dr. Goodheart), and it would almost appear that close contact with the infected individual so as to inhale his breath was necessary to give the disease. It is impossible dogmatically to deny that the poison of whooping cough can be conveyed on the person or by clothes to a distance and so affect the healthy; but it is certainly exceptional; the common way in which it spreads is by direct contact with the sick. A very short contact is all that appears to be necessary—such, for instance, as a child meeting another for a moment in the street or in a shop; several instances of attacks contracted in this way have come under our notice. The epidemics, like those of measles, appear to occur in large cities every eighteen months or two years. It has been asserted that there is some definite relation between these two zymotics, as they frequently prevail epidemically together or one immediately preceding or following the other; it is very doubtful if this association is anything more than accidental, as they both are apt to recur every eighteen months or two years. The whooping cough epidemic lasts longer and more slowly reaches its height than the measles epidemic. Like measles, whooping cough seems to prevail at all seasons of the year; but, as one would naturally expect, it is more fatal in the colder months of the year than in the warmer months, in consequence of the broncho-pneumonia which is so apt to supervene if the child takes cold. The mortality is mostly high among very young and weakly children, while in older children it is rarely fatal. During the decade 1878–1887, 3,669 cases

of whooping cough were treated in connection with the children's dispensary, with 281 deaths, or a mortality of 7·6 per cent. Of these, 217 or 77 per cent. were under two years of age, 63 or 13 per cent. were from two to five years of age, and only one fatal case occurred in a child over five years of age. It is certain that these figures do not represent the total mortality, as they do not necessarily include those who die some months later of tuberculosis and gastro-intestinal atrophy.

Incubation.—It is difficult to fix the latent period with precision, as the onset is gradual and the symptoms are often indefinite. It is usually seven to fourteen days before the child begins to cough, and another week or ten days before the characteristic 'whoop' is heard. This makes an interval of two to three weeks between being infected and commencing to 'whoop.'

Symptoms and Course.—The course of the disease is marked by three stages: (1) The *catarrhal* or premonitory stage; (2) The *convulsive* or *spasmodic* stage; (3) The stage of decline or *convalescence.* These stages, it is needless to say, are not well marked, but one gradually succeeds the other, and this is especially true with regard to the third.

The *catarrhal stage* begins with the symptoms of a feverish cold and tickling dry cough, which is not readily relieved by ordinary remedies. The cough is especially apt to recur at night, and it is remarked on by the friends as being more than usually troublesome, the child coughing and straining as if to relieve a persistent irritation in the throat. The cough keeps it awake at night or it wakes up coughing and fails to get to sleep for some hours. During the day the child may appear well, or, on the other hand, the appetite fails and he looks pale and poorly. The cough, if not paroxysmal from the first, becomes so in the course of a few days, before the actual whoop is heard. There is usually some degree of fever at night, and dry rhonchus may often be heard on listening to the chest. The first stage may be complicated with bronchitis or pneumonia. In young children or infants the convulsive stage sometimes begins with a convulsion or series of convulsions.

The Convulsive Stage.—The cough now comes not only in paroxysms, but there is a distinct whoop; there are a number of short forcible expiratory efforts, as if an attempt was being made to expel some irritating matters, followed by the long-drawn characteristic inspiration which is technically called a 'hoop' or 'whoop,' or in some parts of the country a 'chink.' It is perhaps hardly right, at any rate when the second stage is well established, to speak of the expiratory coughs as 'efforts'; the child, prompted by a peculiar tickling sensation in the throat, attempts to relieve it by coughing, but in a moment the coughing goes on in spite of any voluntary effort to repress it, so that the child's face becomes congested and the facial veins distended, before the inspiratory act takes place, and the air rushes into the air-passages and lungs through the narrowed glottis. Fit after fit of coughing will often follow one another, till the child vomits or a rush of stringy mucus, perhaps streaked with blood, pours out of its mouth and nose. In the worst cases the distress occasioned by these fits of coughing is extreme, and the child dreads their recurrence, not only on account of their discomfort, but from the aches and pains it suffers by reason of the over-strained and weary respiratory muscles. To a weakly child the disease is necessarily a formidable one; the exhaustion produced by the

constant muscular efforts, the frequent vomiting which prevents a proper amount of food from being assimilated, together with the intestinal catarrh which in a greater or less degree accompanies it, often reduce the child to a feeble and emaciated condition. It can easily be imagined that forty or fifty attacks of coughing every twenty-four hours produce great muscular exhaustion, and affect the child's vital powers. In milder cases, where the fits of coughing do not exceed twelve, the child may appear quite well between the paroxysms, and, though perhaps vomiting after the cough, it is quickly ready for another meal, with sharpened appetite. Fever is mostly present in the second stage in variable degree, especially at night. An examination of the chest will generally disclose bubbling râles in the larger tubes, the secretion being freer than in the first stage.

The Stage of Decline.—After a variable period of four to six weeks, during the latter portion of which the attacks of coughing have been diminishing, the characteristic whoop disappears, and convalescence may be said to be established. Mostly the paroxysmal character of the cough remains, and often the vomiting; gradually the bronchial catarrh disappears, and the cough ceases, though it is very likely to return, and the whoop along with it, whenever fresh cold is taken.

Complications.—By far the commonest is some form of **broncho-pneumonia**; **pleurisy** and **empyema** are not unfrequent. There is nothing specially characteristic about the broncho-pneumonia of whooping cough; it is usually double, is very apt to be generalised rather than 'patchy,' and tends to resolve, or slowly passes into a subacute or chronic state. **Croupous pneumonia** is not uncommon in older children who take a chill during convalescence, and may be followed by empyema. **Empyema** and **atelectasis** are very apt to occur in connection with bronchitis in small and rickety children. Young children are sometimes convulsed, the convulsions being due to asphyxia, and perhaps **meningeal hæmorrhage**; drowsiness and coma are usually due to the same causes. We have seen a temporary hemiparesis arise during whooping cough. Cerebral symptoms, whether **convulsions** or drowsiness, are of grave import. **Intestinal catarrh** and diarrhœa of a mucous character are also common; the catarrhal condition of the air passages extends to the intestines, and large quantities of mucus are secreted, which prevent the digestion and assimilation of food, and cause a rapid passage of the food through the intestines. The child passes small mucoid stools many times a day, is feverish and rapidly wastes. Sometimes the diarrhœa is of a dysenteric character. **Tuberculosis,** especially of the bronchial and intestinal glands, is a sequela rather than a complication, and usually follows some months later. A wasting during the third stage is oftener due to intestinal catarrh or chronic broncho-pneumonia than to tuberculosis. Among the minor complications are ulceration of the frænum linguæ, stomatitis, and sores about the nose and lips. Small conjunctival hæmorrhages are very common. The child often remains for a long time in a weakly state of health, and may take long to regain its former strength. Permanent deformity of the chest may remain as a legacy left by an attack of whooping cough.

Diagnosis.—Often no diagnosis can be made in the early stages, and this is the more unfortunate as there can be no doubt that the disease is infectious

during this stage. The fact that whooping cough occurs in epidemics will often aid us in coming to a conclusion. Difficulty may often arise in more chronic cases, in which there is a paroxysmal cough followed by more or less of a stridulous sound, as to whether such are specific and are to go into quarantine. The diagnosis will turn largely on whether any cause for the spasmodic cough can be discovered as well as on the history ; if there has been previous wasting, and there is some evidence of tuberculosis of the lungs, enlarged mediastinal glands would be suspected as the cause of the spasmodic cough. Diagnosis is often difficult in infants, as also it sometimes is in older children, who may have whooping cough without any characteristic 'whoop' ; the 'whoop' may also cease when pneumonia supervenes.

Prognosis.—The fact that the mortality is vastly greater in children under two or three years of age than it is in older children must be borne in mind in forming a forecast of results. The prognosis in the case of an infant or a weakly child of eighteen months or two years of age is very uncertain, and death may occur suddenly during a fit of coughing from convulsions or spasm of the glottis. The prognosis is always rendered grave by the presence of broncho-pneumonia ; the latter when it follows whooping cough is more fatal than when non-specific. Whooping cough during the winter months is always more likely to be complicated with chest disease than in the summer ; and while this is specially true of the poorer classes, it holds good also to a lesser extent in the better housed classes of the population. The presence of rickets affects the prognosis unfavourably. The diagnosis between chronic broncho-pneumonia and tuberculosis and between chronic intestinal catarrh and mesenteric disease is very difficult ; but the tubercular diseases are much more likely to follow at a distance with a period of comparative health intervening, while the simpler forms are more likely to complicate or immediately follow. A chronic pneumonia often clears up, and the child recovers, and a subacute intestinal catarrh may not improbably do the same. Death in rare cases occurs from sheer exhaustion.

Quarantine.—Six weeks is usually stated as the time the infection lasts, dating from the commencement of the whoop ; but in all cases it is wise to keep up the quarantine till all cough has ceased and the child is quite well. If the cough or even whoop recur after a period of undoubted health, there is no fear of infection.

Pathology and Morbid Anatomy.—The epidemic prevalence of whooping cough and its infectious character would suggest its cause being due to some micro-organism. Letzerich and others have described such micro-organisms in the sputum of patients suffering from whooping cough ; and more recently Czaplewski has described a small bacillus resembling the influenza bacillus, which he believes is the specific micro-organism of whooping cough. Jochman and Krause have also described a micro-organism which they assume is specific.

No characteristic appearances are found on the *post-mortem* table ; the lesions found will vary according to the mode of death. The brain is usually congested, especially the veins ; there is often some subarachnoid fluid on the convexity and much fluid in the lateral ventricles. Various lesions may be found in the lungs, such as injection of the mucous mem-

brane of the larynx and bronchi, with excessive secretion, emphysema, collapse, and various stages of broncho-pneumonia.

Treatment.—The most important part of treatment consists in confining the patients to well-aired rooms which are free from draughts and maintained at an equable temperature. Two large rooms should, if possible, be set apart for the treatment, the one occupied being maintained at a temperature of 60°, while the other is being thoroughly aired or disinfected, the latter being again warmed before the patients are removed. There can be no doubt that the attack is rendered more intense and protracted by rebreathing the infection as well as by a fresh catarrh being set up. Except in the warmest weather, the patient should be confined to his rooms in the house the whole time the disease lasts, as long as any 'whooping' is present, and as long as any râles or rhonchi are heard in the chest. Too great care cannot be exercised here; the bronchial tubes and lungs remain exceedingly sensitive to cold, and many severe attacks of pleuro-pneumonia have resulted both in old and young from a chill caught at outdoor games or from having gone to the seaside for change of air. Children are much better at home until well over the attack, not only for the sake of others but for themselves; and the pleadings of the friends for change of air must be sternly resisted until six weeks at least from the commencement of whooping. With regard to medicinal treatment, there is no lack of remedies which have been tried, and no disease has been more ineffectually though diligently drugged. It is quite safe to say that no specific has as yet been discovered. During the catarrhal stage, when the cough is hard, the expectoration scanty, and there is fever, the best remedies include small doses of antimony, ipecacuanha, liq. ammon. acetatis, or nitrate of potash. At night, when the cough is especially troublesome, hot mustard poultices should be applied to the chest, and hot demulcent drinks such as black currant tea, or barley water, or lemonade may be taken. Beef tea is often of service for the night, and a dose of hot brandy-and-water will sometimes induce sleep. The room should be kept moist with hot steam if there is much bronchial catarrh or laryngitis. In the spasmodic stage, when the secretion is free, the expectorants should be stopped, and sedatives and small doses of narcotics substituted. At this stage the diffusion of carbolic acid vapour through the apartment is frequently of great service; this may be done by vaporising strong carbolic powder in one of Calvert's carbolic vaporisers; it is not certain how this acts; no doubt to some extent it soothes by acting as an anæsthetic to the fauces. Among the internal remedies antipyrin and phenacetin are useful in doses of two to five grains every four hours. (F. 53.) Of other drugs at this period belladonna, chloral, bromides, opium, cannabis indica, quinine, take the first place, but all at times fail to give any appreciable relief. Tr. belladonnæ is best given in small doses every four or six hours, increasing the frequency rather than the size of the dose. The combination of belladonna and cannabis indica is a favourite one; they may be combined as in F. 52. Heroin has more recently been used with some success.

The bromides and quinine dissolved in syrup of lemons with syrup of Santa Yerba is also a good combination. Croton chloral is highly praised by Dr. Webb; he orders a drachm of this drug to be dissolved in two ounces

each of tr. cardamomi and glycerine, giving half a teaspoonful to two teaspoonfuls every four hours to children of one to ten years. Dr. Ringer advises tr. lobeliæ, and gives doses of five to ten minims every hour even to young children. Opium is of all drugs the most certain to relieve ; but it is perhaps best reserved to be given in one dose at night ; one to five drops of nepenthe or half to two grains of Dover's powder will often secure a fairly good night. The bowels should be carefully attended to, and a laxative will frequently be required. Unless the secretion is very copious, poultices or fomentations in this stage give more relief than liniments.

In the later stages, when the secretion is copious and the cough less and less spasmodic in character, nitric acid, alum, quinine, are most likely to be of service. Alum may be given with some sedative as conium or hyoscyamus, the old formula of Golding-Bird's being a good one : Alum. gr. j, succi conii ♏v, syrup. rhœados ♏x, aq. anethi ad ℥j ; ℥j every four hours. Of external applications there are a goodly number which have been employed with varying success. Equal parts of lin. camph. co., lin. saponis, and lin. belladonnæ, used cautiously to tender skins, make a good stimulating liniment. Some have great faith in oil of amber, as in the following : Ol. succini ℥ij, tr. opii ℥ij, sp. camph. ℥ss, ol. amygdalæ ℥ss. The liniment of iodide of potassium and soap is useful. The diet both in the spasmodic and catarrhal stage should be carefully arranged, and it is difficult on account of the vomiting so frequently present. It will often be necessary to feed little and often to make up for food vomited. The complications, such as bronchopneumonia and intestinal catarrh, must be treated on the general principles given elsewhere.

Mumps, Parotitis.—Mumps is an infectious disease which is apt to prevail in epidemics ; sometimes these extend over wide areas, though at other times cases occur and there is little tendency to spread. We have never noticed an extensive epidemic in hospital, but the nurses are apt to catch the disease from children who have been admitted incubating mumps, and it would seem that close contact, perhaps inhaling the affected person's breath, was the commonest way in which an attack was contracted. It sometimes happens that there is no spread of the disease in the ward where the affected child was, but cases have occurred in other wards, the infection being carried from one ward to another perhaps by a nurse who has herself had a slight attack.

Incubation.—According to Dr. Dukes, fourteen to twenty-five days. In some cases observed by us, it was fourteen, seventeen, and twenty-one days respectively.

Symptoms and Course.—Mumps is usually a mild disease attended by discomfort rather than serious illness. The attack usually begins with chilliness, stiffness about the jaws, local tenderness, often neuralgic pains ; there is often no fever, sometimes the temperature goes up suddenly to 102° or 103°. The swelling is at first one-sided, involving the region of the parotid, which is prominent and tender ; deglutition is difficult and painful. Both sides are usually swollen in a day or two, and the patient presents a characteristic appearance. The fauces and tonsils are normal. While the parotids are usually affected, in some cases the swelling is entirely confined to the sub-maxiliary salivary glands on one or both sides ; it is in these

cases that the nature of the attack is likely to be overlooked. The attack lasts, as a rule, from a few days to a week. **Orchitis** occasionally occurs in boys about puberty. **Hemiplegia** has been known to follow (Gowers).

Diagnosis.—We have known cases of mumps sent into a scarlet fever ward as cases of scarlet fever, and we have also seen a case of tonsillitis with enlarged cervical glands, probably scarlatinal, which was diagnosed as mumps. In all cases of doubt as to the nature of the external swelling, the appearances presented by the tonsils should be decisive. The swelling due to mumps in the majority of cases corresponds to the parotid region, the swelling of cervical glands secondary to tonsillar affections is at the angle of the jaw or just behind it. There is rarely much fever or illness with mumps ; in diphtheria or scarlet fever, where there is much external swelling or cellulitis, the child is evidently gravely ill, and if a satisfactory view of the fauces can be obtained, they will be seen to be swollen, œdematous, and perhaps covered with exudation. In adenitis, attended by fever, it is the lymphatic glands rather than the parotid which are affected. In spite, however, of these distinctions, difficult and doubtful cases may occur.[1]

Treatment.—Not much is required except hot fomentations or belladonna liniment to the parotid regions, and a saline followed by a tonic. Three or four weeks, according to the severity of the case, should elapse before the patient returns to school or mixes with his fellows.

Malarial Fever.—Children who live in malarial districts suffer from malarial attacks as frequently as do adults ; indeed, according to Holt, they are peculiarly susceptible. In this country many opportunities do not occur of seeing the disease in its early stages ; the cases which mostly come under observation are those which are chronic ; having acquired the disease abroad and having been invalided home. In these cases marked anæmia with enlarged spleen, and perhaps intermittent fever, form the commonest symptoms. The anæmia is frequently profound, and the spleen attains to an enormous size. Nephritis as a sequela of aguish attacks is sometimes seen in this country. Such a case we saw with Dr. Massiah, the attack having been contracted in Brazil ; there was marked anæmia, enlarged spleen, the urine was highly albuminous, and contained fatty and fibrinous casts. According to Lewis Smith, intermittent fever when it affects those over 3½ years differs little from the adult form, while below that age it presents some peculiarities. Malarial fever may be hereditary, being derived from the mother. In one case, recorded by Lewis Smith, an infant showed distinct symptoms a week after birth ; the mother had suffered from tertian ague at intervals during the two years prior to her confinement. In the infant the type is quotidian, rarely tertian ; there are three stages presented by an attack : the second or febrile is well marked, the temperature rising to 104° to 106° ; the first and third less so. The spleen soon enlarges, and after a week or two, if the attack continues, there is marked anæmia. The enlargement of the spleen fails to take place in some of the cases. Dr. Emmett Holt, of New York, in making an analysis of the symptoms of 184 cases of malaria in children, has pointed out how much more insidious the invasion of the disease is in children than in adults, and consequently there

[1] Suppuration in a parotid gland may take place in enteric or pyæmia ; but this can hardly be mistaken for mumps.

is more liability to overlook it and attribute the symptoms to other causes. Even the periodicity of the recurrence may not be regular, which would still more throw the physician off his guard. In his cases with a gradual invasion he noted anæmia, frontal headache, constipated bowels, muscular weakness, vomiting, furred tongue, drowsiness, and epigastric pains; these symptoms usually recurring in the afternoon. The spleen was enlarged, but there were exceptions to this. The fever noticed by this author assumed three types: the first, in which the fever remained high for twenty-four to seventy-two hours, when a marked remission took place, the temperature then assuming a remittent type; secondly, the fever is at first slight and only present at one period of the twenty-four hours, but gradually increases in intensity and assumes a remittent type; thirdly, assuming a distinctly remittent or intermittent type from the outset. Cerebral symptoms are common; there are frontal headache, drowsiness, and apathy, occasionally convulsions; pains in various parts of the body; various spasmodic disorders, as torticollis and motor paralysis, are less common, but sometimes take the form of paraplegia. Dr. Holt has also pointed out that the malarial poison may complicate and modify other diseases; of these bronchitis and pulmonary congestion are common, the latter closely resembling pneumonia in the onset, but subsiding in a few hours, to come on again in the course of twenty-four hours. Spasmodic asthma of malarial origin may occur. Various gastro-intestinal disorders, as vomiting and diarrhœa, occur periodically at a certain time daily. The diagnosis in these cases depends upon: (1) Periodicity of the symptoms; (2) the co-existence of splenic enlargement; (3) failure of the usual remedies to relieve; (4) their prompt disappearance under the use of antiperiodics.

Treatment.—The treatment consists, as in adults, in the administration of antiperiodics, such as quinine, cinchonine, and arsenic.

CHAPTER XVI

DISEASES OF THE RESPIRATORY APPARATUS

The Thorax in Infancy and Childhood.—It is necessary when examining the chest of an infant or child for the first time to have it completely bare, so that a thorough examination can be made, the infant lying in its cot or on its mother's lap ; care must, of course, be taken to have the room sufficiently warm, as infants readily take cold when a large surface of the skin is exposed.

On *inspection* it will be noticed, *firstly*, that an infant's chest is deeper than an adult's, or, in other words, the antero-posterior diameter more nearly approaches the transverse, the ratio being 1-2 in an infant, 1-2½ during childhood, and 1-3 or 3½ in adults ; the horizontal section is thus more circular in form during infancy than in later life. *Secondly*, the angle which the costal cartilages make with the sternum is larger in children than in adults, that is, the lower part of the thoracic cage is widened out more ; this may be in part due to or accentuated by the abdominal viscera occupying a relatively larger space and pressing the diaphragm upwards. This is seen in an exaggerated form in children who have enlarged livers and constant gaseous distension of the stomach and intestines. Any acquired deformity should be carefully noted ; various rickety deformities may be present—one side of the chest may be contracted from an old pleurisy or empyema, or the left chest may be bulged outwards by an enlarged heart or distended pericardium.

The way in which the child breathes should be carefully noticed. There may be a 'crowing' inspiration as in laryngismus, or there may be some obstruction both to filling and also emptying the chest. The cough may have a metallic or clanging ring ; the rhythm of the respiratory movements may be altered, as in meningitis.

Note must also be made of the frequency and character of the respiratory movements, whether deep or shallow, whether one side moves more freely than the other, or if there is any sinking in of the epigastrium or intercostal spaces and ribs during inspiration. It should be borne in mind that mere frequency of respiration does not necessarily mean any respiratory disease, but may be due to rapidity of the heart's action accompanying high fever or cardiac feebleness. Note also if there is any paralysis of the diaphragm or intercostals. The position of the cardiac impulse should be determined.

After inspection it is usual to *percuss* the chest, placing one finger of the left hand against the chest wall and striking it with more or less force with the middle finger or forefinger of the right hand, taking care that the child lies or sits up straight, for if the body be twisted, so that one side

bulges out more than the other, a fallacious resonance may be produced. All the regions of the chest must be carefully examined in turn. Too much stress should not be laid on a slightly impaired resonance, especially if the child is crying, unless the result of auscultation corresponds, and a subsequent examination confirms the result. A typical 'cracked-pot' sound is readily elicited in an infant on account of the yielding nature of the chest walls quite apart from the presence of cavities or any lung lesion. Careful note must be made of any spot where there is dulness or impaired resonance or hyper-resonance denoting emphysema, but bearing in mind that at times a 'boxy' note is elicited over lung in an early stage of pneumonia or acute congestion. It must not be forgotten in examining the chest that the diaphragm usually takes a higher position in children than in adults, especially when the stomach and intestines are distended with gas.

In *auscultation* the ear may be placed directly against the chest wall, or (what is much more convenient) a binaural stethoscope with a small chest piece may be used. All parts of the chest should be carefully examined, noting the character of the breathing, whether the air is entering every part of the lungs equally, or whether the air is not entering one part freely while other parts are being overworked. Weak breathing may be due to an early stage of pneumonia, effusion of fluid, collapse of lung, compression of a bronchus, or a pneumo-thorax.

'Puerile' or harsh breathing is due to a portion of lung being overworked ; it is never safe to accept it as a sign of a lesion in the lung, as at first a student is inclined to do, and, moreover, the breath sounds may appear loud and harsh to an ear accustomed only to adults. It is not uncommon in young children to note on one occasion that the breathing is weak or almost absent at one base and loud elsewhere, whereas after a fit of crying, or the next day, the weak breathing has completely disappeared ; in these cases a bronchus with its branches has been temporarily plugged with mucus, which has become displaced by coughing. Bronchial breathing is present in consolidation of the lungs from pneumonia or tubercular infiltration, but it is also present in the majority of cases in effusion of fluid, though in this case it is usually weak and distant instead of being intense and blowing. Cavernous or amphoric breathing is not often heard, as cavities of any size are rare in young children. Among the adventitious sounds, fine crepitation is rarely heard in the early stage of pneumonia, the râles being mostly of medium size ; they may be 'consonant' or 'ringing' in character when conveyed to the ear through solid lung, or subcrepitant and ill-defined when the secretion is thick and they have to pass through normal lung to reach the ear. Vocal resonance, or fremitus, often gives no definite result in girls or young children, though when the child is crying violently the increased resonance of the voice heard over a base or apex may be of diagnostic importance. It is needless to add that the physical examination of young children is often beset with difficulties on account of their restlessness or fright, and the examiner may have his patience often sorely tried, and perhaps may fail to obtain a satisfactory examination from this cause.

Congenital Laryngeal Stridor—Congenital Respiratory Spasm.—It is not uncommon to meet with infants, who from their birth have made

a peculiar stridulous sound during respiration, more especially during inspiration. In most cases this noisy respiration lasts for some months, perhaps getting worse for a while, and then gradually improving, so that before the middle of the second year is reached it has entirely disappeared.

The infants affected in this way are usually perfectly strong, and their health does not appear to suffer. The stridor in some cases is continuous, but worse when the infant is excited and breathes irregularly, and less marked or absent during sleep or when it is quiet. It does not become cyanotic, but the chest wall is frequently sucked in during inspiration and the chest tends to become constricted where the diaphragm is attached. Inspiration is laboured and noisy, expiration is comparatively easy. In some cases when excited and crying the hands are clenched and the thumb turned in during inspiration. Dr. J. Thomson describes the stridor as follows: 'Inspiration begins with a croaking noise and ends in a high-pitched crow, which two of the mothers described as being just like a hen.' He is inclined to regard this condition as a developed neurosis, like stammering. On the other hand, Sutherland and Lack, who examined six cases, came to the conclusion that the stridor was not produced by spasm of the glottis, but at the upper aperture of the larynx.

We agree with Thomson in looking upon congenital stridor as due to spasm of the glottis and expiratory muscles, as the result of some congenital developmental failure. In one instance coming under notice an infant with a posterior meningocele had marked stridor and obstruction to the air entering. It died when 5 weeks old; the larynx and naso-pharynx were normal. In another of our cases an infant with congenital diplegia had marked stridor during inspiration, especially when excited. Infants of 10 or 12 months who have been stridulous during the early months and have gradually got better will 'crow' when excited or crying, though not at other times. Dr. Eustace Smith has attributed stridor in infants to post-nasal adenoids; this may be true in some cases, but certainly not in all, as *post-mortem* examinations show.

In some few cases we have noted, in addition to a certain amount of noisy respiration in infants, there is a tendency to choke when drinking, some of the fluid entering the larynx by accident. This condition, though alarming to the friends, does not appear to be dangerous, and gradually improves as the infant grows older. Thus in an infant of 13 months there is constant choking during the second act of deglutition when fluids are being swallowed. Some fluid goes the wrong way, then there is choking and spluttering. It can swallow 'sops' all right. This difficulty comes and goes, and is worse when the infant is excited. There is apparently some want of co-ordination of the muscles of deglutition.

In other cases of 'clumsy' deglutition there is no stridor, and we have noticed this difficulty in children as late as three years old. They will take sops well, but when thirsty will splutter badly in drinking; or they will gargle the fluid in the mouth and only swallow it very slowly.

Laryngismus. Spasm of the Glottis. 'Child Crowing'

The term laryngismus is applied to a peculiar form of laryngo-respiratory spasm which occurs almost exclusively in rickety infants. In laryngismus

there is no lesion of the larynx, or only in a small minority of cases is there a laryngeal catarrh ; it is usually a pure neurosis, and it is only for the sake of contrasting it with other forms of laryngeal troubles that it is placed in this section rather than among the convulsive disorders, to which it more properly belongs.

In by far the majority of cases the symptoms of rickets and chronic indigestion are present, but we must not in all the cases expect to find marked enlargement of the epiphyses, especially in infants of a few months old. Sometimes cranio-tabes may be detected ; usually there is some beading of the ribs and recession of the chest wall during inspiration. In the majority there is marked gaseous distension of the small intestines and pale pasty stools.

The characteristic feature of the attack is a sudden 'holding of the breath' for a few seconds ; then the glottis is burst open, the air rushing in with a stridulous sound or in a series of short 'chinks,' but in many cases there is no abnormal sound, the attack consisting entirely of holding the breath. The seizure closely resembles, only in an exaggerated form, the 'catch of the breath' which takes place as a preliminary to a good fit of crying, or, as Gay points out, of rage or bad temper. The condition seems to be as if the expiratory respiratory centre discharges for a few seconds an excessive quantity of nerve force, producing a spasm of the glottis and of the muscles of expiration, while the more powerful inspiratory centre, as it is more and more stimulated by the increasing venosity of the blood, strives as it were, for mastery, and at length, when it succeeds, the glottis is burst open, and air rushes in through the narrow chink. In a severe attack not only is the glottis closed by the adductors of the cords, but the epiglottis may be felt by the finger to be spasmodically applied to the superior aperture of the larynx, and the respiratory muscles are in a state of spasm.

Semon and Horsley have shown that the expiratory respiration centre is situated in the monkey in the cortex, 'just posterior to the lower end of the præcentral sulcus at the base of the third frontal convolution.' Stimulation of this region produces adduction of the vocal cords, and if the excitation be powerful enough, spasm of the muscles of the face, neck, and upper limbs. The same observers failed to discover any inspiratory cortex centre, but found that excitation of the accessory nucleus in the medulla oblongata evoked adduction of the cords. In rickets the nerve centres are in an unstable condition, and liable to liberate nerve force on the slightest provocation. In some cases many of the cortex centres discharge, and a general convulsion is produced ; in other cases it may be, at first at any rate, the expiratory respiration centre only, and a spasm of the glottis is produced.

The exciting causes are probably many. The commonest is some emotional disturbance : a fit of crying or of anger may quickly pass into an attack ; fright or sudden start may bring one on. The act of swallowing seems also sometimes to give rise to an attack. Dentition, irritation of the mucous membrane of the pharynx and larynx, nasal adenoids, constipation, may perhaps act as exciting causes. In a patient of ours the attacks were apparently worse during the time it was suffering from aphthous ulcers on the soft palate. We have also seen cases which were associated with laryngeal and bronchial catarrh. We are not inclined to attach much

importance to an enlarged thymus, swollen bronchial glands, or cranio-tabes as exciting causes.

Symptoms.—In the milder cases, which are most common, the child's inspiratory movements are accompanied by a slight 'crowing sound,' which does not appear to distress it, and which passes off during sleep. Sometimes the crowing will last for days, and pass off again for some time. In some few cases the stridor is present during sleep as well as during the time the child is awake. In the most severe cases the attacks come on at frequent intervals, and are distressing in the extreme ; without warning, the infant is seen to screw up its face as if for a crying fit, it holds its breath, no air enters, and the respiratory muscles are rigid and motionless, the veins on the face and scalp become distended with venous blood, the face and lips become blue, or of a dusky tint ; then after ten or more seconds the obstruction to the air entering the lungs is overcome, and air rushes into the now open glottis. In some cases we have noted that while at first the respiratory muscles are quite motionless, in others, after the obstruction has lasted some seconds, the diaphragm begins to work spasmodically, and will often succeed in forcing the glottis, so that for a few seconds air is admitted at short intervals into the chest ; then for a time the attack is over, but may be shortly followed by another.

These seizures, especially the more severe ones, are accompanied by clonic spasms of the limbs ; sometimes we have seen in these attacks the infant throw his hands up like a drowning man, and then, after the laryngeal spasm is over, the nerve discharge passes into the limbs, and the hands become set, as in tetany, with the thumbs turned in, and the feet in a position of equino-varus.

These attacks may come on at all times of the day or night, and on very slight provocation. We have already referred to the most common exciting causes ; the most important, perhaps, is some emotional disturbance. One of these seizures, as we have already pointed out, is very much like what takes place in the early stage of a fit of crying ; the facial muscles are contracted, the mouth is open, the breath is held, the air enters the chest spasmodically by the contraction of the diaphragm. Herbert Spencer remarks that an 'overflow of nerve force, undirected by any motive, will manifestly take the most habitual routes ; and if these do not suffice, will next overflow into the less habitual ones.' We can easily understand on this principle that a discharge of nerve force from unstable nervous centres may take the routes which in infants produces a good cry, and may overflow into the muscles of the extremities, producing a spasmodic condition, i.e. 'tetany.'

One point we must not forget to emphasise, and that is, that many of the most severe seizures are not accompanied, or rather followed, by a definite crowing sound. It is really the less severe ones in which the crowing inspiration is best marked ; the danger necessarily depends more upon the length of time during which the breath is forcibly held, than upon the manner in which the air again enters. In many of the worst cases it is admitted spasmodically in sobs, and not in a long-drawn crow.

Children who suffer from laryngismus are not only rickety, but are nearly always dyspeptic. There is often a difficulty in digesting cow's milk, the stools contain much undigested curd, and there is chronic distension of the

bowels. They are not infrequently well nourished, as far as fat goes, but their muscles are poorly developed. It is unnecessary to say that it is artificially fed infants who are the chief sufferers from laryngismus. It seems very likely the unstable condition of the nerve centres is due to toxin poisoning, the toxin being absorbed from the intestinal contents. The following case illustrates some of the points we have referred to :

Laryngismus ; Recovery.—S. H., aged 10 months ; admitted February 28. Mother states he has never been strong, has had a 'croupy cough' since 14 days old. For the last few weeks has had many choking fits, sometimes as many as twenty in one day. Weight, 9 lb. 14 oz. He is small for his age and cannot sit up ; he has no teeth, fontanelles widely open and tense ; no cranio-tabes ; some recession of the chest walls during inspiration ; no marked beading of the ribs. When disturbed he makes a crowing sound with inspiration. During this time there is marked indrawing of the chest wall, lasting for a few moments. At other times the breath is held tightly for a few seconds till he becomes blue in the face. He was ordered milk, half a pint, and whey, one pint and a half daily, and some rhubarb and soda. March 2.—Has had many attacks of 'crowing,' and between the attacks there seems to be more or less constant spasm. March 4.—Ordered tr. belladonnæ ɱiv. pot. bromidi gr. ijss, om. 4tis hor. He had six attacks yesterday ; no general convulsions. From this date he began to improve, the attacks becoming less. He went home on March 21 (weight, 10 lb. 1 oz.), having had no attacks for ten days or more.

Spasm of the glottis is sometimes the cause of death in cases where the obstruction is not complete, as in the following case. A boy of 1 year old had difficulty in breathing from birth, was seized with a bad attack, and was admitted to hospital ; there was undoubted obstruction to inspiration and much recession of the chest walls, necessitating tracheotomy, which was followed by much relief. Death followed five hours later without apparent cause. At the *post-mortem* there were no signs of rickets ; there was slight congestion of the larynx and the thymus gland ; all the other organs were healthy. Sudden death from spasm of the glottis occasionally occurs in cases of tuberculosis with enlarged and caseous mediastinal glands.

Diagnosis.—The following table gives the chief points :

Laryngismus : Spasm of the Glottis	*Spasmodic Laryngitis (False Croup)*	*Membranous Croup*
Occurs in rickety children under 18 months of age.	Rarely occurs under 2 years of age, commonest 2–7 years.	Occurs at all ages during childhood.
No fever, and no coryza or laryngeal catarrh.	Slight fever, mostly coryza and laryngeal catarrh.	Variable amount of fever, and perhaps some diphtheria of the fauces.
Occurs at any period of the 24 hours, and often many times.	The attack occurs at night.	Mostly worse at night.
No cough, inspirations are stridulous.	Metallic cough, stridulous respiration, variable dyspnœa.	Metallic cough, stridulous respiration, progressive dyspnœa.
Contractions of the limbs, or general convulsions, not uncommon.	Convulsions rare.	Convulsions rare.
The attack lasts a few seconds, and frequently recurs.	Attack passes off in the course of an hour or two.	Becomes steadily worse, though variations occur in its progress.
Occasionally fatal.	Rarely fatal.	Very often fatal.

Prognosis.—The great majority of infants who suffer from 'child crowing' recover; the prognosis, however, must always be a guarded one, and as long as there is any tendency to spasm of the glottis the child cannot be regarded as out of danger. A 'crowing' child may at any time have general convulsions and die in a few moments. Improvement in the child's general condition, and especially of its digestive powers, quickly leads to an improvement in the 'crowing'; this we have noticed in several cases which rapidly improved under the careful feeding and attention in the hospital, but which quickly relapsed again when they were discharged. An attack of bronchitis or broncho-pneumonia is very likely to prove fatal in a child subject to laryngismus.

Treatment.—During the spasmodic stage, when the breath is being held, every effort must be directed towards exciting reflexly the inspiratory respiration centre. A sponge well wetted with cold water may be dashed into the face; patting on the back, or a vigorous shake, will sometimes be successful. It is useful to have a hand fan within reach, and use it vigorously during an attack to fan the face.

We have found that hooking back the epiglottis with the forefinger has been followed by an inspiration. In one of our own cases a child who was subject to these attacks had a severe seizure while under chloroform for the removal of post-nasal adenoids, and his life was only saved by the rapid performance of tracheotomy. In such cases a catheter passed into the larynx would suffice to insure the entry of a small quantity of air.

The first indication for treatment is to give a dose of calomel gr. ½–gr. i. to act on the bowels and clear away all decomposing milk foods. The most useful medicines for temporary use to keep the attacks in check are chloral, bromide, and minute doses of morphia. We should only give these drugs in the severe forms of spasms in order to soothe or render less irritable the unstable state of the nervous system. Five grains of bromide with two and a half of chloral may be given to an infant of nine months, and repeated every six hours. A drop of liq. morphiæ may be given every six hours, its effect being carefully watched.

The most important part of the treatment is with regard to the diet and surroundings of the child. It is of the greatest importance that it should get fresh air. A steam tent or hot close room is the worst possible place for an infant suffering from laryngismus. A change away to the seaside often works wonders, by improving the infant's digestive powers and general health. A food or foods must be found and given in quantities which the child can digest. It will probably be found that the child is taking more milk than it can digest, and is passing large pasty stools. The amount of milk must be diminished. Peptonised foods, cream mixtures, thin oatmeal gruel, beef juice, beef tea with vegetables, all have their value in these cases, if given in suitable quantities according to the child's digestive powers. Medicines which assist the digestion and regulate the bowels are often necessary; extract of malt, rhubarb and soda, acids and pepsine, and, above all, cod-liver oil, when it can be taken and digested. Constipation must be removed. If a child has laryngismus and post-nasal adenoids, is it safe to operate? We have several times operated with great advantage; but it is necessary to be on the look-out for spasm of the glottis. Intubation may be performed or

a catheter passed into the trachea, if necessary, and artificial respiration performed.

Spasmodic Laryngitis. Catarrhal Spasm. False Croup.

This affection differs from the last described in that it consists in a sudden but not complete stenosis of the glottis associated with a laryngeal or pharyngeal catarrh. A child, usually above 2 or 3 years of age, goes to bed apparently well, or there may be a slight hoarseness or cold in the head ; after a few hours' sleep he is suddenly awakened with alarming symptoms of laryngeal obstruction. There is a loud metallic cough, stridulous respiration, more especially with inspiration, the dyspnœa and distress are very great, there is recession of the chest walls, and all the accessory muscles are called into requisition. The orthopnœa and distress are so great that death seems imminent. In the course of a few minutes, probably before the arrival of medical assistance, which is hastily summoned, the laryngeal obstruction has ceased, and the child, tired out by its unwonted exertions, falls into a quiet sleep. The symptoms of a catarrh or tracheitis persist for some days, perhaps with some clanging cough and more or less pronounced attacks of dyspnœa at night. Children who thus suffer are extremely liable to a recurrence whenever they take cold, and it is not uncommon for mothers to say that their child is very subject to 'croup.' Though these attacks are alarming, they are rarely fatal, thus contrasting with laryngismus ; but it must be remembered that the latter is frequently associated with general convulsions, and, moreover, occurs at an age when spasm of the glottis is necessarily dangerous, if severe, on account of the weakness of the respiratory muscles and want of rigidity in the chest walls. Children who have chronically enlarged tonsils or nasal adenoids are exceedingly apt to suffer from spasmodic laryngitis.

These attacks of spasmodic croup differ very much in severity ; in some cases they are very mild, but on account of their occurring at night, and the dread in which all forms of croup are held, they are exceedingly apt to alarm the friends. Several children in the same family may suffer, and there is often a history of these attacks to be obtained in other members of the family.

Treatment.—Great care should be exercised to protect children subject to such attacks from cold. A damp house or a damp situation should be avoided, and exposure to the cold east winds of spring should be carefully guarded against. Great benefit is usually derived from residence at the seaside. Cold sponging with tepid salt and water every morning on getting up will greatly assist in keeping the child free from attacks. Warm woollen clothing should be worn next to the skin, and care taken that the legs and neck are well protected. Enlarged tonsils or adenoids must be removed. During the attack most relief is given by applying hot sponges to the throat and by administering an emetic of ipecacuanha powder (3 to 10 grains) or a teaspoonful or two of ipecacuanha wine. As the child gets older he becomes less and less liable to these attacks, which cease altogether before puberty is reached.

Compression of Trachea. Spasm of Glottis

An abscess or tumour in the posterior mediastinum may compress the trachea within the chest and give rise to obstruction to the entrance of air into the lungs and also spasm of the glottis. The symptoms of such an event are a 'metallic' or 'croupy' cough, noisy stridulous breathing, orthopnœa and attacks of difficulty in breathing, especially at night. Later, probably, there will be noted marked obstruction to the entrance and exit of air to and from the chest. There may, in addition, be choking attacks, or difficulty of swallowing from pressure on the œsophagus, and dilated jugular veins from obstruction to the venous circulation. The compressing abscess may arise from caries of the bodies of the upper three or four dorsal vertebræ, from the mediastinal glands or thymus. Lympho-sarcoma of the mediastinal glands may give somewhat similar symptoms. The following cases illustrate mediastinal abscesses. (See also Spinal Caries.)

Tuberculous Abscess of the Thymus; Pressure on the Trachea; Tracheotomy.—Margaret S., aged 20 months; admitted November 24, 1892. Mother states she has been weakly from birth and subject to bronchitis. Five days ago she began to cough and breathe with difficulty. Sweats a good deal, and cannot lie down; her lips are blue at times. On admission the child was cyanosed and there was much orthopnœa; she was given three teaspoonfuls of vin. ipecac. in divided doses, but she was not sick. A few hours after tracheotomy was performed by Mr. Westmacott, but it failed to relieve the breathing, and she died two hours after. *Post-mortem.*—On removing the sternum an enlarged thymus was noted, extending from the upper border of the sternum to the bifurcation of the trachea, and lying in contact with the trachea, and evidently compressing it. Some caseous lymphatic glands were adherent to the mass. On section it was found to contain a large abscess cavity filled with thick pus. There were some miliary tubercles and broncho-pneumonia in both lungs.

Caries of Cervical Spine; Abscess compressing Œsophagus and Trachea.—Richard L., aged 3 years; admitted February 19, 1894. Mother states for the last fortnight he has had a barking cough and wheezing; he gets feverish and restless at night. On examination it was noted he had a harsh metallic cough and husky voice; prolonged expiration and rhonchus all over the chest. March 19.—For the last week the breathing has been much worse, noisy, and markedly stridulous; the cough metallic, and some recession of the chest. April 11.—Breathes with a croupy sound; has attacks of difficult breathing at night; gets blue and distressed. Air enters the chest with a long-drawn sibilant sound, is held, and then slowly goes out. Resonance is boxy over the sternum. Face puffy; no enlarged veins. May 14.—Lips and fingers somewhat cyanosed. Sits up if awake, but when asleep lies down, though always raised more or less on pillows. Swallows solids and liquids fairly well. July 10.—Temperature been irregular since last note; varies 97° to 100°. Breathing has improved of late; there is a tendency to choke when he feeds. September 11.—All laryngeal symptoms have disappeared. Chokes when he feeds; no post-pharyngeal abscess; no pain in the neck, but he cannot hold his head up, and the last two cervical vertebræ are very prominent; he cries with pain if his head is rotated. Temperature 98° to 101°. October 13.—Much worse; for some time past has been wasting; hectic temperature; had a bad attack of dyspnœa early this morning; much vomiting, pus running from nose and mouth. Death October 23. *Post-mortem.*—Mediastinal glands enlarged, but not caseous; a small cicatrix at the apex of left lung; bronchitis, but not tubercle. In upper part of the posterior mediastinum, and behind the œsophagus, is an abscess cavity holding about ℥ij; it has compressed the œsophagus and opened into it. The trachea has been flattened for a couple of inches opposite the abscess. Posterior wall of abscess cavity formed by spinal meninges in position of seventh cervical and upper three dorsal, the bodies having completely disappeared.

Catarrhal Laryngitis

Children of all ages are liable to suffer from a catarrh of the larynx and trachea, though it is perhaps most common and is certainly most dangerous during the first two or three years of life. These attacks differ somewhat from those of spasmodic croup just described, inasmuch as there may be no violent exacerbation at night, yet in many cases all the symptoms are apt to be worse towards evening. In both cases there is laryngeal catarrh and laryngeal spasm, and they differ only in degree; in the spasmodic variety there is usually little catarrh, but severe attacks of spasm of the glottis; in the catarrhal variety the catarrh is much more severe, and perhaps the spasm is not well marked, but all these cases are apt to become much worse at night, apparently from the presence of more or less spasm. They are mostly the result of cold, exposure to cold winds or a chill, and they may be associated with measles, either belonging to the premonitory symptoms or following the disappearance of the rash. The attacks are preceded for the most part by coryza, feverishness and cough, the first suspicious symptom being the changed character of the cough, which is at first hard or hoarse, and then assumes the characteristic 'croupy' or 'brassy' character, which announces that there is some stenosis of the larynx. An examination of the fauces will probably show enlarged and congested tonsils with excessive secretion, and if the epiglottis can be seen, the mucous membrane will be found to be of a pinker colour than usual; but it is rarely possible to get a view of the larynx by means of the laryngoscope. As the symptoms become more marked, the air is heard to enter the larynx with a hissing sound, there is dyspnœa, the alæ nasi work, the chest walls fall in during inspiration, and there is often much distress. In some cases the child has to be propped up in bed, and pays no heed to its toys, its whole attention being taken up in its efforts to breathe. The fever is variable, rarely high, usually 100° to 101°; the pulse is quick and hard. In most cases the symptoms are milder than those just described, there being only a croupy cough and some acceleration of breathing. In the later stages the secretion becomes freer and muco-purulent. On the other hand, the case may become so urgent that intubation or tracheotomy is required to stave off impending death, though usually the effects of treatment render this unnecessary. Cases of simple catarrhal laryngitis in children rarely present the picture of stenosis of the larynx which is seen in the membranous variety; there is probably the 'croupy' cough and frequent breathing, but between whiles, especially after a fit of coughing, the child is comparatively comfortable, and falls into an easy sleep. The prognosis depends upon the diagnosis; if the case is one of catarrhal laryngitis and the child is over 2 or 3 years of age, there is strong probability that it will recover. The younger the child, the greater is the danger.

Treatment.—The first appearance of 'croupy' symptoms should never be neglected; the hard metallic cough, when once heard, should be the signal for placing the child in a warm room, where the temperature is maintained at 60° or 65° both day and night, giving at the same time fluid food or sops, demulcent drinks, and medicines which promote diaphoresis. If the symptoms become more pronounced, the child must be confined to its cot, and a tent rigged over it by means of sheets stretched over cords or a clothes-

horse, so as to protect the patient from draughts, and a moist atmosphere must be secured by the aid of the steam kettle. Some carbolic acid or tr. benzoin co. may be placed in the kettle. The temperature inside the tent should be maintained at about 70°, and steam from a kettle allowed to play freely into it, so as to render the air thoroughly warm and moist. The usual tendency of the friends of the patient is to overdo the steam and maintain too high a temperature, so that it is not uncommon to find the patient almost parboiled.

During the early stages of laryngitis, when there is much swelling of the mucous membrane of the larynx, with little secretion, the steam gives more or less, at least temporary, relief. This is most marked in the cases of hospital patients who have been much exposed before being admitted ; in these cases the amount of relief given by the steam tent is often an important element in the diagnosis of catarrhal *versus* membranous croup. A steam kettle should be heated by means of a spirit lamp rather than by gas or by placing it on the fire, as in the latter case the patient's cot has to be placed close to the fire. The products of the combustion of gas are objectionable, especially in a small room. Local applications applied over the larynx in the form of hot sponges or spongio-piline wrung out of hot water are often of much service. The sponges should be taken out of the hot water and squeezed by wringing in a piece of flannel and used continuously ; but if this exhausts the child too much, a piece of spongio-piline may be secured *in situ* by tapes and renewed every half-hour. An emetic in this stage is often of much value in relieving the breathing and producing free expectoration, ipecacuanha powder answering very well. Five grains may be given in syrup of orange-peel every ten minutes till vomiting is produced. Sulphate of copper in gr. $\frac{1}{4}$ to gr. $\frac{1}{2}$ doses, repeated in a few minutes, will generally produce vomiting. It is useless to repeat emetics if they fail to give relief. It need hardly be said that it is wrong to give emetics in the later stages, when the breathing has become laboured and the lips blue or pallid ; to give emetics under these circumstances is to risk failure and to waste invaluable time. Of medicines, antimony unquestionably holds the first place, and in sthenic cases should be given with a free hand, though as an emetic it is too slow and nauseating. Either the wine or tartar emetic may be given, in combination with citrate of potash or acetate of ammonia. (F. 46.) Tartar emetic may be given in powder or in 'tabloids,' gr. $\frac{1}{30}$ to gr. $\frac{1}{15}$ every two or three hours, according to age. Both ipecacuanha and aconite in small and repeated doses are useful.

The only food admissible is milk diluted with barley water or soda water, preferably given warm to assist in producing perspiration. In most cases of catarrhal laryngitis relief of the most urgent symptoms follows this line of treatment, though probably for several days many of the symptoms will remain, with exacerbations at night ; in such cases the antimony may be given in nauseating doses.

The question as to whether intubation or tracheotomy should be performed is always a difficult one, inasmuch as in many cases the most urgent symptoms will disappear under the influence of treatment, and the operation, even in the most skilful hands, adds another element of danger to the case. It is impossible to lay down any rule for the performance of the operation,

or to select any one symptom which is to be taken as the signal. Dyspnœa and recession of the chest wall do not necessarily indicate any immediate danger, and most of us will have seen cases in which there has been indrawing of the epigastrium and ribs recover without operation. If, however, the case passes into a later stage in which the voice almost disappears, the respiration becomes laboured, all the respiratory muscles joining in the attempt to draw in air and expel it from the chest, while the distress and restlessness are on the increase, it is then quite certain that the time has come for affording relief. If there is marked pallor of the face, coma, delirium, or other symptom of toxæmia, there is not a moment to lose.

The difficulty is in large measure due to the uncertainty of our diagnosis. If we are sure that we are dealing with a case of catarrh pure and simple, even though the symptoms of obstruction are threatening, we can afford to wait, and give our treatment a fair trial before proceeding to operate, knowing that much of the obstruction is due to spasm, which may at any time suddenly subside. Death from asphyxia must be very rare in a case of catarrhal laryngitis over two or three years of age. But it is comparatively seldom that we can make a certain diagnosis—at first, at any rate—between catarrhal and diphtheritic laryngitis, as it may be only after tracheotomy has been performed, and sometimes even a day or two later, that membrane is coughed up. It is often not easy to decide as to the time for operative interference, but in a case where there was a history of the child having suffered before from 'croup,' and where the breathing tended to get worse at night and afterwards improved, for a while at least, we should delay operative interference as long as possible, in the hope that improvement might take place. On the other hand, in a case that steadily got worse without any intermissions, we should certainly advise operative interference in good time, as there would be little chance of a successful issue to the case unless the obstruction were relieved. Inject antitoxin in every case in which the diagnosis is in doubt.

Diphtheria of the Air Passages

Is membranous laryngitis always diphtheritic? Can there be diphtheria of the larynx without membrane being present? In the great majority of cases there can be no doubt that if membrane be present on the tonsils, epiglottis, or larynx, the case is one of diphtheria; but it cannot be said with certainty, if there is no membrane there is no diphtheria. In the present state of our knowledge it is not wise to take up a dogmatic position, except in so far as to view every case of laryngitis, whether we find membrane or not, with the greatest suspicion, as such cases may turn out in the end to be diphtheria, and we may regret when too late that we did not at first inject antitoxic serum. Every case of membranous laryngitis should be treated as diphtheria.

Symptoms.—The initial symptoms of membranous croup, whether diphtheritic or not, are practically identical, inasmuch as they are those of stenosis of the larynx. When the larynx is the primary seat of attack the symptoms are those of catarrh, with restlessness, feverishness, and brassy cough. In the course of a day or two, sometimes sooner, there is more or less loss of

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voice and the cough has a peculiar ringing or metallic character, which is very characteristic.

It now becomes evident that there is some obstruction in the larynx, as the air enters the trachea with a hissing or stridulous sound, and the child is constantly endeavouring to cough something up and clutches at its neck as if to remove some obstruction. The tonsils are usually swollen, the fauces reddened, and perhaps the seat of false membrane. There is marked restlessness ; the child wants to be nursed, then put back again into its cot, perhaps gets a few minutes' sleep, waking up with a hoarse cough and difficulty of breathing. The voice now is nearly lost, the child speaking in a whisper and making itself understood with difficulty. There is marked dyspnœa, which tends to increase as the disease progresses ; the alæ nasi dilate, the extra inspiratory muscles are called into action, and the epigastrium and inferior lateral region of the chest, the intercostal spaces, and supra-sternal fossa are drawn in during inspiration. The expiratory efforts are laboured, so that the abdominal muscles act with some force, and the air escapes through the larynx with a noisy sound. So laboured and noisy is the breathing that it can be heard some distance off. While the child goes from bad to worse, there are usually more or less marked exacerbations ; the child is easier after a fit of coughing, during which mucus or perhaps some membrane is actually dislodged. All the symptoms are apt to be worse at night.

If no relief is obtained the symptoms of toxæmia begin to present themselves. There is a marked pallor or lividity about the lips and face ; perspirations break out on the forehead ; the restlessness is often intense ; the child is perhaps drowsy and delirious, perhaps attempting to get out of bed ; presently complete insensibility comes on, the pupils dilate, the attempts at respiration become more and more feeble, and death quickly ensues. The temperature is usually raised a degree or two in the earlier stages, but may be subnormal as the blood becomes more venous. An examination of the chest does not always yield positive results as to the state of the lungs. The whistling or stridulous sound produced in the larynx is heard all over the chest, masking the vesicular breath sounds, and making it difficult to diagnose the condition of the lung. The supraclavicular regions in front are usually unduly resonant from the presence of emphysema, while at the bases posteriorly the resonance is mostly impaired on account of the lung being collapsed, or air entering it very imperfectly. The diagnosis of pneumonia is difficult in the absence of impaired resonance, as the typical signs may be wanting on account of the small supply of air entering the chest : moreover, the pneumonic consolidation may be masked by emphysema. It is difficult to diagnose the presence of membrane in the trachea and bronchi ; but if after tracheotomy has been performed the breathing is still laboured, with indrawing of the chest walls, there will be strong reason to suspect that the bronchi are obstructed by membrane.

When the larynx is affected secondarily the symptoms are frequently much less marked, more especially if the membrane only spreads to the larynx after it has existed for some days in the pharynx or nasal mucous membrane. In this case the weakness and depression which exist before the laryngeal complication supervenes mask the symptoms of laryngeal stenosis. There is usually much less dyspnœa and distress than when a

healthy child is suddenly attacked. When the primary seat of the membrane is in the bronchi and it ascends to the larynx, the symptoms closely resemble purulent bronchitis, as in the following case :

Ascending Diphtheritic Croup.—Thomas Mac., 7 years. Boy was quite well till February 8. He complained of his throat, and became hoarse ; he had also a cough. On February 8 he came to the Manchester Throat Hospital, where examination showed the cords and larynx were healthy. February 11.—Seen by Mr. Westmacott at the Children's Dispensary ; hoarseness and signs of bronchitis were noted, and he was sent to hospital. On admission he is a well-nourished boy, some dyspnœa, but a good colour. There is recession of the lower part of the chest. Pulse, 100 ; respiration, 28 ; temperature, 99·8 ; chest resonant. Rhonchi heard all over chest. No enlarged glands to be felt ; some diffused redness of fauces ; no membrane. Steam tent ; sick twice after pulv. ipecac. gr. xv. February 12.—There is more marked recession than yesterday ; spits some purulent sputa ; râles heard in chest. At noon, intubation by Mr. Lea, coughed up much stringy mucus. Temperature 98°–101° ; no membrane. February 13.—Respiration easy ; tube remains. Temperature 101°. February 15.—Tube removed ; breathes easily, but coughs up a good deal of greenish pus. Urine contains a trace of albumen. February 16. —Respiration easy ; no recession ; urine a large amount of albumen. Intubation at 10.45 ; coughed tube up in a few minutes. Intubation again at 1 P.M. ; much muco-pus coughed up. February 17.—Child much worse ; great pallor. Respiration 32. Urine scanty ; large amount of albumen ; weak pulse, low tension. February 18.—Tracheotomy this morning, dyspnœa increasing ; no membrane seen. Child died of asthenia early morning. *Post-mortem.*—Thin membrane extending down the trachea and bronchi to the smallest bronchi in the lungs ; much mucus present. Some membrane on the epiglottis and larynx ; none on the fauces or nares.

Albuminuria exists in a large number of cases in the early stages, in nearly all in the latter stages ; the urine may be highly albuminous and scanty. Occasionally there may be suppression of urine and uræmic symptoms.

Diagnosis.—The diagnosis of stenosis of the larynx is not difficult, nor is it likely to be confounded with bronchitis or broncho-pneumonia where the obstruction resides in the bronchial tubes, or where there is extensive consolidation of the lung. In laryngeal stenosis the air rushes through the larynx, giving rise to a crowing or stridulous sound, especially during inspiration, but there is obstruction to the expiration also ; the respiratory movements are laboured, as if to overcome the obstruction, and with this there is marked recession or sucking in of the chest walls during inspiration. There is loss or great impairment of voice. In pneumonia or bronchial obstruction the dyspnœa may be great and the respirations frequent, with much indrawing of the chest wall, but there is no stridor or loss of voice. The diagnosis of obstruction of the bronchial tubes, in addition to stenosis of the larynx, as in those cases where the membrane has spread downwards or where there is an accumulation of mucus below the larynx, is difficult and uncertain ; but in all such cases the dyspnœa will be great, and tracheotomy urgently required, and the presence of obstructed bronchi would not contraindicate operation, as an opening in the trachea would favour the coughing up of the obstructing material.

The diagnosis between diphtheria and non-diphtheritic croup is often a matter of difficulty by clinical observations alone, and until the case has remained under observation for some hours or days often impossible. Even

after tracheotomy has been performed, the nature of the case may still be doubtful, inasmuch as thick fibrinous mucus may be coughed up with no distinct membrane, and recovery may take place without the diagnosis having been determined. The question of diphtheria or not diphtheria is one of the greatest importance, but unfortunately there is not much that can be said with certainty. It is easy to say that in diphtheritic croup there is asthenia, while in catarrhal laryngitis the attack is sthenic in nature. But, as a matter of fact, it occurs in practice that if the primary seat of the diphtheria is the larynx, the first and only symptoms are those of stenosis of the larynx, and the pallor and depression and asthenia which result are due to the toxæmia produced by want of oxygen, rather than by the working of the diphtheritic poison. It is for this reason that the symptoms of membranous formations are practically the same whether produced by diphtheria or not. If, however, the larynx is affected after the existence for some days of diphtheria of the fauces, the symptoms are necessarily modified. The diagnosis of diphtheria when primarily situated in the larynx has often to be made less from the symptoms of the patient than from his surroundings.

If diphtheria is epidemic at the time, or if the fauces are covered with membrane, or there is albumen present in the urine, the case is almost certainly diphtheritic. The discovery of Loeffler's D-bacillus in the secretions would place the diagnosis beyond doubt, and in every case with suspicious laryngeal symptoms a swab should be taken and submitted to a competent bacteriologist. This, however, in any case takes time, and it is not always possible, especially in country districts, to obtain the services of a skilled bacteriologist.

Stenosis of the larynx may be caused in other ways than by the exudation of membrane; the larynx may be compressed by an abscess situated posteriorly between the larynx and œsophagus, or even laterally; in this case there will be difficulty of swallowing as well as dyspnœa. The trachea may be compressed below the larynx by an enlarged thyroid or new growth, but the history of the case as well as the local enlargement would distinguish between the two. In infants and young children spasm of the glottis will in rare cases simulate membranous laryngitis, as in the case given (p. 348).

Pathological Anatomy.—The *post-mortem* appearances found in those who have died of membranous or diphtheritic croup differ according to the immediate cause of death. In the majority of cases this is due to the formation of membrane below the tracheotomy wound and to the lungs becoming choked or collapsed. In such cases membrane may be found beginning at the epiglottis and extending downwards to the smallest bronchi. As a rule the membrane is tough and firmly adherent to the epiglottis and larynx, being separated with difficulty, while lower down the membrane is far less tough, and is much more easily detached; the bronchi usually contain semi-purulent fluid, and the bases of the lungs are usually pneumonic or collapsed, while the apices are emphysematous. In some cases death results from asthenia or from septic poisonings, the result of diphtheritic infection; in such cases the trachea and bronchi may be free from secretion. It is exceedingly rare to find at the *post-mortem* that the membrane is confined to the larynx in those cases where tracheotomy has been performed. Broncho-pneumonia is frequently present.

Treatment.—Every case of laryngitis occurring in a child should be at once isolated, as what may appear in the early stages to be a mild case of catarrhal laryngitis may in the end prove to be diphtheritic. There are mild attacks of diphtheria of the larynx, just as there are mild cases of diphtheria of the tonsils and fauces. In the early stages the secretion coughed up may be muco-purulent only, and later, either before or after tracheotomy or intubation has been performed, the secretion may be membranous.

In every case of laryngitis where there is even a suspicion of diphtheria 2,000 to 3,000 units of antitoxic serum should be injected without delay. It may be impossible to make a diagnosis of diphtheria in those cases in which the larynx is first attacked, but inasmuch as diphtheria of the larynx is an exceedingly fatal disease, and as the success of the serum treatment depends upon it being begun within 24 to 48 hours of the commencement of the illness, it is better to err on the safe side and treat a suspicious case as diphtheria from the very first. If in a case, seen for the first time, there is a whitish or yellowish exudation either in points or patches on the tonsils or fauces, we should not hesitate to use antitoxin. Our experience agrees with that of others, that in some cases, at least, improvement in the symptoms takes place within 12 to 24 hours, and in cases in which tracheotomy is necessary the mortality is less now than formerly it was without antitoxin. The antitoxin apparently has the effect of loosening the membrane and preventing extension. Goodall comes to the conclusion, from the consideration of the statistics of various institutions, that out of every 100 cases of tracheotomy for diphtheria in the pre-antitoxin days not more than 29 were saved, now at least 53 recover ; and in those cases not operated on in the old days not more than 48 recovered, now at least 75 cases end in recovery.

Much that has been said under the head of treatment in catarrhal laryngitis will apply to the treatment of diphtheritic laryngitis. A steam tent should be provided with a free supply of air, and warmth and heat should be applied externally to the larynx, though any blistering or abrasion of the skin must be carefully avoided. If the case is certainly one of diphtheria we doubt the value of either emetics or expectorants. If there is membrane in the larynx there is small chance of its being loosened or detached by these means. The medicinal treatment appropriate for diphtheria should be given (see *infra*). The only food should consist of fluids.

Tracheotomy.—The operation of opening the trachea in cases of membranous laryngitis must be looked upon as a means of relieving the mechanical obstruction to respiration ; it can in no way influence the constitutional effects of the disease, though it may prevent the addition of gradual asphyxia to the other depressing influences of the poison. Further, we may, by the operation, prevent the spread of the membrane down the trachea, and thus, perhaps, lessen the risk of absorption of the virus as well as get rid of the obstruction.[1] What certainly may be looked for from the operation is that death from mechanical obstruction to the upper segment of the windpipe may be averted, and that the distress caused by dyspnœa may to a great degree be relieved. It must not be forgotten that tracheotomy has its own dangers : first come the risks of the operation itself—hæmorrhage, injury to important

[1] *Vide* R. W. Parker.

neighbouring structures, and entrance of blood into the trachea ; later, there are the dangers of septic absorption, the exposure of a raw surface to the diphtheritic poison, tracheitis, pneumonia, and so on, from exposure of the tracheal mucous membrane to cold ; that this is a real danger a paper of Sir S. Wilks shows.[1]

While we have thus indicated the objections to and the limited uses of the operation, we would yet urge its performance in all cases where there is severe dyspnœa subject to the alternative of intubation as discussed later, and of course to the due administration of antitoxin ; we have no means of knowing that the child will die of asthenia, we do know that he will die of suffocation if unrelieved, and the other dangers mentioned are all usually avoidable by careful operating and after-management.

Extreme prostration without distinct evidence of asphyxia, and the presence of pneumonia or capillary bronchitis, may be looked upon as indications that tracheotomy will be of no avail. If tracheotomy is otherwise indicated the presence of bronchitis may not in all cases prevent the operation being successful. We have seen a case in which it succeeded perfectly under these circumstances as far as relieving the dyspnœa went, though the child died, when apparently convalescent, from ulceration into the innominate artery.

The younger the child the earlier should tracheotomy be done. Inasmuch as the operation is nearly always one of urgency, we must be prepared to do it under unfavourable circumstances as regards nursing, light, help, and appliances. It is, however, usually possible to improvise fairly serviceable arrangements for the operation itself. A dressing table or the top of a chest of drawers in private houses is the usual operating table. Candles give generally the best obtainable light when, as is so often the case, the operation has to be done at night, and care must be taken that the lights are entrusted only to those members of the household who can be depended upon to bear seeing the operation. These makeshift arrangements, together with the small size and anatomical relations of the parts, the urgency of the case, and the movements of the trachea in difficult respiration, make this operation, though often lightly spoken of, one of the most anxious in surgery.

If possible, at least one skilled assistant should be obtained besides the anæsthetist. As regards anæsthetics, it is in our opinion a question to be settled for each case ; if the child is so asphyxiated as to be unconscious of pain, and not likely to struggle, it is far better to do without an anæsthetic. We have seen chloroform prove fatal before the operation was begun ; on the other hand, if the case is operated upon earlier, and the child is conscious and restless, it is on all grounds better to give chloroform.

The child then should be placed upon a table of convenient height, and the lights, if necessary, arranged carefully. Everything required in the operation should be laid out upon a table or chair ready to hand before the child is taken out of bed, since at any moment the movement or the giving of the anæsthetic may increase asphyxia and demand instant action.

As soon as the child is unconscious, and not before, since it increases the dyspnœa, one pillow should be taken from beneath the head and placed

[1] *Guy's Reports*, ser. iii. vol. vi.

under the shoulders, so that the head falls back and fully exposes the front of the neck. Parker recommends a wine bottle wrapped in a towel as a neck support. The head must be held by an assistant exactly straight, so as to avoid any chance of the operator missing the mid line of the neck. The thyroid cartilage is then to be felt for, and an incision, one and a half or two inches in length, according to the size of the child, made in the middle line from the lower border of the thyroid cartilage downwards nearly to the top of the sternum. The first incision should be carried through the skin and subcutaneous fat ; the second assistant should then draw the edges of the wound apart with retractors, and the operator should by successive cuts divide the tissues until he reaches the intermuscular septum between the sterno-hyoids or lower down between the sterno-thyroids : on reaching this

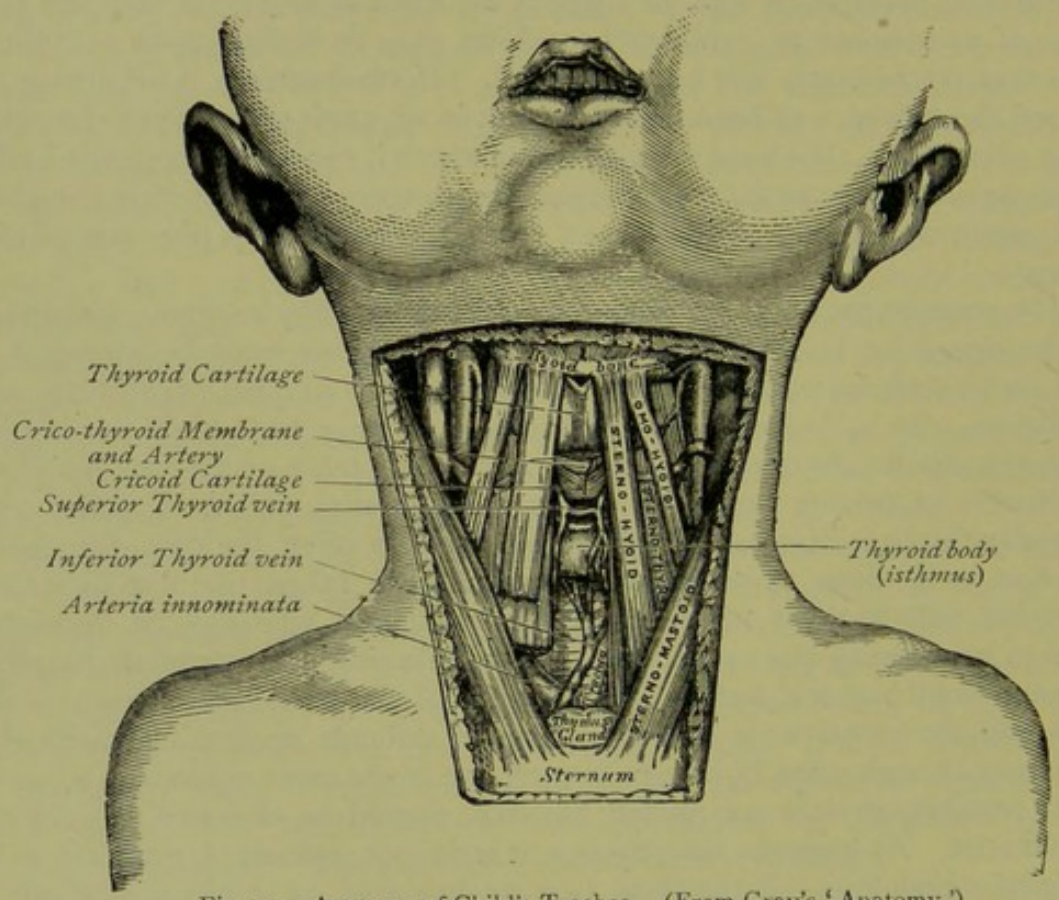

Fig. 70.—Anatomy of Child's Trachea. (From Gray's 'Anatomy.')

he should with a director tear through the line of junction, and the assistant should separate the muscles with the retractors. The tracheal fascia will now be exposed, and should be torn through in like manner, and the trachea bared. The tracheal hook is next fixed in the trachea, and drawn slightly forwards so as to steady the windpipe and make it prominent ; a short, somewhat round-shouldered knife—i.e. one rounded at the back and nearly straight in front—is then made to pierce the trachea, and as soon as it has entered the handle is slightly depressed, and the windpipe is divided from below upwards for at least three-quarters of an inch. The knife is now laid aside, the dilator passed into the trachea and opened, and the hook removed ; a free blast of air and the driving out often of mucus or of membrane follows. If the trachea is free from membrane, the tracheotomy tube

fitted with tapes is then passed in between or above the dilator blades, and the dilator is removed ; as soon as a blast of air through the tube shows that it is in place, the tapes should be tied round the neck, and the operation is over. The child should be kept upon the table well wrapped up, with a warm sponge over the tube, for a short time, to recover itself, and that it may be seen that there is no bleeding or other complication ; after a quarter of an hour the inner tube may be put in after clearing away all coughed-up matter, and the child should be put into its cot and the steam kettle arranged.

Such are the general outlines of the course of an operation in which there have been no complications and no hurry ; it is, however, seldom that such a favourable state of things occurs, and it will be convenient to consider more in detail the various difficulties that may arise. First, then, one or more large veins, inferior thyroid or branches of the anterior jugular, may be met with ; if there is no urgency these may be ligatured, either before or immediately after division, or forcipressure forceps applied. Should, by any rare chance, an artery of any size be wounded, it must of course be treated in the same way. In all cases the veins are necessarily intensely congested when dyspnœa is marked. In order to avoid danger of wounding veins some surgeons lay aside the knife after the first incision and tear through the tissues down to the trachea with dissecting forceps or director.

Next, the most rigid care must be taken to keep in the middle line ; in young fat children it is not difficult to miss the trachea, which in them is not only small, but so soft as to be readily compressed or pushed aside and so missed. Everyone has heard of, if not seen, cases in which the dissection has been carried to one side of the trachea, and thus the great vessels &c. endangered. In tracheotomy low down, the anterior jugular vein is the vessel most likely to be injured. This is, of course, of minor importance.

The depth of the trachea must also be remembered, and the fact that it recedes from the surface towards the lower part of the neck. The deep incisions must not be carried too close to the sternum, or the innominate vessels will be endangered, nor must the trachea be opened so high up as to divide the thyroid cartilage and probably injure the vocal cords ; it is well, however, to get as low an opening as practicable, in order, if possible, to be clear of the obstruction.

No regard need be paid to the thyroid gland, nor should any attempt be made in children to make a 'superior' or 'inferior' tracheotomy. In almost every case in which the operation has been done examination will show that two or three rings of the trachea and the cricoid cartilage, together with, of course, the isthmus of the thyroid gland, have been divided—that, in fact, a laryngo-tracheotomy has been done, and this is as good as any other operation.

It is not by any means necessary to use a tracheal hook ; if it is not employed, the left forefinger should be used as a guide and the trachea steadied by it or between it and the left thumb, while the knife is carried upwards by the side of the finger or between it and the thumb ; in many cases, however, the hook does undoubtedly simplify the operation.

It is of great importance to have the skin wound very free, both to give room for the deeper steps of the operation and to prevent the possibility

of discharge or air being pent up in the cellular tissue of the wound; no stitches should ever be put in. The tracheal opening should be large, median, and vertical; nothing is gained by a small opening, and much trouble may arise in inserting the tube. The knife should enter the trachea somewhat sharply, but not with a stab or plunge which would endanger the posterior wall; cases have been recorded where the knife failed to pierce the mucous membrane, and hence the tube was passed into the submucous tissue; in other instances a tough diphtheritic membrane has been pushed before the knife and tube—under either condition, of course, no relief was obtained by the operation.

If there is any large collection of membrane or of thick mucus in the trachea, the tube should not be inserted at once, but the edges of the tracheal wound should be held apart for the child to cough out freely the contents of the air passages, and for the surgeon to clear them away and examine the surface of the trachea so as to pick off any visible membrane above or below the opening. Parker advises the systematic use of the dilator and swabbing out the trachea and larynx with a feather dipped in solution of carbonate of soda before putting in the tube. Systematic curetting of the trachea has been done by some operators.

The tracheal aperture may be held open either with the dilator or with artery forceps, or Golding-Bird's dilator may be worn for a time.

In inserting the tube it is sometimes difficult to get it into the slit-like orifice in the trachea; under these circumstances the dilator is useful, or if one is not at hand, one end of the opening may be depressed by the finger so as to make the aperture gape. A bivalve tube is of course the easiest to insert for this reason, though it is not by any means the best variety. The surgeon should never be satisfied that the trachea is properly opened unless free blasts of air are driven out on coughing, nor that the tube is in the windpipe unless air and mucus are blown out through the tube freely.

The instrument most commonly used to clear the trachea of membrane is a feather; some of the shorter tail feathers of a pheasant will be found the best—if the longer ones are used, the end which is too flexible should be cut off. We have had some common brush pipe-cleaners tipped with coralline for this purpose, and also a miniature bristle probang made to sweep out the trachea. Membrane can often be picked out with forceps. Aspirators of all kinds are of use chiefly if not solely for blood and the thinner form of mucus; adherent membrane and thick mucus cannot be drawn out by them; neither is sucking by the mouth any better, hence it is not worth the risk to the operator. Anyone who has tried it will know how impossible it is to suck out anything except the fluid material, and even for this suction is often unsuccessful. Parker, however, strongly advocates the use of aspirators after loosening and softening the membrane by instillation of carbonate of soda.[1] Where breathing has ceased or is becoming very feeble, artificial respiration should be performed, and if necessary a catheter may be passed down the trachea and the lungs inflated.[2]

Such are the more important points about the operation itself in cases where everything can be done deliberately and Trousseau's classical advice,

[1] Sodæ carbonat. ℥ij, glycerine ℥ij, water to ℥viij (Parker).

[2] *Vide* Jennings, *Arch. Pædiatr.* September 1884.

'Opérez lentement, très lentement,' followed. In many cases, however, if the operator is slow the child will be dead before the trachea is opened, and if not actually dead the almost complete asphyxia will seriously add to the dangers of the case. Under such circumstances it is necessary to cut the steps of the operation short ; a free incision through the skin, another down to the trachea, and the third upwards in the trachea itself. We have often had to operate in this way with three cuts, using no instrument except the knife and the tracheotomy tube ; after the first two incisions the left fore-finger is passed down to the trachea, which is steadied by it ; the opening is made and the finger kept as a guide for the tube, which is at once inserted. The finger and thumb may be usefully employed to push back the tissues on each side, and, as it were, press forward the trachea. In some cases there is free bleeding for a moment or two from the engorged veins ; this must be neglected, the tube put in at once, and the child instantly turned over on its face to prevent any blood from running into the trachea ; as soon as air enters the lungs freely the circulation is re-established and the venous bleeding ceases without any treatment. The objection to this mode of operating is that it is of course more difficult, and there is some risk of blood getting into the air passages ; it is, however, necessary in some cases. In very urgent suffocation the operation may even be done in one incision through skin and trachea upwards, but this can hardly ever be necessary, and has several objections, the chief being that in children the trachea can by no means always be felt through the skin, and there is great likelihood of emphysema from insufficiency of the superficial wound.[1] Even if the child is apparently dead before the trachea is opened, the operation should be rapidly completed, a long feather passed down the trachea and withdrawn, and artificial respiration performed. Recovery will often follow even if respiration has ceased for what appears a very long time.

It is well to remember that venous bleeding in tracheotomy is always more formidable in appearance than in reality, and always ceases at once after the trachea is freely opened.

Emphysema occurring at the time of the operation is due to too small a skin wound or to opening up the cellular tissue in attempts to pass the tube ; it may be very extensive and spread down into the thorax ; in such cases it is sometimes fatal from pressure upon the lungs. Champneys has shown experimentally that there is serious danger of mediastinal emphysema and pneumo-thorax when artificial respiration or sudden violent inspiratory effort is made after division of the deep cervical fascia ; hence the tube or dilator should be put in quickly and the fascia disturbed as little as possible.[2]

A possible danger from entry of air into a wounded vein need only be mentioned ; instant pressure on the vein and rapid opening of the trachea are the remedies.

Opinions differ greatly as to the best form of tracheotomy tube for immediate use. The bivalve is the easiest to insert ; the lobster-tailed tube

[1] St. Germain operates by one incision downwards, beginning by perforating the crico-thyroid membrane. Neither this plan nor operation with the thermo-cautery has anything to recommend it.

[2] *Med.-Chir. Trans.* 1882.

of Durham is open to the objection that it is very difficult to clean ; probably Parker's so-called angular tube is the best, and is certainly anatomically the most correct ; it has also the advantage of being polished inside. It is, however, a matter of little importance what shape of tube is put in for the first few hours, provided it is of sufficient size and has a movable shield to allow it to lie evenly. The largest size that the trachea will admit should always be used to give as much breathing space as possible and to prevent play of the tube in the trachea. Parker has shown that the diameter of the windpipe is exceedingly variable, and no rules for size in correspondence with age can be given. In any case it is advisable to change the tube after twenty-four to forty-eight hours, and this gives time for the substitution of a Parker's tube for any other that may have been used at the moment. After ninety-six hours the metal tube can often be replaced by a Morrant Baker's rubber one, or at least a metal tube of different length from that first employed, or, better still, the tube may be in favourable cases left out altogether.

As soon as the trachea has been cleaned and the child has become quiet after the operation, i.e. usually in about half an hour or less, he should be removed to the tent, the arrangement of which has been already described.

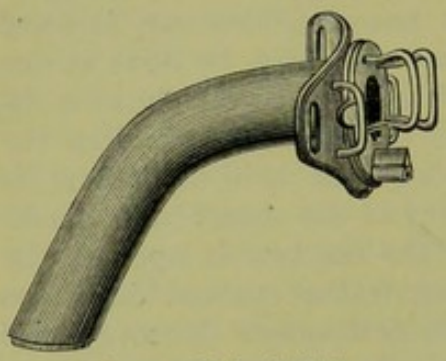

Fig. 71.—Parker's Tube.

The lower part of the wound should be dusted over with iodoform, and a piece of gauze slipped beneath the shield of the tube to protect the skin and wound from it. If the edge of the shield cuts into the wound, the tube does not fit well, and probably the inner end is pressing upon the tracheal wall ; it is either too long in the straight part or the curve is wrong. A single layer of gauze wet with 1-40 carbolic or some other antiseptic solution should be laid over the mouth of the tube and removed when there is any coughing.

The child must be constantly watched, and at the least sign of dyspnœa or any cough the tube should be cleaned with a feather, and coughing excited, watching for the moment when mucus appears at the mouth of the tube to wipe it away before it is drawn in again. The inner tube should be put in as soon as the child has settled down, and taken out every half-hour or oftener at first to be cleaned. Special watch must be kept for any sudden plugging of the tube by pieces of detached membrane or thick mucus—a frequent cause of sudden death after tracheotomy ; immediate removal of the tube and membrane is required in such circumstances. Abundant discharge of thin mucus is a good sign, in so far as there is less likelihood of there being any membrane in the trachea if free secretion occurs.

After-management.—Success in the results of tracheotomy cases depends more upon after-management than upon anything else, and if surgeons could nurse their own cases the mortality after the operation would be much less. Constant watchfulness, *readiness to remove the tube altogether and clean out the trachea*—if membrane continues to form, this should be done at least once daily ; the timely administration of stimulants, regulation of temperature and moisture are essentials, and can only be satisfactorily seen

to by the surgeon himself. Cocks[1] well insists upon this, and points out that sudden obstruction is most often due to inspissated mucus, not to membrane ; this thick mucus is secreted generally about twenty-four hours after the operation, and at the end of three or four days the discharge becomes thinner and more puriform (Jennings).

It is well to feed the child by nutrient enemata for the first few hours, but if he is thirsty a few teaspoonfuls of iced milk may be given. During the first few days the milk not infrequently comes out in part through the tracheotomy tube from imperfect closure of the glottis during deglutition, and not, as might be supposed, from any accident to the œsophagus ; on account of this occurrence it has been advised to give more solid food by the mouth. A certain amount of risk is incurred from this imperfect power of swallowing, in that food may pass into the lungs and set up the so-called 'deglutition pneumonia ;' any such danger may be avoided, as pointed out by Dr. Habershon, by feeding the child through a soft catheter ; from 2 to 6 oz. of milk may be given in this way every four hours,[2] but the plan is rarely required.

If possible the tracheotomy tube should be removed altogether on the fourth or fifth day, but this must depend upon how far the disease has subsided ; if membrane is still coming away, the tube must remain, and it may be the eighth or tenth day before it is got rid of. If, as not infrequently happens, the dyspnœa returns on closure of the orifice of the tube with the finger (always supposing that the tube has a perforation at the bend) or on its removal, the difficulty is due to the presence either of membrane or of granulation tissue, which may form a polypoid mass springing from the site of some patch of membrane, from the edge of the wound, or from an ulcer due to the pressure of the tube. Granulation masses, according to Parker, are most common about the fourth to the eighth day, and may be expected if there are exuberant masses on the margin of the tracheal wound. Morell Mackenzie says they occur from the fifteenth to the thirtieth day, never after two months. Parker treats them by the application of nitrate of silver. Black patches seen on the outer tube when it is removed are said to indicate ulceration at the corresponding spot of the trachea, and should be looked upon as an indication for change of the tube to one of different length (Parker). Or the dyspnœa may be due to adhesions in the larynx or possible paralysis of the laryngeal muscles, inflammatory softening of the trachea, or swelling of the mucous membrane.

Where, then, the tube cannot be removed entirely after the fifth day, the metal one should be replaced by a rubber one, or frequent changes made in the *length* of the tube, and daily attempts made to dispense with the tube altogether. Should the obstruction continue, search must be made for its cause ; the most common is the granulation mass which may sometimes be seen on using the dilator and be removed, its base being touched with nitrate of silver. Failing this, it is well to wait a week or so and allow the child to regain strength ; it should then be examined under an anæsthetic, and, failing the finding of granulations or other obvious cause, a flexible probe should be passed up through the glottis from below and a piece of

[1] *Archives of Pædiatrics*, January 1884.
[2] *St. Bartholomew's Reports*, 1885.

silk carrying a small sponge be attached to it ; the probe should then be drawn out through the mouth, and the sponge carried through the larynx sweeps it out, breaks down any adhesions, and clears away mucus or any granulations there may be. We have by this means succeeded in restoring the breathing powers after many attempts at doing without the tube for a long time.

The dangers, then, of the too prolonged retention of the tube are the possible development of granulation masses and ulceration of the trachea which may either lead to hæmorrhage from perforating the innominate artery or vein, or to subsequent tracheal stenosis from cicatricial stricture. Roger, in 1859, and Heilly (*Le Progrès Médical*, November 29, 1884) estimated that in about one in five of the cases of tracheotomy there is ulceration of the trachea, but these results are from *post-mortem* observations. The ulceration may be either on the anterior or posterior wall of the trachea and gives rise to no special symptoms at the time, unless some important vessel is opened.

Sometimes mere nervousness and fear of suffocation prevent the removal of the tube ; in such cases attempts must be gradually made by the use of a tube with a large fenestra to allow the passage of air through the larynx, while the external orifice of the tube is closed with the finger or a cork for gradually increased periods of time. Careful watch must always be kept upon these cases for fear of sudden asphyxia, which may come on after removal of the tube, as soon as the tracheal orifice becomes small, or even later than this from growth of granulations from the inner surface of the wound. In such cases the wound may require to be reopened and the tube to be inserted afresh. In some few cases the tube can never be dispensed with, and has to be worn permanently ; but usually some cause of obstruction can be found. Sometimes a tough dense cicatricial membrane forms about the lower aperture of the larynx or upper part of the trachea, and requires removal by enlargement of the tracheotomy opening or by thyrotomy. Intubation with or without removal of cicatricial tissue is effectual in some cases.[1] In any case where the tube has to be long retained, great care must be taken to avoid ulceration and to see that the tube is not corroded ; it has several times happened that the tube has dropped off the shield and fallen into the trachea after long wear.

As to the application of lotions &c. to the interior of the trachea after operation, the number of specifics is as great as that for the throat ; the soda lotion and lime water[2] do, no doubt, soften the membrane and mucus, and allow it to be more easily detached : of the other remedies probably the best is the instillation of 2 or 3 drops of 1–2000 mercurial solution. The applications may be made with a brush or spray producer, or a drop or two may be instilled through the tube from time to time. Smearing the tube with iodoform ointment each time it is replaced is a good plan. The wound should be swabbed over daily with a solution of perchloride of mercury (1–2000), and then powdered with equal parts of iodoform and boric acid.

After the operation the child is greatly relieved, usually falls asleep, and all goes on well for twenty-four hours to forty-eight hours, and then in fatal

[1] *Vide* Pitts and Brook, *Lancet*, January 10, 1891.

[2] Lime water is soon rendered inefficient by the CO_2 of the expired air.

cases death occurs, often suddenly. This sudden death may be due to various causes; blocking of the tube with detached membrane or mucus, extension downwards of the disease, possibly irritation of the vagus (Parker), simple asthenia or poisoning by the disease, pneumonia, or cardiac failure.

There is no doubt that the majority of cases of tracheotomy for diphtheria die; the mortality varies with the epidemic and with the operator, for necessarily the surgeon who will only operate in the most favourable cases will have a lower mortality than he who gives a chance of relief to less hopeful cases as well. Hence statistics are of no value. It is, however, roughly true that a large proportion of the cases described as croup recover after tracheotomy, while those classed as diphtheria mostly die.

Age has a very important bearing on the success of the operation. Children under 2 years comparatively seldom recover[1]; the feebleness of the child, the increased difficulty of the operation and of the subsequent management, all make the prospect of this age worse. R. W. Parker has had 50 per cent. of successes in his own practice, but this must be considered far better than the average result.[2]

Archambault, in the Paris Children's Hospital, gives the following table of tracheotomy cases:

	Cases	Recoveries
1–3 years	976	104
3–4 „	820	175
4–5 „	736	174
5–6 „	497	148
above 6 „	547	198

Jacobson says one case of recovery in three or four is a good average ('Operations of Surgery,' 1897, 3rd ed.).

For the general management and feeding of diphtheria cases, as well as for the treatment of the fauces and mouth, see Diphtheria.

Apart from diphtheria or croup, tracheotomy may have to be considered in cases of *scalds of the glottis*, usually the result of an attempt to drink from the spout of a tea kettle. In such cases, as Sir S. Wilks has shown, a false membrane may be produced exactly like that of diphtheria.[3] The symptoms usually come on immediately, and in slight cases soon subside if the child is kept in bed in a warm moist atmosphere. Sudden spasm, bronchitis, and pneumonia, and the formation of false membrane, are the chief dangers. The treatment of such cases consists in keeping the child in a tracheotomy tent and giving antimony or an emetic. If the child is steadily getting worse, tracheotomy or intubation should be performed. The tracheotomy tube may be removed usually on the third to eighth day or earlier, and the intubation tube, according to the severity of the case, from twenty-four hours

[1] But Lindner, *Jahrbuch f. Kinderheilk.* B. xx. H. 2, records 38 per cent. of successes for 'croup and diphtheria,' and most of the successes were in the second year of life; and Chaym, *Archiv. f. Kinderheilk.* B. iv. H. 11, 12, has collected 220 successfnl cases under 2 years; the youngest cases are 6 weeks and 9 weeks respectively; the latter, however, was for post-pharyngeal abscess.—*Berliner klin. Woch.* 1880.

[2] *Edin. Med. Jour.* November 1888.

[3] *Guy's Reports*, 1860, and Bryant in the same number.

onwards. Scarification is often recommended, but is more easy to write about than to perform.

Foreign bodies often find their way into the air passages of children. A bead, or grain of maize, or a plum stone, or other foreign body is held in the child's mouth, and a sudden inspiration may cause it to pass into the larynx. The body may lodge in the upper opening of the larynx or in the rima, or may pass into the trachea or either bronchus, usually the right.

Parker records a case in which a caseous lymphatic gland ulcerated its way into and blocked the trachea.[1]

If the body is in the larynx there will be dyspnœa and more or less loss of voice, with hoarse or ringing cough, and if in the trachea possibly a loose rattling sound may be heard on listening over the front of the neck, indicating the movement of the body in the trachea. If the substance is lodged in the bronchus there will be impaired breath sounds, and possibly collapse of the lung on the same side.

If the history is clear, tracheotomy should at once be performed, as sudden asphyxia often comes on quite unexpectedly; hence urgent symptoms should not be waited for. The opening in the trachea should be free, and the edges should be held apart to allow of the ready expulsion of the body, which is often blown out at once. If this does not occur, the larynx should be searched, a probe being passed in from below and the finger made to explore the throat from the mouth. If the body is lodged below the opening, the child should be inverted and shaken, and if this is unsuccessful, an attempt should be made to extract the substance with forceps or a brush passed down the trachea. Bronchitis and pneumonia usually speedily result if the foreign body is not removed.

Should the attempt at removal fail, if the body is in the larynx and cannot be pushed up into the mouth or removed from below, it is probably better to follow Holmes's advice and divide partially or wholly the thyroid cartilage so as to expose and remove the impacted mass; the operation is likely to do less harm than the retention of the foreign material. If the substance is lodged in the lungs, it may possibly be removed at a second attempt or may become loosened and coughed up; occasionally such bodies ulcerate their way out and may even reach the surface of the chest. In other cases death results from pneumonia or pulmonary abscess.

Certain other conditions may demand tracheotomy in children—congenital syphilitic laryngitis, chronic simple laryngitis, papilloma, or, as already mentioned, pressure of pharyngeal abscesses.

Intubation of the larynx.—We owe to O'Dwyer, of New York, the practice of intubation as a substitute for tracheotomy. It has been urged in its favour that it is a less severe measure than that operation, and is likely to be permitted by friends when a cutting operation is refused; that it does not prevent opening the trachea later, should that become necessary; and that it is efficient, while it does not expose a raw surface to the diphtheritic poison nor allow unwarmed air to reach the lungs. A special set of instruments is required for this plan. From 20 to 30 per cent.[2] of successful results were originally obtained, but since the use of antitoxin the successes

1 *Brit. Med. Jour.* October 1, 1890.

2 *Vide* Waxham, *Brit. Med. Jour.* September 29, 1888.

have increased to something like 70 per cent. or even more. However, several drawbacks to its use are admitted, such as the difficulty of the manipulation, the liability of displacement of the tube, and its obstruction by membrane. Our experience of the operation has shown that a little practice is required to learn readily to introduce the tube; it is much more difficult to remove the tube from the larynx unless a thread is employed. Several improvements have been made in the apparatus, and the method has a large

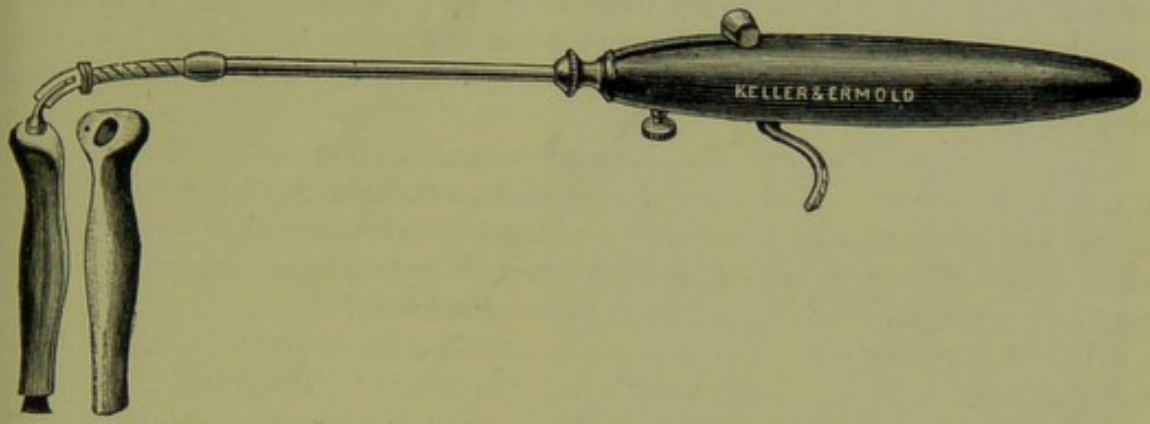

Fig. 72.—O'Dwyer's Intubation Apparatus. The figure shows the 'introducer' with a tube fitted on. A separate tube is also shown.

though not universal field of usefulness. Intubation, as suggested by Symonds, is certainly useful in some cases where after tracheotomy there is a difficulty in getting rid of the tube. On the other hand, where there is much membrane, or where intubation fails to relieve or the child cannot do without the tube, tracheotomy is still required, as well as of course in the cases

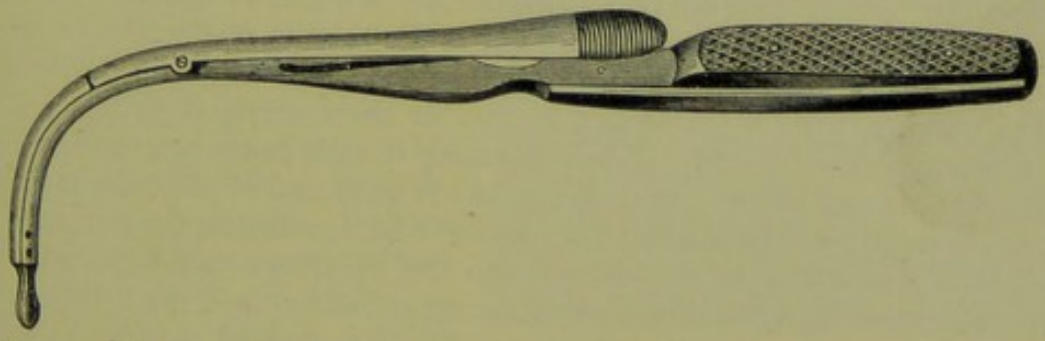

Fig. 73.—O'Dwyer's Extractor. The jointed beak fits into the tube and holds it firmly when the lever is depressed by the thumb of the operator.

where the apparatus is not at hand. The adequate use of antitoxin largely reduces the need for either operation, and diminishes the mortality of both.

In one instance in which we performed intubation upon a living child the result was disastrous; a portion of the membrane was pushed down before the tube, and the child instantly choked: it was only by immediate tracheotomy and the use of artificial respiration that breathing was restored. Others have had similar experience. We have had some experience of the method in various forms of laryngeal obstruction, and have not been led to take a very favourable view of its suitability for cases of diphtheria where false membrane in any quantity is present. Of ten cases of intubation under our care, in three success followed, in three tracheotomy was subsequently

successfully performed, and in four instances the children died in spite of tracheotomy. Steward in 1905 gives 27 per cent. of deaths after intubation, but of course not due to it. The operation appears best adapted for cases where there is little or no false membrane—i.e. certain types of acute laryngitis, for scalds, for the less severe forms of diphtheria, where tracheotomy is for any reason undesirable, and for use in cases where mechanical obstruction remains after tracheotomy, or results from cicatricial contraction in the larynx. It is certainly unsuitable for bronchitic and pneumonic patients. A special pattern of short wide tubes has been used for cases where there is much loose membrane or discharge.[1] Vulcanite tubes are also sometimes employed.

Lovett,[2] from a study of 858 cases operated upon at the Boston City Hospital either by tracheotomy or intubation, concludes: 'In general I would be glad to advocate the performance of tracheotomy instead of intubation in most cases of severe laryngeal diphtheria, except in the cases of children under two years, when intubation is to be performed.'

The apparatus used for intubation, and figured on p. 369, consists of a special tube with an 'introducer' and 'extractor.' The child should be swathed in a blanket and held upright in the nurse's arms. The mouth is held open by a gag, a tube of proper size selected, threaded, and its pilot screwed on to the introducer; the left forefinger passed to the back of the throat pulls forward the epiglottis and serves as guide to the tube. Any difficulty in introducing the tube may, we have found, be got over by waiting for an inspiratory effort on the part of the patient and then slipping in the tube: this is a little practical point of much value. As soon as the tube is in the larynx the introducer is withdrawn with the pilot, and if the tube is in position the thread may be also withdrawn. We are of opinion that it is, however, much better to leave the thread in the tube to facilitate extraction; usually it sets up little or no irritation. The tube is then left in position for a time varying from a few hours to two or three days, according to the circumstances of the case. If left too long it may cause ulceration of the larynx or trachea,[3] while if it is removed too soon and obstruction recurs, it will be necessary to replace it. To remove it an anæsthetic may or may not be given, the extractor is introduced into the opening of the tube, which is then withdrawn, or by external pressure upon the trachea the tube may be pressed out into the mouth and removed. If too small a tube is used, it may slip into the trachea. Without practice the tube is apt to be passed into the œsophagus.

After the introduction of the tube, relief, though not necessarily immediate, is usually speedy. There is sometimes difficulty in feeding, from a tendency for fluids to pass into the trachea. If this difficulty occurs it can be met by feeding the child with its head hanging far back or by giving semi-solid food, or by feeding through a stomach tube.

Chronic Laryngitis.—Both infants and older children suffer from chronic hoarseness, with occasionally acute or subacute exacerbations, with croupy symptoms. Such cases may take their origin in a past attack or

[1] Northrup, *Brit. Med. Jour.* December 29, 1894.
[2] The *Medical News*, August 27, 1892.
[3] Carr, *Lancet*, March 28, 1891.

attacks of subacute laryngitis, a certain amount of thickening being left behind. Other cases are apparently syphilitic, especially in infants. Tuberculous laryngitis may also occur, but it is certainly uncommon. The larynx is also sometimes affected in cases of chronic pharyngitis where the tonsils are enlarged and perhaps post-natal growths also exist. If the symptoms do not yield to astringent applications or the use of caustics such as nitrate of silver, there may be so much progressive thickening and dyspnœa that tracheotomy may be required; that is, however, very rarely the case.

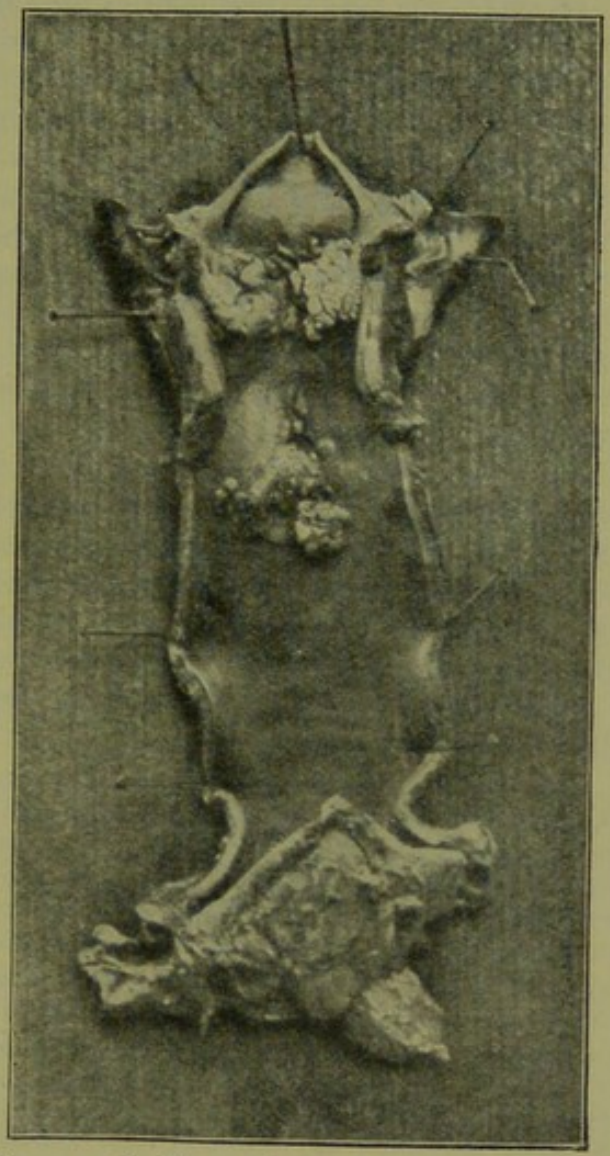

Fig. 74.—Papilloma of the larynx. Girl aged 5 years. The growths are seen attached to the vocal cords, and are also present in the neighbourhood of the tracheotomy wound. One or two caseous glands are seen at the bifurcation of the trachea. See case. (From a photograph by F. H. Westmacott.)

Papilloma of the larynx is a somewhat rare affection, consisting of one or more warty outgrowths from the neighbourhood of the true vocal cords. The chief symptoms are chronic hoarseness, loss of voice, stridulous breathing and croupy cough. Later there may be intermittent attacks of dyspnœa, especially coming on at night. There may be loud laryngeal stridor during inspiration and sucking in of the chest walls, which is worse at some times than others. There may also be loss of pulse during inspiration. Where laryngoscopy is practicable, inspection shows the warty mass or masses usually about the anterior end of the cords. Sudden obstruction of the aperture may result from spasm set up by impaction of a pendulous growth between the cords, or gradual asphyxia may come on. A case has been reported in a child as young as 14 months; it is possible these growths may be congenital in some instances. In a case of our own, in a girl of $3\frac{1}{2}$ years, there was a history of laryngeal stridor from birth. Three modes of treatment are possible—removal of the growths by endolaryngeal operation, a method applicable only to late childhood and adults; the second is tracheotomy, with or without an attempt to remove the growths from the tracheotomy wound; and the third is thyrotomy, with excision of the warts when fully exposed. The last plan, which is the simplest, is open to the objection that injury is likely to be done to the vocal cords and permanent aphonia

may result. Several successful cases by Parker, Davies-Colley, and others, have, however, been recorded. On the whole, in this disease, it is probably best to perform tracheotomy and trust to spontaneous disappearance of the growths, leaving resort to thyrotomy for cases in which long use of the tracheotomy tube is unsuccessful.

In two cases under treatment at the Children's Hospital by our colleagues Dr. Hutton and Mr. Collier, and by ourselves, repeated operations were required both in the shape of thyrotomy and of scraping out the growths through the laryngeal aperture. The tendency to recurrence was very marked indeed, and more than once the windpipe had to be reopened to prevent suffocation after the children had appeared to be convalescent. In both cases it was found impossible to dispense with a tube. The growths sprang from all parts of the interior of the larynx and upper portion of the trachea. Hutton[1] points out that cases of spontaneous disappearance of these growths have been recorded after portions had been coughed up, as well as after tracheotomy without further operation, and after an attack of one of the exanthemata.

Dr. Railton has published two cases in girls aged 3 years and 3 months and 4 years respectively who were treated by tracheotomy only. The former wore a soft tube for 45 months and the latter 25 months ; in both cases the warty growths disappeared spontaneously. It must be borne in mind that the growths are very apt to form in connection with the tracheotomy wound on the inner surface of the trachea (see fig. 74).

The following case unfortunately ended fatally by sudden laryngeal obstruction :

Papilloma of larynx.—Mary C., æt. 5 years, was admitted into Blackburn Infirmary under Dr. Hunt with severe laryngeal obstruction, for which tracheotomy had to be performed March 1897. She had suffered from attacks of dyspnœa and hoarseness for some time before. Several attempts were made subsequently to dispense with the tube, but without success. She was admitted to the Children's Hospital November 20, 1897. During her stay in hospital, the tube was removed on several occasions and a probe passed upwards into the mouth ; the probe passed readily without meeting with any obstruction. Examination with laryngoscope was very difficult and without a definite result. The tube was removed at first for short intervals, and later removed altogether. She breathed easily at night, but at times had attacks of dyspnœa ; her voice was hoarse and whispering. Her temperature latterly varied from 97°–100°, and she lost flesh. She had an attack of urgent dyspnœa December 20, 1897, and died suddenly. At the *post-mortem* there was early tuberculosis at the apex of the right lung and caseous mediastinal glands. There was a mass of papillomata on the vocal cords, and also at the site of the tracheotomy wound (see fig. 74).

In this case it was no doubt unwise to remove the tracheotomy tube ; it would have been better to have allowed her to wear a soft rubber tube for many months, or years if necessary, taking care to remove as far as possible the warty growths which form inside the trachea at the seat of the tracheotomy wound. The fact that the girl was suffering from an early stage of tuberculosis of the bronchial glands and lung, suggests the possibility of a hospital infection with tuberculosis through the tube. Presumably there is more risk of this happening to the wearer of a tracheotomy tube than when breathing in the normal way through the mouth and nose.

[1] Hutton, *Med. Chron.* vol. i. N.S. 1894.

CHAPTER XVII

DISEASES OF THE RESPIRATORY APPARATUS—*continued*

Bronchitis and Catarrh

CATARRH of the bronchial tubes is a common affection at all periods of life and in every social grade, but it is in early childhood that it is perhaps the most common, and it is at this period that it assumes the greatest importance from the diseases which are liable to follow in its train. In old age, when the lungs are damaged by emphysema, and the chest walls have lost their elasticity, bronchitis is apt to be a serious and often fatal disease ; but not less so is it in the very young, in whom the chest walls are alike wanting in elasticity and rigidity, the bronchial tubes easily collapse, and the lungs very readily join the inflammation. The greatest liability appears to occur during the first two years of life ; certainly at this age it is most fatal. Exposure to cold is in a large number of cases the exciting cause ; climatic influences are seen, especially in late autumn or early winter, in the large number of cases of chest affections which occur at this period. That the larger number of cases should occur among the lower and worst-housed class is only what is to be expected, inasmuch as the lives of the infants and children are spent either in the foul and stuffy atmosphere of an overcrowded and ill-ventilated house, or they are exposed, imperfectly clad, to all sorts of weather in the streets.

The predisposing causes are many ; some children seem to inherit a tendency to bronchial catarrh, and, in spite of the greatest care and the most constant 'coddling,' suffer every few months, perhaps for the whole of the winter, from bronchial catarrh or severe colds, which pass into bronchitis with the greatest readiness ; dentition, rickets, measles, whooping cough, intestinal catarrh frequently play a more or less important part in the production of a bronchitis. Rickety children are specially prone to suffer from bronchial affections, and in them it is especially serious on account of the softness of the ribs, and the weakness of the muscles of respiration, resulting in deformed chests and collapsed lung.

Symptoms and Course.—The attack is often preceded by a cold in the head ; the infant sneezes, its nose runs, and it begins to cough. If the bronchial catarrh which follows is mild, and the catarrh does not extend beyond the trachea and large bronchi, the general symptoms are slight : there is no distress, no dyspnœa, only a troublesome cough, perhaps some wheezing during respiration and a slightly elevated temperature at night. In the more severe attacks, in which the smaller bronchial tubes are involved

their mucous membrane being swollen and the secretion thick and viscid, dyspnœa from obstruction to the air entering the lungs will be present. The pulse is hard and accelerated, the number of respirations increased according to the amount of obstruction, the alæ nasi working, the skin hot, and the infant restless and thirsty. In attacks of acute capillary bronchitis, the dyspnœa is very excessive. The child is dusky, with blue lips and anxious expression, with intense distress in consequence of oxygen-starvation. The note over the chest is tympanitic, the respiratory murmur loud in places and absent in others, or weak and accompanied by minute râles. On placing the ear to the chest, dry hissing or snoring sounds will be heard during inspiration, as the air rushes through the pulmonary divisions of the bronchi, in the severer cases entirely obscuring the respiratory murmur. In the milder attacks rhonchi will only be heard with some respiratory movements, being more especially heard at the roots of the lungs.

In infants and young children, especially if their ribs are softened in consequence of rickets, there is recession of the chest walls, chiefly at the epigastrium and lower lateral region of the chest, due to the imperfect filling of the lungs, the chest wall falling in in place of the lungs expanding. In a later stage the sibilant or rhonchial sounds become mixed with moist râles : these are not distinctly and sharply crepitant, as of bubbles passing through thin fluid, but indistinct bubbling sounds as of air forced through thick tenacious mucus. The moist sounds succeeding the dry, point to a freer secretion of mucus from the hitherto swollen and congested mucous membrane. In some cases in infants mucous bubbling râles are heard from the first. If convalescence is quickly established, the abnormal sounds are gradually replaced by the normal respiratory murmur, though rhonchi or râles may be heard for some days or weeks. Percussion of the chest walls during an attack of uncomplicated bronchitis shows the resonance normal, although perhaps there may be some hyper-resonance at the sub-clavicular regions from the presence of more or less emphysema.

In attacks of bronchitis there is, as a rule, more or less disturbance of the digestive organs. The bowels may be confined and distended with flatulence, the tongue is coated, and there is often more or less vomiting.

The fever in uncomplicated cases is never high ; there may be an evening rise of a degree or two, while the morning temperature may be normal or subnormal, especially in weakly children. The cough, which in the early stages is hard, in the later stages becomes looser, mucus is coughed up into the pharynx and then quickly swallowed, unless extracted by means of the nurse's finger. Children under five years rarely expectorate—mucus is coughed up, but they have not the sense to spit it out.

An attack of bronchitis usually lasts a week or ten days and ends in recovery, leaving the child subject to a second attack.

Complications.—Bronchitis in infants and young children is frequently accompanied by one or more complications, the commonest being collapse of the lung, catarrhal pneumonia, bronchiectasis, and emphysema. In a fatal case it is almost certain that one, or more often all four, of these complications will be found.

Collapse of Lung.—During an attack of bronchitis or bronchial catarrh it is not uncommon to note that the respiratory murmur is weak or absent

over a portion of lung—as, for instance, one or other base ; then perhaps after a vigorous cough a plug of mucus is dislodged from a large bronchus and the breath sounds, with perhaps some loose râles, are heard over the same area. At other times the breath sounds are absent, and by the next day the ordinary respiratory murmur will again be heard. In this case a plug of thick mucus lodged in one of the larger divisions of the pulmonary bronchi prevents the ingress and egress of the air from the lung, but is expelled and coughed up by an extra effort.

If, however, thick mucus is drawn into the smaller bronchi, perhaps filling up a series of small branches, the most powerful expiratory effort the child can make fails to clear the occluded bronchi, especially when the respiratory muscles are weak and the ribs are soft and easily bend. Two things are now certain to happen—the lung supplied by the occluded bronchi collapses and more or less dilatation of the bronchial tubes and emphysema of the neighbouring lung occurs, unless the chest walls fall in to take the room of the collapsed lung. The lung collapses in consequence of the absorption of the imprisoned air, the air entering the blood-vessels, as shown by the experiments of Lichtheim. It is clear that this collapse of lung and vicarious emphysema at least temporarily damages the lung, and if this should occur to any great extent in acute bronchitis, it adds considerably to the danger of death by asphyxia.

The symptoms to which collapse gives rise are not always very definite, and unless tolerably extensive there may be no sign of its presence. In some cases it may supervene suddenly, possibly by the sucking in of mucus which has accumulated in the trachea during sleep into the bronchial tubes ; the dyspnœa becomes urgent, the child's lips go blue, it rolls about in its cot struggling for breath, and convulsions come on which perhaps prove fatal. In other cases, while the symptoms may be alarming for the time, they quickly pass away, a result due to the mucus being expelled. If the collapse is scattered in patches throughout the lung, especially if accompanied by emphysema, it will be impossible to detect it by any physical signs ; there may be hyper-resonance due to the emphysema, weak breath sounds, and perhaps some moist râles. If any extent of lung is involved, as part of an apex or base, there will be some loss of resonance, but this is rarely well marked unless some broncho-pneumonia be associated with it, a pneumonic patch and a collapsed patch lying side by side. The respiratory murmur over the collapsed patch is weak, and rhoncus or moist sounds may be heard. In some cases there appears to be a mixed condition of collapse with much congestion of the vessels and œdema, or possibly, as some authors believe, the collapsed lung becomes the seat of a low form of pneumonia, leucocytes and epithelioid cells being present in the air sacs.

Bronchiectasis and Emphysema.—Dilatation of the bronchi frequently takes place during acute bronchitis, the walls of the medium-sized and small bronchi being thin and their calibre increased, a result no doubt due to inflammatory softening of their walls. Bronchiectasis also occurs in association with chronic bronchitis, pleurisy and fibroid lung. Emphysema is also constantly present in association with dilated bronchial tubes. The chest walls during an acute attack assume the position of inspiration, and, particularly the infraclavicular regions, become hyper-resonant, while the

expiratory murmur is prolonged. As already remarked, compensatory emphysema is constantly present in association with broncho-pneumonia and collapse. In rare cases of acute capillary bronchitis and broncho-pneumonia following measles or whooping cough the emphysema is extreme and a subpleural rupture of the air vesicles takes place. This interstitial emphysema may be confined to the lung and mediastinum, or the air may find its way from the mediastinum into the neck and affect the face and sides of the chest. We have seen this subcutaneous emphysema in several instances, the most marked being in a boy, aged 7 years, after measles. There was intense dyspnœa and distress ; the subcutaneous emphysema affected the face, neck, and sides of chest.[1] He finally recovered.

Chronic Bronchitis and Bronchiectasis

Children and infants, like adults, suffer from chronic bronchial catarrh ; they recover slowly, and then perhaps within a few weeks another attack

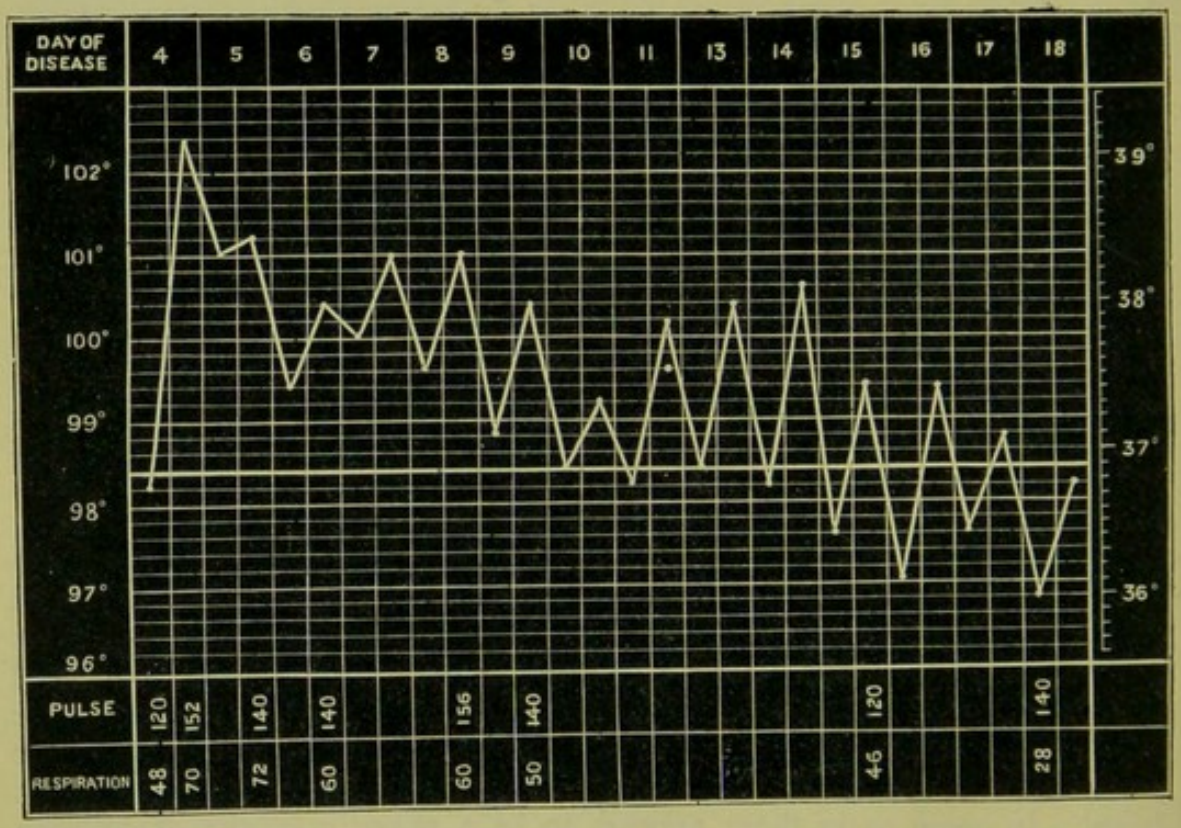

Fig. 75.—Temperature Chart of a case of Bronchitis with disseminated patches of Pneumonia. Boy of 5 years. Recovery.

supervenes. Some children show such a tendency to these attacks that they have to be kept prisoners almost all the winter, as exposure to even slight cold is sufficient to lay them by for weeks. Frequent and long-continued attacks of bronchitis are certain sooner or later to produce emphysema, dilated bronchial tubes, and dilatation of the right side of the heart and the veins which empty into it. Such children present a typical picture ; they are mostly thin, with rounded drooping shoulders, barrel-shaped chests,

[1] See also Guillemot, *Traité des Maladies de l'Enfance*, 2nd edition, ed. by Grancher and Comby.

enlarged superficial jugular veins and often injected capillaries on the cheeks. In some of these more or less dulness may be detected at one base or another, and they constantly cough up large quantities of very foul mucus. Such cases are anything but welcome inmates in a ward on account of their extremely fœtid expectoration. They are very chronic and not much amenable to treatment. We have attempted external drainage of the dilated bronchial tube, but have not met with much success, as the patient gradually sank. In the milder cases such children with care improve greatly, and frequently by puberty lose their tendency to bronchial troubles, and grow up, if not strong, at least not with impaired health. On the other hand, there is always the risk of an intercurrent and perhaps fatal pneumonia; we have seen children of this class with marked emphysema come regularly into hospital perhaps twice in a winter with attacks of croupous pneumonia. There is a risk of chronic bronchitis passing into a chronic broncho-pneumonia, the lung tissue around the dilated bronchi becoming fibroid and indurated. There is also the risk of tuberculosis, but we have not often been able to trace a connection between chronic bronchitis and tuberculosis, though those suffering from chronic bronchitis are often mistaken for phthisical subjects.

Broncho-pneumonia

In many cases the attack begins with a bronchial catarrh and quickly passes on into a broncho-pneumonia, the inflammation extending from the bronchi into the air-cells. In other cases the bronchial symptoms may be slight or absent, and the attack may closely resemble a croupous pneumonia. Between these two types all gradations may be met with. When the pneumonia supervenes on bronchitis, all the symptoms become exaggerated, the child is restless, the cough shorter and more hacking, the skin hot and dry, the evening temperature usually reaching 103° or 104° with morning remissions of several degrees, so that the fever assumes a remittent type; sometimes there are evening instead of morning remissions, the temperature being at its lowest in the evening; the dyspnœa is usually great, the respirations numbering forty or fifty, but varying with the amount of fever and extent of lung involved. If the pneumonia is extensive, the face wears a distressed expression, the alæ nasi work vigorously, the child lies weak and helpless in its mother's arms, too feeble to cry, or if it resists examination for a while it is soon exhausted and passively submits.

An examination of the chest, if made when the attack is fully developed and severe, shows that the accessory muscles of respiration are brought into play, the respirations are rapid and shallow, with recession of the epigastrium and intercostal spaces. The percussion note varies according to the position of the consolidated lung; this may involve an extended portion at one or both bases, at an apex, or be scattered in patches over the lungs. To detect the pneumonic portions both light and strong percussions should be practised, carefully comparing any spot where the resonance appears impaired with the opposite side. There may be hyper-resonance, especially anteriorly, from the presence of emphysema. A considerable amount of pneumonia may exist if diffuse or patchy without any definitely impaired resonance. There is never complete dulness in pneumonic consolidation unless much

lymph or some fluid be present. On auscultation rhonchi are usually heard over the chest, while over the pneumonic portions râles of a consonant or ringing character are heard, which contrast with the subcrepitant râles of a simple bronchitis, inasmuch as they are more intense, from the fact of their travelling to the ear through consolidated lung. Even though no consolidated lung can be detected by percussion, the presence of consonant intensely ringing râles with a temperature of 103° or 104° points almost certainly to pneumonia.

In the early stages the respiratory murmur is weak ; later there is mostly well-marked bronchial breathing over the dull area. If a fatal result is about to occur, the respirations become more hurried, the distress greater,

Fig. 76.—Temperature Chart of a case of acute Broncho-pneumonia in a boy of 2½ years ; death fifteenth day. At the *post-mortem* both bases of lungs showed generalised broncho-pneumonia with 'graines jaunes.'

and the pulse weaker and weaker ; râles and rhonchus are heard over the whole chest, the heart flags, and the child becomes pallid and comatose, death taking place with symptoms of toxæmia on account of the bronchi becoming choked and the lungs consolidated. The temperature usually falls towards the close ; the child is frequently convulsed. If, however, the attack takes a favourable turn, towards the end of the first week or earlier the temperature approaches normal, the breathing is easier, and the child, instead of concentrating his whole attention on himself, begins to notice those about and to play with his toys. The physical signs change but slowly, the bronchial breathing and râles being heard perhaps during the second or even the third week.

While the above is the description of a typical attack, the pneumonia may be of much less well-marked character. The child may seem ill with little or no cough, while there is loss of appetite, coated tongue, and feverishness, especially well marked during the afternoon or evening. An examination of the chest may at first yield no positive result, yet in a day it will be noted that there is a patch of lung at the extreme base, axilla, or near the root where the air does not enter well, and the respiratory murmur is replaced by breathing of a distinctly bronchial character. In a few days or a week the temperature may again become normal.

Sometimes an attack of broncho-pneumonia closely simulates the croupous variety, and there may be a doubt as to which category to refer it. The onset may be sudden, accompanied by a convulsion or series of convulsions, the temperature may rise to 104° or 105° (see fig. 77), the physical signs may point to an extended portion of lung being involved, and only the course of attack, the temperature becoming intermittent, and reaching normal gradually by lysis, would seem to indicate that the attack is rather of the catarrhal than the croupous variety. Some cases may from first to last be open to doubt.

Course.—While broncho-pneumonia is frequently an acute disease, proving fatal in a few days or a week, its course in many cases is subacute or chronic, lasting for several weeks, or even more, and yet ending in apparently complete recovery. In some instances recovery takes place, to be followed by a relapse, the temperature again becoming remittent for a few days or a week. The termination of the fever is nearly always by lysis. In these protracted cases the possibility of tuberculosis or a local empyema must always be borne in mind.

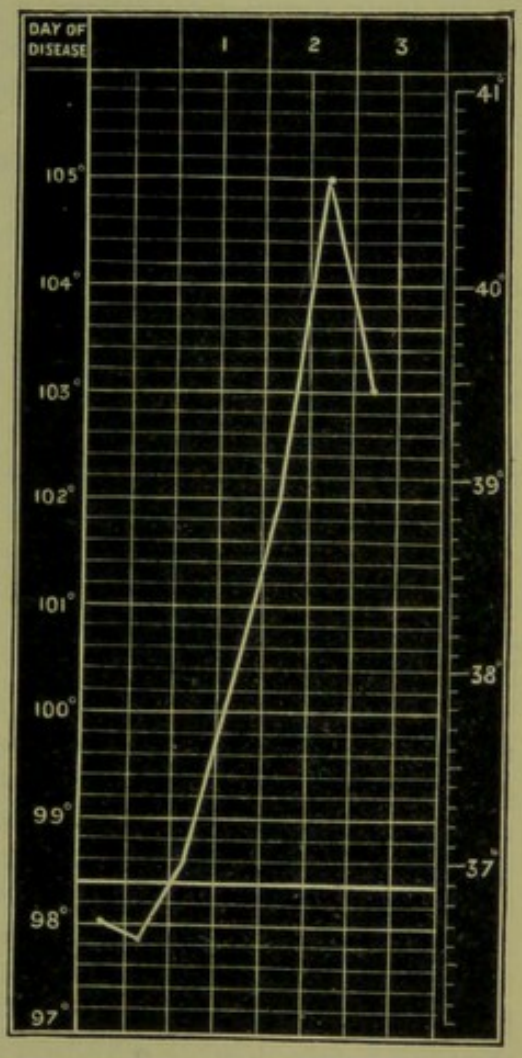

Fig. 77.—Temperature Chart of a case of acute lobar Pneumonia in an infant of 9 months; death on third day. The whole left lung except a small part of upper lobe, which was emphysematous, was solid; section of lung not so solid as red hepatisation; lobules distinct, some of a pink and others of a greyish colour.

Secondary Pneumonias.—Pneumonias, mostly of the broncho-pneumonic form, occur as complications of many diseases, and may in consequence be modified in their course and in the symptoms they present. Thus a **miliary tuberculosis** may give rise to an acute broncho-pneumonia, which may run a short or protracted course, the two conditions present essentially modifying each other. In **whooping cough, measles, scarlet fever, diphtheria, enteric fever,** pneumonia may supervene, caused by

the specific micro-organism of the fever, or, in many cases at least, by the septic organisms present. While the pneumonia occurring in these diseases is usually of the broncho-pneumonic form, yet it is mostly fibrinous, and in the worst cases exhibits a tendency to pus formations, so that small purulent abscesses may be found *post mortem*. In some cases a true croupous pneumonia may occur. In diphtheria the pneumonia is often hæmorrhagic, small patches of dark red extravasated blood being seen on section of the pneumonic lung.

In acute summer **diarrhœa** a pneumonia is very apt to be present and add to the gravity of the attack; in the **chronic intestinal catarrh** of infants the immediate cause of death is frequently an intercurrent attack of inflammation of the lungs.

Chronic Broncho-pneumonia.—Attacks of broncho-pneumonia are apt to become chronic in consequence of an imperfect clearing up of the lung and the resulting caseous degeneration. Catarrhal pneumonia following measles or whooping cough is very apt in an unhealthy child or one who inherits tuberculous tendencies to take a subacute course; a base, or, less often, an apex of a lung remains more or less dull, the breath sounds are bronchial, moist sounds are heard, and the evening temperature rises to 102° or 103° F., with night sweats and emaciation. This state of things may go on for weeks, and it may be impossible to say if caseous changes are progressing or not. The risk in such cases is undoubtedly that, although the lung may clear up, the bronchial glands may become caseous, and a general tuberculosis of the lung, or perhaps tuberculosis meningitis, follow. Most cases of chronic broncho-pneumonia terminate in recovery, though in some instances they run a very chronic course, resembling a chronic phthisis; the bronchi become dilated, caseous and fibroid changes occur, and present in their later stages the signs of consolidation of a portion of lung at an apex or base, the chest wall is retracted, there is bronchial breathing, sharp ringing râles, and very fœtid expectoration which is coughed up in large quantities. Such children are thin, anæmic, are easily put out of breath, have clubbed fingers and dilated right hearts. The course is usually very chronic. At the *post-mortem* dilated bronchi filled with thick, foul secretion, cheesy nodules around the bronchial tubes, much fibroid and indurated lung tissue, and emphysema are found. In some cases there is gangrene of the lung before death. Children liable to bronchitis, or who suffer from it in the chronic form, require to be warmly clothed and protected from cold. Residence in a warm climate and pure atmosphere during the winter, and at high altitudes during the summer, should be insisted on where possible. A warm house is necessary if they have to winter in this climate. Every means must be employed which will improve their general health. In the following case chronic pneumonia was followed by acute meningitis.

Chronic Pneumonia. Acute Meningitis.—Rose S., aged 5 years. Child comes of a tuberculous family; has had acute pneumonia several times. She had acute pneumonia several weeks before admission, and was sent to the seaside. Admitted July 7. There is dulness on the left side behind, extending from the spine of the scapula to the base; over this area there is weak bronchial breathing, and what is apparently redux crepitation. Temperature 101°. No albumen; child well nourished, but pale. Temperature fell to normal during the next day or two. On July 15 the temperature suddenly rose to 104° F.

Towards evening she began to vomit continuously; temperature rose to 105° F.; there were some muscular twitchings, and then she was severely convulsed. The convulsions continued till early the next morning, when she died.

Post-mortem.—Left lobe solid; sinks in water; bronchi contain much purulent secretion, and their walls are thickened; excess of fibrous tissue in the lung, spreading from the root. Lung substance dark red, soft, and contains some small cavities size of peas, containing thick, almost cheesy, pus. No obvious tubercle anywhere. Brain: arachnoid everywhere cloudy, beneath it there is an excess of fluid of a cloudy yellow tint. Sylvian fissures are matted with semi-purulent lymph. Much lymph at the base of the brain. No tubercle anywhere.

Prognosis.—Broncho-pneumonia is always a dangerous disease, but more especially so in children under 2 years of age who are rickety or weakly. The prognosis is necessarily serious if the pneumonia follow any other disease, as measles, whooping cough, or summer diarrhœa, or when it occurs in scarlet fever through the extension of the inflammatory process in the throat. In any severe case the danger depends upon the amount of lung involved and the softness of the chest walls. It must also be remembered that a young child may struggle through the bronchial affection only to pass into a condition of atrophy—the result of a gastro-intestinal catarrh. Both high and also very low temperatures are indicative of danger. The pneumonia may become chronic and tuberculosis supervene.

Morbid Anatomy.—The appearances seen *post-mortem* in the bodies of children dying of bronchitis and broncho-pneumonia are very various, and are apt to puzzle those unaccustomed to the autopsies made on children; and much confusion has existed in the past in reference to them, especially in confounding the various forms of pneumonia and carnification of the lung with collapse. Collapse of the lung is mostly patchy in its distribution, rarely affecting any continuous extent of lung or involving the whole thickness of a lung. It affects the anterior and inferior edges of the lungs, especially the anterior edge of the middle lobe of the right side and tongue of the left which covers the heart; it is sometimes present along the posterior border of the lung; the collapsed portions are depressed below the surface, purple in colour and airless. Taken between the finger and thumb, there is no substance to be felt as in pneumonia. The collapsed portions can be inflated through the bronchi. The collapse is brought about in at least two ways—either from occlusion of a small bronchus by thick mucus, the air being first imprisoned and then absorbed by the capillaries, or by feeble inspiratory power aided by obstruction to the entrance of air, especially when the ribs are soft, as in rickets; in this case the chest falls in during inspiration, instead of the lungs becoming distended; it is in this way that collapse is produced along the anterior edges of the lung. The collapsed portions become œdematous from the stagnation of the circulation; according to some they become pneumonic.

What happens to the collapsed portions of lung in the long run is not clear. In most cases, apparently, recovery takes place; but we believe in some cases fibroid changes are set up, as evidenced by those chronic cases of bronchitis and dilated tubes, the latter surrounded by indurated lung. Acute emphysema plays an important part in the acute lung disease of children. It is sometimes produced very rapidly: thus, a child may die of acute broncho-pneumonia complicating measles in three or four days, and

extensive emphysema may be present, no doubt produced during the period, and contributing very materially to the fatal result (see p. 376). The bases of the lungs are in an early stage of pneumonia and collapse, the upper lobes are overworked, the constant coughing consequent on the acute bronchitis produces emphysema, and the only remaining normal lung is thus damaged, and a fatal result quickly ensues.

The chief types found may be described shortly in the following groups :

1. **Acute Bronchitis involving the Smaller Tubes, Collapse of Lung, Vicarious Emphysema.**—On opening the chest the lungs are found to be in a condition of deep inspiration ; their surfaces are studded over with clusters of lobules which are depressed and purple in colour (collapse), and with raised portions which are of a pale pink colour (emphysema). On section, thick semi-purulent frothy mucus exudes from the large and small bronchi ; the latter sometimes contain a semi-membranous exudation. The cut surface of the lung exudes much blood-stained frothy fluid, due to congestion of the lung ; the lungs are crepitant, except where collapse has taken place. The large veins and right heart are much engorged. It is not uncommon to find in acute cases that the emphysema, especially along the upper anterior edges of the lungs, is extreme, and that transparent blebs are present, the result of dilated air vesicles, or vesicles which have ruptured into one another. These may be the size of peas or several peas together. In rarer cases there may be subpleural or interstitial emphysema, an air vesicle having burst and air escaped beneath the pleura. The air may find its way into the mediastinum and into the neck, or beneath the costal pleura.

2. **Disseminated Broncho-pneumonia.**—The bronchial tubes contain much frothy fluid, one or both lungs, especially the lower lobes posteriorly, have a semi-solid feel, but crepitate, and perhaps some nodules of various sizes may be felt. The section exudes much serum, purulent mucus exudes from the small bronchi, the cut surface of the lung has a mottled appearance, caused by clusters of lobules, which are grey or pale pink and have a firm feel, and bright red portions of crepitant lung. The paler portions are pneumonic and solid ; the red portions are air-containing congested lung, which surround the pneumonic portions. Portions of lung which are removed will float in water, but easily break down on thrusting in the finger. The upper lobes are emphysematous.

3. **Acute Generalised Broncho-pneumonia, Pleurisy.**—The posterior inferior or whole of one or both lobes has a semi-solid feel, though less solid than in croupous pneumonia, with but little or no sense of crepitation. The surface is purplish in colour ; the pleural covering may have minute hæmorrhages on its surface, or be roughened from the presence of lymph. The cut section has a solid feel, yet it is not granular as in true croupous pneumonia, but easily breaks down on pressure with the finger, and sinks in water. It has a mottled appearance, in consequence of the lobules surrounding the terminal bronchi being paler in colour and in a later stage of consolidation than the intervening portions of lung. There will probably be collapse of the anterior and inferior edges, as well as acute emphysema in the same positions ; some of the vesicles are frequently distended to the size of millet seeds, or even peas, and perhaps one here and there is ruptured. In a still

later stage, especially if the inflammation is intense, as in measles or scarlet fever, a lobe may be solid, and on the surface beneath the pleura there are a number of yellow spots, the size of millet seeds or larger, which on pricking yield a drop of thick pus. On section, these yellow spots are seen scattered through the lung ; they are the 'graines jaunes,' or 'abcès péribronchique,' of French authors, and are, in fact, minute abscesses surrounding the terminal bronchioles, formed by the softening of the pneumonic lobules. Pleurisy with lymph or serum may be present ; when the pneumonia is double the temperature usually runs high.

The following case illustrates this form of pneumonia :

Acute Double Pleuro-pneumonia, Hyperpyrexia, Suspicion of Meningitis.—John H., aged 14 months ; admitted April 26, 1824. His mother states he has been a healthy child up to the present illness. A fortnight ago he became ill with cough and fever. Breathing has been very bad at nights. He vomits frequently. He is fairly well nourished ; his head is somewhat retracted, and muscles of the neck are rigid. The right apex in front and the base behind are very dull ; bronchial breathing and sharp crepitations are heard over these areas. On the left side there are râles, but no dulness ; ℥ij of clear serum were withdrawn from the right side behind. Temperature 103°. Vomits constantly. April 27.—General convulsions, mostly right-sided ; marked rigidity of the neck ; vomits constantly. Well-marked *tache cérébrale*. April 28.—Very short breathing ; dulness well marked at the left base as well as the right. Oxygen given. Temperature 106°. Graduated bath. April 29.—Marked retraction of the neck ; constant vomiting. Temperature 106·4°. April 29.—Temperature 106·4° twice during the day. Death May 1.

Post-mortem.—Right pleural cavity contains ℥j of yellow serum, and lymph covering the lower lobe, which is partly compressed and partly solid ; upper lobe solid at the back, showing broncho-pneumonia and emphysema in front ; lower lobe, lymph on surface, pneumonia on section. Much clear fluid escaped from surface of the brain and lateral ventricles ; no lymph anywhere. Arachnoid cloudy ; veins full. It was suggested that the infant had meningitis complicating the pneumonia, but this was not borne out by the autopsy.

4. In **infants under 6 months** a form of pneumonia is sometimes found which does not agree with the above description. A lobe, generally one of the lower, is semi-solid, its surface depressed and purple, surrounded, perhaps, by raised emphysematous vesicles. The cut section is smooth and of a uniform plum colour, the lobules indistinct and airless, but the lung has not the solid feel of red hepatisation.

5. **Chronic Broncho-pneumonia** may be disseminated or generalised. The lung tissue is indurated, and perhaps fibroid, with dilated bronchial tubes. It may be associated with caseous changes in the bronchial glands, due to chronic bronchial tuberculosis.

The **micro-organisms** present in the broncho-pneumonia occurring in children have been studied by recent observers, more especially by Neumann,[1] Queisner,[2] Strelitz,[3] Prudden and Northrup, and Netter. The commonest micro-organism found appears to be the Fränkel-Weichselbaum diplococcus, less often Friedländer's bacillus, and the influenza cocco-bacillus of Pfeifer. In the septic pneumonias present in scarlet fever, measles, and diphtheria various micrococci—including *Staphylococcus pyogenes aureus* and *albus*, and *Streptococcus pyogenes*—are usually present. In the present state of our knowledge it is unwise to lay too much stress on the presence of

[1] *Jahrbuch Kinderh.* Band xxx. p. 233. [2] *Loc. cit.* Band xxx. p. 277.
[3] *Archiv f. Kinderh.* Band xiii. p. 468.

these organisms in the pneumonic lungs ; but it seems exceedingly probable that there are several micro-organisms which, if the conditions are favourable, are capable of giving rise to inflammation of the lungs.

Diagnosis.—A clinical distinction between the above conditions is often impossible, inasmuch as bronchitis, collapse, emphysema, and catarrhal pneumonia may all exist in the same lung, and more or less mask one another. However, a few points may be emphasised. In simple bronchitis the temperature is rarely high, there is no impairment of resonance, and the moist sounds, if present, are indistinct and distant. In broncho-pneumonia the temperature is higher, usually there is impaired resonance, perhaps whiffy or bronchial breathing, and the moist sounds are clear, sharp, and ringing. The diagnosis of collapse is much more uncertain unless much lung is involved ; then there are impaired resonance and weak and distant bronchial sounds.

In all cases of broncho-pneumonia we must bear in mind the possibility of some localised collection of pus being present over a dull patch, and also that the case may be one of miliary tubercle as well as broncho-pneumonia.

Treatment.—The colds in the head and bronchial catarrhs of children call rather for careful hygiene than active treatment. Confinement to a well-warmed and ventilated room or suite of rooms, as long as the symptoms of a cold are present or rhonchi are heard in the chest, with a light, mostly fluid diet, will in many cases be all that is necessary. Merely to confine a child to the house and let it run about in cold passages and stand in draughts is useless, and likely to give rise to another cold before the first has completely passed away. Some children are exceedingly liable to take cold, and bronchitis follows very readily, and with these extra care must be taken, and the last trace of a cold must have disappeared before they are allowed to go out. In those cases where there is a laryngeal or tracheal catarrh the cough is often troublesome, especially keeping the patient awake at night and disturbing the whole household. Among the household remedies for cough which are useful are black currant jelly, glycerine lozenges, and jujubes simple or medicated. A cup of hot beef tea or cocoa the last thing at night will often soothe a troublesome cough. In many cases it will be necessary to give small doses of some sedative, especially in the case of older children. Morphia, codeia, aconite, hyoscyamus, bromide of ammonium may be given for this purpose, made up in the form of a linctus with syrup of orange or tolu or glycerine. The morphia and ipecacuanha lozenges of the B.P. made with fruit paste or glycerine jelly are very convenient. Codeia jelly acts exceedingly well in soothing irritable coughs.

The diet should consist largely of fluids, milk, beef tea, light puddings. Lemonade, barley water, linseed tea, to assuage thirst and tend to produce free action of the kidneys and skin are likely to be useful ; salines such as citrate of ammonia or potash, or liq. ammon. acet., may also be given.

The prevention of attacks of bronchial catarrh and colds is a matter of much importance, especially in the case of those who are liable to bronchitis or asthmatic attacks whenever they take cold. A house in a dry and bracing situation, with well-warmed living rooms, passages, and bedrooms—while the ventilation and sanitation are carefully looked after—is a first necessity

in the prevention of colds. Care must be taken that these children are properly clothed with well-fitting woollen under-garments, that they have plenty of exercise in the open air whenever the weather is suitable, while cold sponging or the tepid douche in the morning whilst standing in warm water is of much service in promoting the circulation in the skin and preventing chills.

Are 'colds in the head' infectious? It is a common experience that almost a whole household is affected at the same time or in succession, and there can be little doubt that in some cases a nasal catarrh passes from one child to another without the latter having been exposed to any chill. Other conditions favouring these attacks may be present, but of these next to nothing is known. Possibly a chill may predispose the mucous membrane to take on inflammation or become a suitable nidus for the cultivation of bacilli or other organisms present in the atmosphere.

If the catarrh passes downwards from the trachea into the smaller tubes, and the child in consequence 'wheezes' and rhonchi are heard all over the chest, the child should be confined to its bed or cot, care being taken to have it warmly clothed and in a situation free from draughts. In the more severe cases of bronchitis and catarrhal pneumonia, especially in small children, a sort of tent should be rigged over the cot, or one or two clothes screens placed around with sheets hung on them so as to form sides and a roof will answer very well. The atmosphere must be kept moist by means of a bronchitis kettle, or the sheets which form the walls of the tent may be kept moist. The temperature in the cot should be maintained at 65°–70° night and day. The diet should consist entirely of fluids if the attack is at all acute. Milk diluted with one-third or one-fourth part of whey or barley water or soda water should form the principal kind of nourishment; a cup of beef tea once or twice a day may be allowed. Moist hot applications to the chest are soothing to the patient, and may be applied in the form of linseed poultices or fomentations. It must, however, be borne in mind that poultices made by unskilled hands may, especially in the case of infants and young children, do more harm than good; to surround the chest of an infant with a heavy poultice when the bronchial tubes are choked with thick mucus and patches of lung are in a state of collapse is simply to invite death by suffocation. The poultices should be well mixed, being not too heavy nor applied too hot (placing them against one's cheek is the best guide), carefully kept in position by means of a flannel binder, and renewed at least every four hours. A mustard poultice is often of great service in the early stage; one tablespoonful of mustard to four or five tablespoonfuls of linseed meal may be used, the poultice remaining on for three or four hours. The strength is not sufficient to produce more than some redness, and it can be renewed or replaced by a simple poultice according to circumstances. For infants and young children hot fomentations applied by means of spongio-piline or flannel are preferable to poultices; they are much more cleanly, and harm is less likely to be done by their application. Several layers of flannel may be used wrung out of water, or if need be mustard and water, and covered with a piece of oiled silk, the whole being surrounded by cotton-wool. Poultices and hot applications are of most service in the early stages, when the mucous membrane is swollen and dry, and the

secretion scanty; in the later stages they are also useful if the secretion is thick and coughed up with difficulty.

In the early stage of bronchitis, if there is much wheezing, dyspnœa, and distress, an emetic is of much service, more so, perhaps, in bronchitis than in catarrhal pneumonia. Pulv. ipecac. in 5-grain doses in syrup of orange peel may be given to a child under 2 years of age and repeated in a few minutes if it fail to act. The act of vomiting, especially after ipecacuanha, will probably be attended by a freer secretion of mucus and relief to the breathing. At this period the depressant expectorants which appear to diminish tension in the vessels, and thus relieve the congested mucous membrane, are mostly used. Of these antimony, ipecac., and aconite are more frequently used than any others. In this stage, when the cough is hard and sibilus is heard in the chest, antimony in small repeated doses, short of producing nausea and depression, is of much service. (F. 46.)

In catarrhal pneumonia aconite in half-minim or minim doses is preferable. The drug may be continued for several days, as long as the fever lasts or the secretion remains scanty or is coughed up with difficulty. Given with caution and in small doses there is little fear of its producing too great depression; in feeble children, however, it may be well to give small doses of alcohol at the same time. Many prefer to give ipecac., or, instead of aconite, antimony, especially in the feeble and cachectic patients so often met with in the out-patient room. Some believe ipecac. combined with alkalies such as bicarbonate of potash to be of especial value when mucous râles are heard in the chest, and the infant or child has much difficulty in coughing up the thick secretion which is formed. Simple salines are preferred by some. Dr. Lewis Smith recommends tr. veratri viridis in half-minim or minim doses every second hour. As long as the cough remains hard, and the mucous secretion scanty or difficult to expel, the antimony or ipecac. should be persevered with, and is far more likely to be of service than the stimulating mixtures so often prescribed. It is when the catarrh continues, the cough becoming loose, the secretion liquid, and the fever is mostly gone, that carbonate of ammonia, squills and terebene are most likely to be useful. At this stage the fomentations and poultices should be given up in favour of a warm cotton-wool jacket, and stimulating applications may be applied to the chest walls. Ammonia may be usefully combined with digitalis and squills, as in F. 60.

Stimulating applications to be rubbed into the chest-wall are useful in producing slight redness without being too severe. (F. 61, F. 62, F. 63.) The lin. potass. iodidi c. sapone B.P. may be used in a similar way. Iodide of potassium is often useful in the subacute or chronic stage, and nitric acid and nux vomica are of much service during convalescence.

In bronchitis pure and simple the temperature is never so excessive as to require any antipyretic treatment, but in some cases of acute broncho-pneumonia, especially where it approaches the croupous type, or when it accompanies whooping cough or measles, the temperature is apt to take high flights. Sponging with tepid water, 'packs,' or when there is drowsiness or convulsions the warm bath gradually cooled down by adding cold water so as to reduce it to 60°, may be used. Phenacetin or antipyrin may be used for the same purpose with care, beginning with a small dose, 2 grains of the

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former for a child of 2 or 3 years of age. Both of these antipyretics have been used in small doses frequently repeated, in acute bronchitis and in broncho-pneumonia. An excessively high temperature, 104°–105°, is sometimes present in an early stage of pneumonia, accompanied by convulsions or coma ; in such cases no time should be lost in resorting to baths or packs, while giving stimulants if necessary by the rectum.

Death usually threatens in bronchitis or broncho-pneumonia from mechanical interference with the air entering the lungs, asphyxia being produced with great depression of the heart's action. This occurs, especially in young infants, by a blockage of the medium-sized and small tubes by thick mucus which is difficult to expel, or is due to capillary obstruction, collapse of lung, acute emphysema, or a large tract of lung becoming involved in the pneumonic process. In young infants with obstructed bronchial tubes all tight binding up of the chest walls by poultices or bandages must be avoided ; the position must be varied from time to time so as to give each lung full play in turn, and an occasional emetic of alum or squills will help to get rid of the excessive and tenacious secretion. The nurse's finger may be usefully employed in removing the secretion from the back of the throat after a fit of coughing. In suddenly produced dyspnœa either from collapse of lung or acute pneumonia, when the circulation through the lungs is obstructed and the right heart over-distended, local bleeding by means of a leech or two is often of the greatest service, and may be the means of saving life. One, two, or three leeches may be applied at the tip of the sternum, and after they fall off the bleeding may if necessary be encouraged by warm applications. Mustard baths, or mustard fomentations, or turpentine stupes applied to the chest are likely to be useful in those cases where there is extensive pneumonia with much dyspnœa and cardiac depression—turpentine must be used cautiously. Ammonia, strychnine, and digitalis must also be freely given under similar circumstances. Oxygen inhalation may be resorted to, but the oxygen must be given freely to be of much use.

The question of the administration of emetics, alcohol and opium, is of importance. Emetics are mostly of value in the early stages of laryngitis or bronchitis when the cough is hard and the breathing difficult on account of the swollen condition of the mucous membrane ; a freer secretion follows the administration, and, moreover, the unloading of the stomach of the accumulated mucus and undigested food seems to have a good effect ; ipecacuanha or sulphate of zinc answers best at this stage. Emetics are sometimes useful in a later stage of bronchitis and collapse when the bronchial tubes are choked with mucus, provided there is no pneumonia or cyanosis ; 10 to 30 grains of alum in a teaspoonful of syrup of squills is preferable to ipecac. or zinc at this time. Alum and honey may be given to infants on a small brush. Alcohol is unnecessary in the early stages, and it should always be used with caution in the later stages, for, like opium, it soothes the cough, and in large quantities its effect is narcotic ; it is therefore contra-indicated except in small doses if there is any tendency to cyanosis. Opium in the form of Dover's powder is often of great value if the child is restless and its cough irritable, but it is perhaps needless to say it should on no account be given if there is much dyspnœa due to the accumulation of mucus in the bronchial tubes or if much lung is involved.

During an acute attack of bronchitis or pneumonia the digestive organs are very apt to suffer ; there may be vomiting, flatulence, and diarrhœa. This impaired digestion must always be borne in mind when the question of dieting is being discussed, and care must be taken not to overload the stomach and bowels with too large a quantity of milk, beef tea, &c. An occasional laxative dose of calomel or rhubarb and soda may be useful.

It is well to bear in mind the possibility that an infant may recover from an acute attack of bronchitis, to succumb finally to a gastro-intestinal atrophy dating from the acute bronchial attack.

Croupous Pneumonia

Croupous pneumonia in its typical form is a common disease in children over 3 years of age, and does not differ either in its course or morbid anatomy from the attacks in young adults, though the mortality is much less. Reference has already been made to the acute lobar pneumonias of infancy and childhood, which are frequently classed amongst the fibrinous or genuine croupous pneumonias on account of the extent of lung involved and also of their termination by crisis. That many of them are fibrinous to some extent is certain, as effused fibrin may be seen in sections prepared for the microscope, but in our experience such lungs when seen on the *post-mortem* table are more spongy and lack the complete solidity of the red hepatisation of true croupous pneumonia, and the outlines of the lobules are readily seen in consequence of their differing from one another as to the extent to which they are affected. Moreover, while they may contain fibrin, the cellular element largely predominates. Fortunately it is of little practical moment under which division these pneumonias are classed : hybrid cases are certain to come under observation both in infancy and childhood, and we have frequently to be content with describing attacks as being of the 'croupous type,' or of the 'catarrhal' or 'broncho-pneumonic' type, according as their symptoms resemble typical attacks of either the one or the other. It is the difficulty of classifying hybrid cases that makes the statistics of one hospital or one year liable to error when compared with those of other hospitals or years.

The statistics (given on p. 389) of our own hospital of the cases entered as croupous pneumonia during the years 1878–1893 illustrate the comparative frequency of the disease at different ages. In this series of cases the total mortality amounted to 5·2 per cent., the highest being among children under 2 years of age.[1]

The *etiology* of croupous pneumonia is not perhaps quite as simple as it seems at first sight. A schoolboy is exposed to a cold east wind after getting hot, or is chilled by a fall into water, and a few days later develops an acute pneumonia : in such cases there can be little doubt that pneumonia in some way or other is the result of a chill. In connection, however, with this, our own hospital statistics do not show much difference in the number of cases admitted during the different months of the year, though there is a

[1] These figures closely correspond with those given by Von Dusch ; in 331 of his cases of croupous pneumonia in children under 10 years of age the mortality was 4·8 per cent.

Table showing the Ages and Mortality of 708 Cases of Croupous Pneumonia.

Under 2 years		2 to 5 years		5 to 10 years		10 to 14 years		Total	Deaths
Total	Deaths	Total	Deaths	Total	Deaths	Total	Deaths		
29	8	213	21	338	8	128	1	708	38

slight preponderance in favour of March.[1] Attacks certainly occur at all times of year, in the warmer as well as in the colder months. On the other hand, it is quite certain that croupous pneumonia is at times epidemic and also infectious, affecting several members of the same household or the same street, and in a few instances there have been widespread epidemics, as, for instance, during the influenza epidemic of 1891. Epidemics of pneumonia associated with tonsillitis have occurred in schools and other large institutions.

It seems probable that these micro-organisms are incapable of setting up pneumonia in healthy lung in a normal condition ; but if the individual has caught cold or is in a low state of health a suitable soil is produced, and if an infection takes place a pneumonia is the result.

The pneumonic diplococcus appears to be almost constantly present in the sputa of cases of croupous pneumonia in the early stage, but it is also found in the pus from an acute otitis and in some cases of peritonitis and also meningitis. It has been found in the sputa of healthy children. It can hardly be said to be pathogenic of pneumonia, but it is apparently capable of setting up pneumonia under certain conditions.

In different epidemics, or in different years or localities, attacks of pneumonia appear to vary in their character, sometimes being of the sthenic, sometimes of asthenic type: this has been specially described by Foxwell.[2]

Symptoms and Course.—The onset is sudden, with symptoms not unlike those of scarlet fever ; there are high fever, dyspnœa, rapid pulse, headache, pain in the side or abdomen, short cough, and perhaps vomiting and diarrhœa. In children under three years convulsions are not uncommon at the onset, but these are rare in older children : the convulsions may prove fatal before the attack of pneumonia has fully declared itself. Delirium may be an early symptom, especially if the fever is high. By the time a medical examination is made the child is usually too ill to be about, and is either in bed or being nursed in its mother's arms ; the cheeks are flushed, the alæ nasi are working, the respirations are perhaps doubled, being possibly 40 per minute or more, the pulse 120 to 140, there is a temperature of 104° or thereabouts, the tongue is dry and brown, and there may be herpetic vesicles on the lips and nose. An examination of the urine shows it to be dark in colour, concentrated, containing albumen and an excess of urea, and deficient in chlorides. The cough is dry and hacking, and pain is often complained of

[1] In 628 cases of croupous pneumonia during the years 1857–1885 Durasz found a slight excess in April and May.

[2] *Practitioner*, July 1886.

during the act ; in young children there is no expectoration, in older ones there may be the usual rusty sputa. The fever and dyspnœa continue ; the child remaining very ill till the end of the week, when, usually between the sixth and the ninth day, the fever suddenly abates, and a marked improvement takes place in all the symptoms, so that it is evident to all that the crisis has come. The crisis is sometimes marked by collapse, the child becoming cold and clammy, with a subnormal temperature.

Physical Signs.—An examination of the chest on the first or second day of the attack will usually lead to the discovery of more or less consolidated lung. Careful percussion, striking now lightly, now more forcibly, will elicit a certain high-pitched note of impaired resonance over some part of the chest wall, as in the infra-clavicular, axillary, or scapular region, or over the root or base of the lungs ; on listening over the affected area some departure from the normal breath sounds will probably be heard. They may be simply weak or distant breathing, as if the air is not entering freely into some part of the lung ; there may be distant or intense bronchial breathing, of various abnormal sounds, as a pleuritic rub, rhonchus, or, more often, subcrepitant or loose ringing râles, the fine crepitation so common in adults being generally absent. There are usually increased vocal resonance and fremitus, though it is not always possible to elicit these signs unless the child cries. If there is much lung affected, loud or harsh breath sounds are heard over the non-affected lung, and care must be taken not to mistake these signs of an overworked for those of an affected lung.

The position of the consolidation varies considerably and does not necessarily correspond to a lobe, but may occupy the whole extent of lung anteriorly or posteriorly ; or the most marked signs may be first detected over the root of the lung behind or in the axilla. The left base and right apex are favourite spots to be attacked, but any part of the lung may be involved, though it must be borne in mind that the apices are more apt to be affected in children than in adults, and it is just at this spot that early signs are apt to be overlooked. In the course of a day or two, sometimes not for several, the physical signs become more marked, the dulness cannot be mistaken, the bronchial breathing becomes whiffy and intense ; in a few days more, usually after the crisis has arrived, coarse, loose, crepitant râles are heard which mark the resolution of the pneumonic lung. The dulness and bronchial breath sounds and râles disappear, but some want of resonance is apt to remain for many weeks, as the lung remains in an œdematous state. While such is the usual course of events in an ordinary case, there are marked differences with regard to the time when the physical signs make their appearance, there being frequently a delay of several days ; they may even appear as late as the fifth day. It is important to remember this, for a mistake in diagnosis is easy, as a most careful examination of the whole chest may reveal nothing suggestive of pneumonia. In such cases there is a strong presumption that the pneumonia is centrally situated, perhaps at the root of the lung, and takes some time to approach the surface ; or possibly there may be an acute inflammatory congestion of a portion of lung and a delay in the transudation of fibrin into the air-sacs. Often a sub-tympanitic or actually a tympanitic note to percussion and weak bronchial breathing, or simply distant respiratory sounds, may be all there is to be heard for a day or two. It is not easy to

say why a tympanitic or 'boxy' note is elicited over lung in a state of acute inflammatory congestion, or in the first stage of an acute lobar pneumonia, but that it does occur we have often had the opportunity of observing. In a few cases the crisis may come and the child recover without the classical signs of pneumonia ever being present.

Temperature.—The temperature usually goes up suddenly at the onset to 104° or thereabouts, and during the course of the attack continues high, with slight morning remissions, till the crisis, when the fall is sudden (see fig. 78), perhaps 4° or 5°, to a subnormal temperature ; the latter may last for a few days, and then the normal line be regained. The day on which the crisis takes place varies greatly ; the attack may end about the fourth or fifth day,

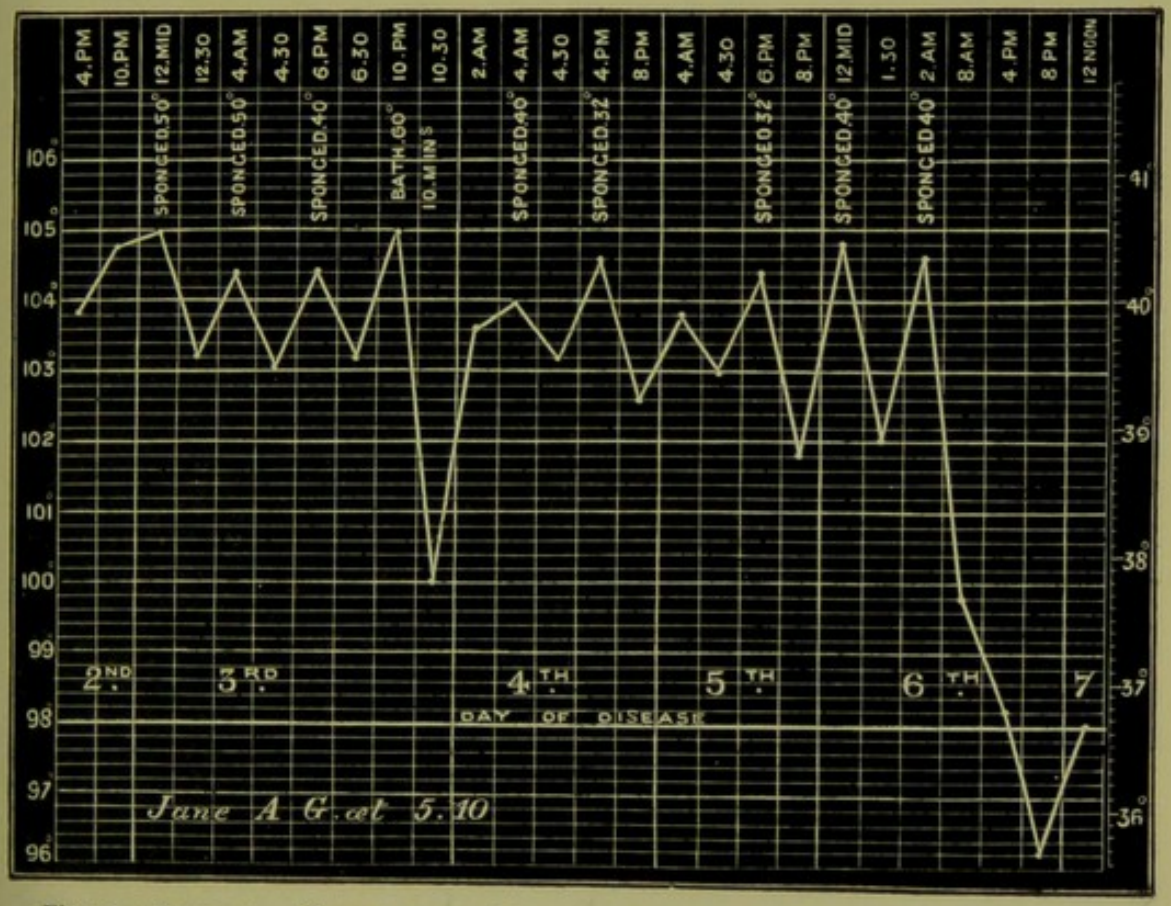

Fig. 78.—Temperature Chart of a case of Croupous Pneumonia of left apex in a girl of 5 years. Crisis sixth day. Recovery.

or earlier, but usually the crisis is delayed till the seventh or eighth, and in the creeping form till the end of the second week or later ; a post-crisial rise often occurs (see fig. 79), the temperature rising a few degrees the following evening, becoming normal the next morning ; or a relapse in which the temperature remains elevated may take place in consequence of another portion of lung being affected. Post-crisial hectic, prolonged for some days or weeks, suggests the presence of an empyema or other complication. In the minority of cases the temperature falls by lysis.

Varieties.—The course of the attack varies ; these varieties have been emphasised by various writers, especially by A. Baginsky ; they may be enumerated as follows : (1) **Abortive Pneumonia.** This variety, as the

name implies, aborts, or the course comes to a sudden termination by crisis, after lasting two, three, or four days, mostly without the classical signs of pneumonia being developed ; yet a careful examination of the lungs will discover some spot where the breath sounds are weak and the percussion note slightly raised or tympanitic. Herpes is common on the lips and nose. (2) **Creeping** or **wandering Pneumonia** has been compared by Henoch to an attack of erysipelas spreading over the surface of the lung. The apex is perhaps the first part affected ; gradually the inflammatory process spreads to the base, and possibly finally attacks the opposite side. Such cases are apt to have a chronic course, the crisis being delayed till the tenth or fourteenth day, or the temperature may fall by lysis, or a hectic may succeed in consequence of an empyema being present. (3) **Relapsing Pneumonia** much resembles the creeping form. Several relapses occur after the crisis has come, some patch of pneumonia occurring in another part of the lung. We have known cases in which six or seven relapses have occurred. In such cases we may suspect pus. (4) **Cerebral Pneumonia.**—In this form cerebral symptoms are prominent, while, in the early stages at least, the symptoms of pneumonia are latent ; there may be convulsions, delirium, headache, and drowsiness. In such cases the fever usually runs high, and the cerebral symptoms may be due to the high fever and poisoned blood. Not unfrequently the lesion in these cases is at the apex. Cough is often absent. (5) **Gastric Pneumonia.**—In these cases gastric symptoms are most marked ; the attack may begin with vomiting, diarrhœa, coated tongue, fever, and abdominal pain, and it is only after a day or two, when the classical signs appear, that a diagnosis of pneumonia is made. The attack may simulate gastro-intestinal catarrh or peritonitis, the abdominal pain being due to diaphragmatic or costal pleurisy. (6) **Pleuro-pneumonia.**—In these cases the signs of pleurisy predominate ; there is sharp stabbing pain, tenderness on percussion, and the child screams when it coughs or turns over in bed. Signs of consolidation are succeeded by those of pleuritic effusion, or an empyema possibly results.

Complications and Sequelæ.—**Pleurisy** frequently accompanies croupous pneumonia ; percussion over the dull area and deep pressure give pain, and friction sounds are frequently heard ; the pleurisy is apt to become suppurative in weakly children, and an **empyema** develop, especially if the pneumonia occurs in the course of scarlet fever, measles, or whooping cough (see *infra*). **Pericarditis** sometimes occurs. **Hyperpyrexia,** a temperature of 105° or 106° occasionally taking place, accompanied by cerebral symptoms, convulsions in young children, or stupor and delirium in older ones. **Meningitis** is rare, though it occurs occasionally simultaneously with the pneumonia or follows as a sequela, being most common in young children. **Nephritis** also occurs in association with pneumonia ; usually the latter is secondary to the former. **Jaundice** sometimes accompanies pneumonia, and is apparently due to an infection of the common bile duct as well as of the lung. **Gangrene of the lung** occasionally supervenes and brings about a fatal result ; this seems mostly to occur either in pneumonia secondary to nephritis, or when pneumonia occurs in a subject who has emphysematous lungs. The possibility of the lung being adherent to the chest and undergoing an indurating or fibroid process must be kept in mind. A chronic

condition of **caseation** may remain, but this is much commoner after catarrhal than after croupous pneumonia. **Diphtheria** of the fauces may complicate it; once or twice we have discovered, to our surprise, late in the attack or on the *post-mortem* table, false membrane on the fauces.

Prognosis.—The prognosis is favourable in cases of croupous pneumonia when it is primary and attacks healthy children over 3 years of age; among such the mortality is small. Double pneumonia is necessarily more fatal than single, but here the amount of lung involved at one time is not necessarily great, as usually while it is advancing on one side it is receding on the other; the danger depends on the amount of lung involved, and the respirations give a more or less useful indication of this. In a child who

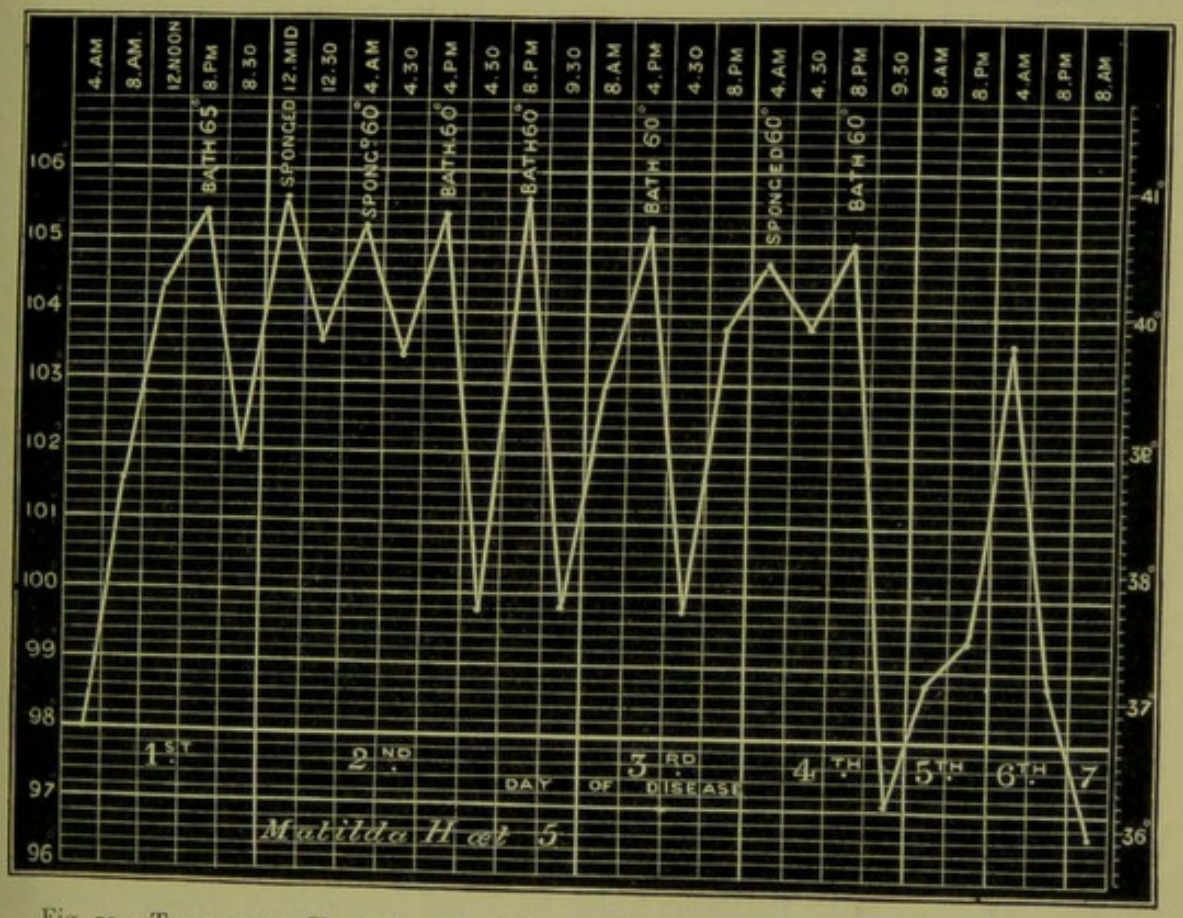

Fig. 79.—Temperature Chart of a case of Croupous Pneumonia of left lung in a girl of 5 years; treated by cold baths. Crisis fourth day; post-crisial rise. Recovery.

already suffers from chronic bronchitis and emphysema or cardiac disease, the prognosis is much worse. Secondary pneumonia, when it follows or complicates scarlet fever, measles, whooping cough, nephritis, or follows operations or is connected with septicæmia, is necessarily a serious and often fatal disease. When much pleurisy accompanies the pneumonia, especially in young children, the prognosis is less favourable than in cases of simple croupous pneumonia.

Diagnosis.—In those cases of croupous pneumonia which begin with vomiting and high fever, and where the physical signs are delayed, there is a certain superficial resemblance to scarlet fever. That such cases are liable to be mistaken for scarlet fever is shown by the fact that not uncommonly

cases of acute pneumonia are sent into fever hospitals certified as suffering from scarlet fever. A careful examination of the patient, and, if necessary, a delay of twenty-four hours before coming to a decision, will, in the large majority of cases, prevent such an error. In the first twenty-four hours in a sharp attack of scarlet fever there may be high temperature, vomiting, diarrhœa, rapid pulse (often 150), tonsillitis more or less developed, no pain in the chest, or cough. The rash usually appears at the end of twenty-four hours. In acute pneumonia there may be high fever, headache, pain in the chest or abdomen, dyspnœa, pulse perhaps of 120, some physical signs in the chest, not often vomiting, diarrhœa, or tonsillitis. There is no rash. Acute pneumonia with marked cerebral symptoms, such as delirium, stupor, or headache, sordes on the teeth, and high fever may be taken for typhus. A careful examination of the lungs would generally decide ; in typhus there may be evidence of bronchitis ; in pneumonia there would usually be some want of resonance at an apex or base, with some distant or bronchial breathing. The presence of a characteristic rash on the third or fourth day would decide the diagnosis ; it is well to remember that in children typhus is usually a mild disease. In young children an acute attack of croupous pneumonia, with high fever, convulsions, drowsiness, or coma, may be mistaken for acute meningitis, or, as a matter of fact, pneumonia and meningitis may co-exist. We should, however, hesitate in the presence of pneumonia and a temperature of 104° or 105° to diagnose meningitis, the cerebral symptoms being due to the high temperature and poisoned blood. In all cases where a young child is suddenly taken with convulsions and high fever, pneumonia should be suspected and a careful examination of the lungs made. We must remember that the temperature may be high, 104° or 105°, as the result of only a small patch of pneumonia. In such cases, especially in infants, the pneumonia may be overlooked and the temperature be attributed to teething. The diagnosis between croupous pneumonia and generalised broncho-pneumonia may not be easy during life ; we cannot often do more than say such and such an attack approaches more nearly to the croupous type, when there is a sudden onset, a local portion of lung involved, a continuous temperature, and a crisis ; that it is more of the catarrhal type when there is much bronchitis, an intermittent temperature, and gradual subsidence of the fever. The difficulty does not always end in the *post-mortem* room, as typical fibrinous pneumonia in patches or more widely distributed may be found in one lung and undoubted lobular pneumonia in the other, while both varieties may be present in the same lung.

Pathology.—In croupous pneumonia the first stage is that of an inflammatory engorgement of an extended portion of lung, the vessels are full, the capillaries are tortuous and distended, encroaching on the air space in the sacs ; in the second stage the engorged vessels relieve themselves by pouring out liquor sanguinis and some corpuscular elements into the air sacs, which become blocked with fibrine, and a condition of red hepatisation results. This red hepatisation, when seen at the *post-mortem*, differs from the lobar variety of catarrhal pneumonia in that it is more solid to the touch, and presents a uniformly coloured surface on which the outlines of the lobules cannot be distinguished ; in children it is less often granular than it is in adults. In a later stage grey hepatisation is found, the lighter colour being

due to the presence of a greater number of corpuscular elements. In lung in a state of red hepatisation, Fränkel-Weichselbaum diplococci may be usually detected by Gram's method. In one of our recent cases of fatal croupous pneumonia, in a boy of 4 years of age, who died on the eighth day (having been deeply jaundiced for three or four days), the left lung was in a condition of red and grey hepatisation, except at the extreme apex. There were some localised hepatised patches in the right base. We were able to obtain cultivations on glycerine agar of the Fränkel-Weichselbaum diplococcus, *Staphylococcus pyogenes aureus*, and *Streptococcus pyogenes*.

Treatment.—An uncomplicated case of croupous pneumonia in a child does not require active treatment, as the course is short, and the heart and arterial system, unlike the condition often found in adults, are free from degenerations, and able to stand the strain imposed upon them. The child should, of course, be confined to his bed in a well-warmed and ventilated room ; he should be allowed only fluid nourishment, such as milk, barley water, and soda water. A piece of spongio-piline or flannel doubled several times may be wrung out of hot water, and applied to the chest. Poultices may be used, and retain the heat better than anything else ; but they are very liable to slip out of place, and are unsuited for infants on account of their weight. In the early stages aconite is of service, one or two drops of the tincture being given every two or four hours, being watched carefully lest it produce too much depression. In many cases no other treatment is required, the aconite being stopped when the crisis comes. If the temperature is not excessive, not much exceeding 103°, no special methods of reducing it need be used, as the course of the fever is short, and often after the first day or two it takes a lower range ; the initial fever in the case of infants and young children is in some cases high, and is, apparently, the cause of the cerebral symptoms, such as convulsions and coma, from which they suffer, and which sometimes prove fatal. When this is the case, no time should be lost in reducing temperature by cold sponging, packs, baths, an ice bag to the chest over the seat of the pneumonia, or by the administration of antipyretics. If the temperature is high—104° or 105°—there is no need to fear any harm accruing from cold water, the simplest method of applying it being by sponging the patient, or—what is more effectual—by a pack at 60° or 70° ; this latter can be applied by wringing a towel out of cold water, folding and applying it round the chest, or enveloping the whole body in a wetted sheet. The process may be repeated at intervals of an hour more or less. If these means prove inefficient, or if, as in the case of convulsions, there is no time to lose, the cold or graduated bath should be resorted to, the child being placed in a warm or lukewarm bath, and the temperature of the water gradually lowered to 60° F. by addition of cold water or ice ; if the patient becomes blue and cold he should be removed at once.

The best antipyretics are quinine and phenacetin, either being given in two or three grain doses to a child of 3 years every four hours ; phenacetin is apt to produce considerable depression, which, however, quickly passes away ; large doses of quinine are apt to produce dyspepsia. The effects of aconite on the pulse should be carefully watched ; any signs of intermission or irregularity should be the signal for omitting it, for a while

at least, and giving some simple saline, as liq. ammon. acet. or citratis; alcohol and stimulant expectorants are best avoided in the early stages; two or three drop doses of tr. digitalis, given every four hours, are often useful if the pulse is poor; citrate of caffeine or sulphuric ether may also be given.

In cases where the crisis is delayed on account of the inflammatory process extending, as in the creeping form, and when the child seems low and weak, there is always a temptation to give ammonia and stimulants, and these may in some cases be needed, especially in hospital patients who are seen for the first time after some days' illness; but our impression is that patients do better in the inflammatory stages, when the process is still extending, on small doses of aconite, antimony, or salines, than they do on a too stimulating treatment. An occasional dose of alcohol may do good when a continuous dosing is harmful; alcohol in large doses acts as a narcotic, and is apt to add to the drowsiness and tendency to delirium. Opium in the form of 'nepenthe' or Dover's powder is of great value in calming the delirium and sleeplessness, as well as soothing the irritable cough and relieving pain when this is a marked feature, as it is in the pleuritic complications. One to three drops of nepenthe or half to two grains of Dover's powder may be given at night to procure rest and sleep. In double pneumonia, where there is much depression with a failing pulse, ether and digitalis must be resorted to. Ether may be injected in three or five drop doses subcutaneously, or sp. ætheris and tr. digitalis may be given every few hours, or inject strychnine subcutaneously in doses of $\frac{1}{100}$–$\frac{1}{50}$ of a grain, every hour. Champagne is a good restorative under these circumstances, but it may cause vomiting if given too freely, and it will be well to dilute it with soda water in the case of young children.

Gangrene of the Lung

Croupous pneumonia, when it attacks children already the subjects of chronic bronchitis and emphysema, is apt to terminate in gangrene of the lung; this we have seen on several occasions. It is apt to follow pneumonia secondary to scarlatinal nephritis and also whooping cough. The principal diagnostic symptom is the exceedingly foul breath; the temperature is usually high, sometimes hectic, suggesting pus, and the pulse is rapid. The lung is found at the *post-mortem* in a state of grey hepatisation, breaking down into ragged cavities and smelling offensively.

Gangrene of Lung; Pyopneumothorax.—Joseph P., aged 9 years. Mother states he has been subject to bronchitis in the winter. On September 10 he came from school complaining of a pain in his side and bad cough. He has been spitting some blood. On admission, September 27, 1894, he is a thin, delicate-looking boy, with clubbed fingers. On examination of the chest: the right side has a boxy note, except at the base behind, which is dull; the breath sounds are very faint; some friction sounds in the axilla; the left side is normal, except that the breath sounds are exaggerated. There is not much dyspnœa, but he is subject to paroxysms of coughing, when he brings up considerable quantities of very fœtid pus. October 2.—Paroxysms of coughing and fœtid expectorations; some dulness at left base behind. Coarse crepitation anteriorly on right side. Explored right side subcutaneously in several different places, but failed to find pus. October 3.—Much collapse. Death October 6.

Post-mortem.—Right lung adherent in front, in axillary region pyopneumothorax; pus very foul; small cavity in middle of lobe, communicating with bronchus and als

pleura cavity; patches of consolidation throughout the lung becoming gangrenous; no definite tubercle. Left lung adherent behind; recent pleurisy. Heart and other organs show nothing abnormal.

Abscess of the Lung

Purulent collections in the lungs are mostly the result of septic embolism from some distant suppurating centre, as in an otitis or some other bone lesion, and are associated with pyæmia. They are usually small and situated on the surface. Small abscesses may be secondary to an empyema, the latter finding its way *viâ* a small abscess into a bronchial tube. Minute abscesses are sometimes a sequence of a broncho-pneumonia secondary to scarlet fever, measles, or whooping cough, suppuration taking place in the lobules immediately surrounding the terminal bronchioles; here small centres containing pus may be found (see p. 383).

In both gangrene and abscess of the lung, if the lesions are fairly localised, or the disease progressing, an attempt should be made to arrest the mischief by incising and draining the abscess or gangrenous cavity. For this purpose it is necessary to localise the abscess, first by the physical signs as far as may be, and, secondly, by exploration with an aspirator needle, though, if the evidence is otherwise strong, failure to draw off pus by the aspirator should not prevent a further exploration; the incision should be made over the abscess, and, if necessary, one or more segments of rib removed; the lung should then be incised and drained, and treated on ordinary surgical principles. We have incised and drained a hydatid of the lung and a pulmonary abscess, with considerable relief to the children in each instance.

Pleurisy and Empyema

That pleurisy must be a common disease in children is shown by the frequency with which the lungs are found adherent to the chest walls when making autopsies on children who have died from various diseases. Here, as in the case of adults, the evidence of a past pleurisy is conclusive. Yet it cannot be said that pleurisy is diagnosed and treated with any great frequency during life, the reason no doubt being that young children are not able to localise attacks of pain, that when fretful it is not easy to thoroughly examine their chests by auscultation, and, moreover, the symptoms may be masked by other diseases in which the pleural lesion plays but a secondary part.

Pleurisy, primary and acute, occurs at all ages during infancy and childhood, the first year of life being by no means exempt. It is apt to follow exposure to cold, or, not infrequently, an accident, such as a fall or blow on the chest. It is, however, far more commonly associated with croupous, catarrhal, or septic pneumonia. It occurs in connection with tuberculosis of the lung.

Affections of the pleura include dry pleurisy, serous pleurisy, purulent pleurisy; these may be only stages in the inflammation or they may assume a definite character from the first. It is clear that the signs and symptoms will differ according as to whether the effusion is lymph only or lymph and much fluid.

Symptoms.—Pleurisy may begin suddenly and run an acute course, though more often it is subacute. The attack begins with a short cough, fever, shallow respiratory movements, the affected side moving less than its fellow, accompanied by sharp pain, which the child, if old enough to do so, refers to the side or very often the epigastrium. In infants the attack may be ushered in by convulsions and its course may be marked by screaming fits, especially if the child is disturbed. If the pleurisy is extensive and acute, an examination of the chest shows the respirations to be shallow, and the movements of the affected side extremely limited, while percussion or pressure in the intercostal spaces with the finger gives rise to expressions of acute pain. On auscultation, while the breath sounds are loud and clear on the normal side, they are weak on the affected, and perhaps accompanied by a friction sound. The pulse is quickened and there is fever, perhaps 100° to 102°, unless pneumonia is present, when it is probably higher. The further course of the attack varies according to whether effusion of serum occurs or not. In the latter case, in the course of a few days the fever subsides, the friction sounds disappear, though perhaps some 'stitch' (stabbing pain in the side) remains for a while. In many cases apparently a local pleurisy takes place during the course of a bronchitis or bronchial catarrh in which little else than a sharp pain in the side or abdomen is present.

In pleurisy occurring between the diaphragm and lung the symptoms are generally obscure, there are pain and tenderness in the epigastric or hepatic regions, with thoracic breathing, the abdominal muscles and diaphragm being kept as quiet as possible. Should effusion take place in any quantity, signs of its presence quickly appear. The child will probably lie on the affected side, so as to give full play to the lung on the sound side ; the infant, as Henoch points out, with fluid in the right pleural cavity takes only the left breast of its mother for a similar reason. On inspection it will be noted that the side containing the effused fluid moves less freely than the other ; and if the fluid is in the left chest, the cardiac impulse is displaced towards the right side. In large pleural effusions on the right side the impulse may be moved towards the left. This displacement of the cardiac impulse is of special value in the diagnosis of fluid in the chest in children, on account of the uncertainty and small value of some of the other physical signs ; as, for instance, the vocal resonance and fremitus, which yield valuable information in adults. The position of the heart's impulse is best ascertained by placing the surface of the hand on the chest wall, and, if necessary, by determining by auscultation the position of the heart by the comparative loudness of its sounds. It is necessary, however, to remember that the heart may be displaced without any fluid being present at the time of examination, as it may have been pushed on one side by a former effusion and have become fixed in an abnormal position by fibrous adhesions ; in this case the lung also will probably be adherent, and a dull note may be elicited over it which suggests the presence of fluid. The heart may also be pulled on one side or upwards by a fibroid condition of lung or chronic pleurisy.

On percussion of the chest, a dull or much impaired resonance will be detected over the area occupied by fluid, while in most cases the subclavicular region and frequently also the supra-spinous fossa and possibly a

strip between the base of the scapula and the spine, will be resonant, often hyper-resonant. If the effusion is great the whole side will be completely dull and give a sense of resistance on percussion. On auscultation the breath sounds are weak and distant, but usually of a distinctly bronchial or tubular character. In the earlier stages of effusion the expiratory murmur is especially accentuated and bronchial, the air from the compressed lung being, as it were, expelled with difficulty. The breath sounds on the healthy side are exaggerated. The vocal resonance and fremitus may be absent or weak, but it may be impossible to elicit any information in this way, as the voices of children, especially girls, are weak, and moreover they may not be old enough to understand what they are wanted to do. During crying, information of value may sometimes be obtained by placing the hand on the chest. Comparative measurements of the two sides show the affected side in recent cases to be larger than the other ; but too much value must not be attached to measurements, as in chronic cases some amount of retraction may have taken place. Of more value is the cyrtometer tracing ; this, as pointed out by Dr. S. Gee, shows a change of shape from the elliptical to the more circular form without the circumference being necessarily increased.

Should a large amount of fluid be poured out in a short space of time, it will necessarily give rise to dyspnœa : the child will turn over on to the affected side or lie upon its back ; the alæ nasi work, and the number of respirations is increased perhaps to forty or fifty. If the amount of fluid is smaller in quantity, the child may be tolerably comfortable while lying at rest, but there is dyspnœa on the slightest exertion. The amount of feverishness varies ; during the inflammatory stage before or during the period the serum is being poured out the temperature is usually raised two or three degrees ; in the course of a few days a gradual fall takes place, and there may be no fever or only a slight elevation at night.

Under favourable circumstances in a healthy child, the serum effused begins to be reabsorbed : this is usually done in the course of a few days, the heart if displaced returning by degrees to its normal position, the level of the fluid becoming lower and lower, till the side regains its normal resonance ; or, what is much more likely, a somewhat impaired resonance, which it retains for many weeks. The reason of this is doubtless that the re-expanded lung remains for some time in a sodden and congested state, and not improbably its pleural surface contracts adhesions with the chest wall. During the stage of reabsorption friction and moist râles are frequently heard in the lung, and the breath sounds are weak. In some cases, however, this desirable reabsorption does not at once take place. The child's health is impaired, he is anæmic and depressed, perhaps thick layers of lymph are covering the pleural surface of the lung and chest wall, and conditions are not favourable for the reabsorption of the fluid after the inflammation has subsided ; or possibly the absorption may go on extremely slowly, *pari passu* with the organisation of the lymph which has been poured out. Under these circumstances much damage may be done, the heart may be fixed in a malposition, the lung may become tied down by a thick layer of fibroid tissue, which, contracting, holds the lung in its grip, while the chest falls in and the spine becomes curved.

But besides a quick reabsorption of the serum, and a chronic pleurisy with its slow course, another result may follow, and that is, the serum may become pus ; this, however, is not a common result. An empyema, as a rule, is an empyema from the first, at least the fluid effused is turbid-looking ; in other words, it is thin pus, and later it becomes thick pus. It is no doubt most common to find that where there is reason to believe fluid has existed in the chest for some weeks or months, the fluid is pus and not serum, but then in all probability the fluid has been pus from the first and has failed to be absorbed, as would have been the case had it been serum. Serum may undoubtedly remain in the chest unaltered for many weeks, perhaps months ; but this is uncommon except in cases of tubercle, or new growths in the lung, or in cardiac disease. An empyema is, in the vast majority of instances at any rate, the result rather of a pleuro-pneumonia than a simple pleurisy. The more intense the inflammation the more likely it is that pus, not simple serum, is poured out, or that the serum poured out quickly becomes pus. This is especially likely to happen if a pleuro-pneumonia follows scarlet fever, measles or whooping cough, or indeed any pneumonia of the croupous type. The symptoms given by an empyema are by no means distinctive as between pus and serum, and often no definite diagnosis can be arrived at until an exploratory puncture has been made. In favour of pus in acute cases would be the occurrence of pleurisy as a sequel of a zymotic disease, especially in a weakly child ; in chronic cases the presence of hectic, diarrhœa, a sallow earthy complexion, the 'pointing' of a collection of fluid in connection with the chest. A collection of purulent fluid may be present in the chest and give very few signs of its presence, except the physical signs. It must be remembered that in any chronic case of fluid in the chest in a child, that fluid is probably, but not invariably pus. The early history of an empyema is generally that of an acute pneumonia which does not clear up, and the presence of pus in the chest is likely to be thought to be consolidation of the lung, especially as there may be well-marked bronchial breathing. As an illustration of this the following case may be cited :

A girl of 9 years was convalescent from scarlet fever. On the thirty-eighth day the temperature rose to 105°, there was intense pain referred to the left side of the chest and epigastrium, especially felt when she turned in bed ; there was also some want of resonance at the left apex. On the third day of the attack there was diminished resonance over the whole left side, with bronchial breathing ; no displacement of the heart. On the sixth day there was slight displacement of the heart to the right, the dulness over the left chest was much more marked, the breath sounds were faint and bronchial. On the eleventh day the signs of fluid had increased, the heart's impulse being felt at the left border of the sternum ; an exploratory puncture showed the presence of pus. On the seventeenth day the chest was incised antiseptically, pus and much lymph escaped, a tube was inserted, and complete recovery ensued (see fig. 80).

It must always be borne in mind if a croupous pneumonia does not clear up and the dulness disappear, or if the temperature remits instead of falling when the time for a crisis comes, pus may be present in the chest. In such cases the signs of consolidation of lung are gradually replaced by those of fluid, the latter accumulating as the pneumonic consolidation disappears.

Pus may be present in the chest, yet not free in the pleural cavity, but confined by adhesion between the lung and chest wall or diaphragm. More

than one localised empyema may be present on the same or opposite sides. Such localised collections may be present in any part, as at the apex in front, the base behind, or in front between the pericardium and anterior edge of the left lung, or between the lung and the diaphragm. We have known a localised empyema situated at the posterior side of the apex of one lung; there was fairly good resonance in front and behind, except over a small area at the back of the apex of the lung. These small empyemas are often associated with broncho-pneumonias and chronic tuberculosis of the lung. It is perfectly obvious that if these collections of fluid are not large and are surrounded by and backed up by crepitant lung, diagnosis will be by no means easy, and it is not surprising that such should be found on the *post-mortem* table, having escaped discovery during life. In these cases physical signs are not distinctive; there will mostly be a patch of dulness, with more or

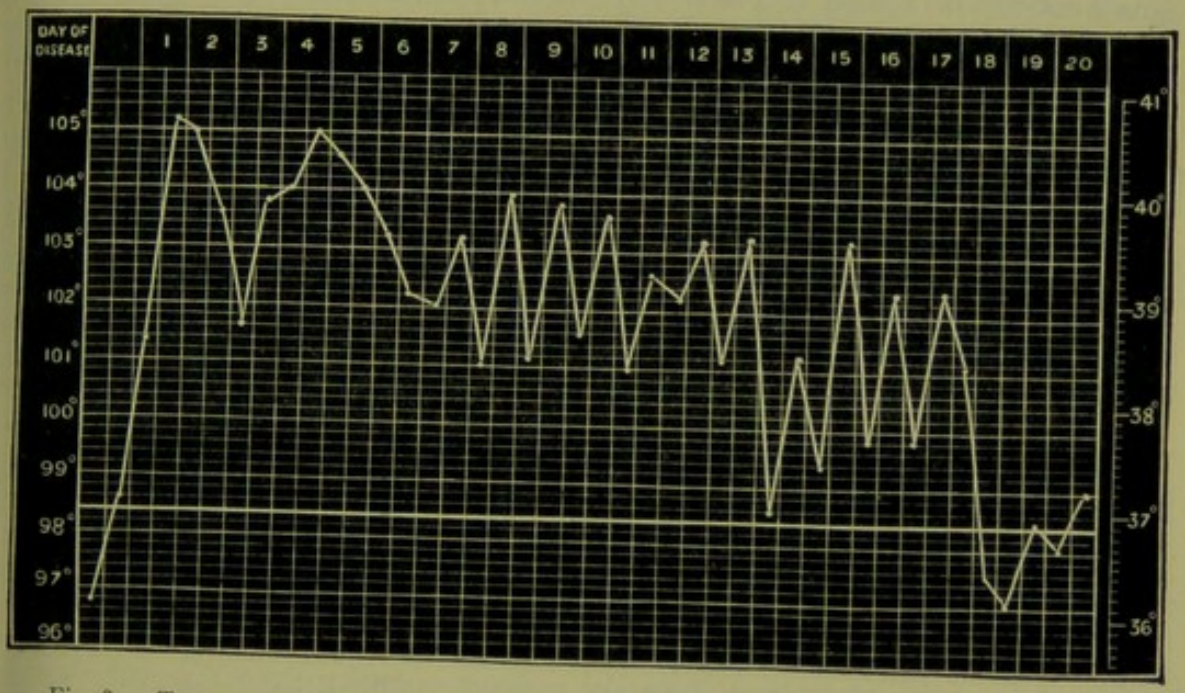

Fig. 80.—Temperature Chart of a case of Pleuro-pneumonia followed by Empyema, in a girl of 9 years. Signs of fluid were discovered on the sixth day, pus on the eleventh day; on the seventeenth day the chest was incised, followed by a fall in the temperature.

less resistance, but an adherent lung with thick fibroid tissue between it and the chest wall will give a similar note. The breath sounds are weak, perhaps bronchial. When in doubt it is wise to explore, not using too fine a needle, as if the bore is too small it is apt to become blocked with a flake of lymph or pus. If the layer of pus is not thick the needle may pass through the pus into lung beyond. These localised or latent empyemas are most likely to be overlooked in wasting infants and young children. No history is given of an acute attack; there is little cough, only wasting and a temperature which is subnormal in the morning and perhaps up a degree or so in the evening. The physical signs are but slightly marked; they are diagnosed as tuberculosis or simple atrophy. At the *post-mortem* it is a surprise to find one or more local collections of pus and no tuberculosis.

Diagnosis.—The distinction between the consolidation of pneumonia and pleuritic effusion in typical cases is made readily enough. The intense

bronchial breathing, with the clear ringing râles and impaired resonance of pneumonic consolidation, form a marked contrast to the weak, distant breath sounds, wooden dulness, and displaced heart distinctive of a large effusion of fluid. In many cases, however, no diagnosis is possible without an exploratory puncture, and even then a negative result does not definitely settle the matter, as it is quite possible to miss the fluid. A pneumonic lung covered with a thick layer of lymph, or a sodden lung covered with fibroid tissue and adherent to the chest wall, gives a wooden dulness and resistance closely resembling that of fluid. On the other hand, when fluid is present the bronchial breathing is sometimes loud and even intense. A good rule to follow is, whenever there is a patch of dulness that does not clear up, especially where there is a hectic or elevated temperature, always to explore by means of a subcutaneous syringe. The diagnosis between a local or small collection of fluid at a base and chronic pneumonia, caseous pneumonia and tuberculous consolidation, is often far from easy, and indeed is generally impossible without exploration. There may be dulness and a hectic temperature, moreover there may be a patch of impaired resonance in the axilla while the apex and base are resonant, or both sides may be affected. It may be necessary to give chloroform and make a number of exploratory punctures in order to obtain a diagnosis. A negative result may be arrived at, and yet there may be a local collection of pus not reached by the needle.

In one of our cases there was intense bronchial breathing and increased vocal resonance over the whole of the right lung, except at the base; it was very dull all over. We removed 7 oz. of pus and more drained away afterwards.

Morbid Anatomy.—It is not often that an opportunity occurs of examining the chest of a child that has died of uncomplicated pleurisy or empyema, though it is common enough to find both in association with pneumonia or tuberculosis. The pleurisy differs much in degree, from a simply roughened surface to a layer of thick lymph; the adhesions which result from the organising of the lymph also varying greatly in toughness and thickness. Serum in varying amount, perhaps in greater quantity than was suspected during life, may be found in association with pneumonia, especially in such diseases as nephritis, septicæmia, and scarlet fever. The lung corresponding to the position of the fluid is collapsed and airless. The result of a past pleurisy, especially when this has been chronic, is sometimes seen at the *post-mortem* in the shape of thick fibroid adhesions which completely surround and infiltrate the lung. The latter is completely adherent, airless, in a condition of cirrhosis, traversed by bands of fibroid tissue, and occupying a position at the posterior aspect of the chest in contact with the spine. In other cases there may be found adhesions connecting both lungs with the chest wall and diaphragm, and on cutting through the lungs they appear to be riddled with cavities, which are in reality dilated bronchial tubes. The relation between empyemas and tuberculosis is interesting and important. It is believed by some that the subjects of chronic empyemas are apt to become tuberculous; in other words, patients who suffer from a chronic empyema are likely to die of phthisis. We do not think, at least as far as our experience goes, that there is any *post-mortem* evidence to support this. That chronic pneumonia may terminate in tuberculosis by the mediastinal glands becoming

caseous is an almost every-day experience, but this certainly does not apply to empyema. Barlow and Parker, however, state that they have met with cases where they believed a tuberculosis was secondary to a chronic empyema. Localised collections of pus may sometimes be found in connection with chronic tuberculosis, but in these cases the pus is apparently secondary to the tuberculous process.

Suppurative or simple pericarditis may take place by extension of the inflammation from the pleura.

The bacteriology of empyemas has received much attention of recent years. These researches show that in children the commonest micro-organism found in the pus is the pneumococcus. Netter found in a series of 90 cases of empyema in children, the pneumococcus in 80·6 per cent., in 73·8 per cent. it was present by itself, in the remaining 6·8 per cent. it was associated with staphylococci, tubercle bacilli, or streptococci. Streptococci were present in 13·3 per cent. and the bacillus of tubercle in 5·5 per cent. This author found the streptococcus and bacillus of tubercle more frequently present in the empyemas of adults than children. His researches led him to form the opinion that the pneumococcic empyemas are more benign and the prognosis is more favourable than in those cases in which streptococci and bacilli of tubercle are found. Thus, a bacteriological examination of the pus from the first puncture becomes of importance. Netter treated 66 cases of pneumococcic empyemas, 3 of them being double, with only 7 deaths; on the other hand, he had 7 fatal cases of streptococcic empyemas out of 9 cases. The latter are usually secondary to scarlet fever, measles, erysipelas.

More recently Dr. W. J. S. Bythell has examined the pus of 40 cases of empyema, most of them being patients at the Manchester Children's Hospital. He found pneumococci in 90 per cent. of the cases examined, in 65 per cent. this organism was also present, in the remaining cases the pneumococci were mixed with the streptococcus, tubercle bacillus, Friedländer's bacillus, and M. tetragenus. Streptococci were present alone in 2 cases out of the 40. The latter cases were mild and not as malignant as Netter's cases. It is clear the prognosis must depend upon age, complications and other circumstances besides the character of the bacilli present.

Treatment.—In the early stages of dry pleurisy, where the pain is severest, the child is necessarily placed in bed, small doses of an anodyne being given, and hot applications applied to the chest. Small doses of opiates relieve the pain best, such as Dover's powder or $\frac{1}{20}$–$\frac{1}{12}$ grain of morphia given subcutaneously; the latter may be administered to children over four years, but not to infants. Hot poultices may be used with less fear than in pneumonia where much lung is involved. Strapping the chest on the affected side with strips of belladonna plaster is often very useful.

The natural course of a dry pleurisy is towards recovery, the inflammatory condition of the pleura subsiding, the lymph effused being organised, and the lung becoming adherent to the chest wall. The adhesions thus formed differ very much in their firmness and strength, the lung being perhaps only loosely attached to the parietes, so that its movements are only slightly if at all impaired, or firmly attached by thick leathery adhesions, so that it cannot be torn away without damage. In the latter case the adhesions are extensive, the movements of the lung are impaired, it never

properly empties itself of air, and it is in consequence always more or less in a congested or œdematous condition, and possibly becomes infiltrated with fibroid tissue while the bronchial tubes become dilated. Such cases are probably the result of chronic or subacute pleurisy ; the chest may also contract and fall in. When an effusion of fluid has occurred, in the vast majority of cases reabsorption takes place after the inflammatory condition of the pleura has subsided, and the tension of blood in the vessels has become reduced to normal. Life, however, may be threatened from the excess of fluid thrown out ; under these circumstances nearly the whole of the blood in the body is passing through the sound lung ; it is consequently intensely congested, and may become œdematous. Moreover, the right side of the heart is over-distended, and as a consequence sudden death is apt to ensue. For this reason no time should be lost, if the dyspnœa and distress become great, in relieving the chest by the withdrawal of some of the effused fluid. On the other hand, the mere presence of fluid in the chest, if there are no signs of distress, does not necessitate operative interference, as in the great majority of cases absorption takes place in the course of a few days or a week. Operative interference, therefore, is called for in all cases where there is dyspnœa or orthopnœa when lying quietly in bed, or where there is much displacement of the heart. In those chronic cases where the fluid is not absorbed or is not diminishing in quantity after the lapse of a few weeks, the serum may be removed from the chest by means either of the aspirator or by trocar and cannula, the small ones introduced by Dr. Southey for the removal of the fluid in ascites answering very well. Whatever method is selected, the fluid should be removed slowly, and there is no necessity to remove all that can be aspirated. Too rapid aspiration of the fluid is apt to lead to bleeding into the chest from rupture of some of the capillary vessels, and may possibly cause emphysema of the lung on account of one part of the lung expanding faster than the other. On the whole, we believe the best results are obtained by the use of Southey's trocar and cannula. One of these may be introduced without difficulty and without pain if local anæsthesia be produced, a piece of fine india-rubber tube attached, and the fluid allowed slowly to drain away for a couple of hours or so, 10 to 20 oz. being thus withdrawn ; if necessary two cannulæ can be inserted. In those cases where the dyspnœa is extreme, relief is more quickly obtained by aspiration. It may not improbably happen that the pleural cavity in part fills up again and a second or a third removal be required. In the less acute cases, where there is no urgency and no removal is attempted, the child should be confined to bed in a warm room and carefully protected from cold. It may be doubted if any drug materially aids the reabsorption of the effused fluid, though the usual treatment in such cases—namely, giving iodide of potassium internally and painting liniment of iodine mixed with an equal quantity of glycerine externally—appears to be useful. The lin. iodi by itself requires using with care, especially in young or weakly children.

The natural course of an empyema differs from that of a simple serous effusion. In a minority of cases, especially where the empyema is small and confined by adhesions, it may dry up, and the inspissated pus in time become cretaceous. But this event can hardly be expected, and should it take place, especially if the empyema be a large one, the result, accompanied

as it is by retraction of the chest and compression of the lung, is anything but satisfactory. The presence of pus in the chest is inconsistent with good health, to say nothing of the risks the patients run of its burrowing in various directions. The child with a chronic undrained empyema probably suffers from hectic fever, is anæmic and sallow, the skin becomes rough, the fingers clubbed, and the child emaciates. Various other results may follow: the pus may find its way through the intercostals, and point in the fourth or fifth space; it may then gradually undermine the skin and a chronic discharge take place. It may open through the lung into a bronchial tube and be gradually coughed up; in this way recovery may eventually take place, though the process is a slow one; or an abscess or abscesses may form in the lung. An empyema on the right side may, either by contiguity or by opening through the diaphragm, give rise to an abscess in the liver. It may open into the abdomen by finding its way through the diaphragm, and set up peritonitis. The pus may burrow any distance, opening through the abdominal walls or simulating a lumbar abscess.

Directly a diagnosis of pus in the chest is made, arrangements should be made to evacuate it, and this in the vast majority of cases should be by free incision and drainage. Aspiration may be tried once or twice in local empyemata, especially in infants and small children; but it is only in the minority of cases that it will succeed, as the cavity usually fills up again and separates the parts which should be kept in contact if a cure is to result.

The surgical treatment of suppuration within the pleural cavity is based on the ordinary principles guiding us in the management of abscesses elsewhere. Hence, although it occasionally happens that pleural abscesses dry up and do not discharge at all, or discharge through the lung or elsewhere and then heal, none of these possibilities should be looked for, and the treatment practically resolves itself into tapping and free incision.

Tapping an empyema with a simple trocar and allowing the fluid to drain away through a tube into an antiseptic lotion is a mode of treatment that is successful in certain cases, but is open to several objections. The cases for which it is suitable are those where the empyema is recent, of small size, contains no masses of lymph or caseous material, and where the lung is not bound down by firm adhesions but is ready to expand on removal of the compressing fluid; further, it is important for the successful employment of this plan that the pus be contained in one cavity only and not be loculated. The dangers of tapping are the risk of wounding the lung by thrusting the trocar too far inwards on the one hand, and on the other the possibility of pushing the thickened pleura or a layer of lymph before the trocar so that the abscess cavity is not opened. There is also the likelihood of the cannula becoming blocked with lymph or caseous material, and of incomplete emptying of the cavity because it is loculated or because the lung cannot re-expand.

Aspiration is open to the same objections, with the additional one that if too powerful suction is employed there is likely to be bleeding from the surface of the lung or the pleura, and the cavity may become partially filled with clot which readily decomposes.

The difficulty of emptying the cavity when the lung cannot re-expand has been met by Mr. R. W. Parker by the plan of injecting aseptic air into the

pleura to replace the pus as it flows away, or lotions may be used with the same object ; but the plan has not met, and is not likely to meet, with general approval. Aspiration, then, may be employed for small, single, recent empyemata, and in some few of such cases after one or two tappings the pus will cease to be secreted. Should there be chronic disease of the lung, caseous material, glandular or other, or disease of the ribs or spine, since the source of irritation remains, pus formation will go on and aspiration cannot be sufficient. Failing, then, tapping or aspiration, the remaining resource is free incision and drainage of the abscess. The general plan of operation may be described first, and certain special points alluded to afterwards.

The incision should be an inch or more in length, and should be made along the lower margin of the space selected, so as to avoid injury to the intercostal vessels. The tissues should be gradually cut through until the pleura is reached, all bleeding being arrested before the pleura is opened. If the membrane is not much thickened, a sharp director may be thrust through it and used as a guide for the knife ; if, however, it is very tough and thick, as may be the case if the disease is of long standing, it is better to incise it at once with the knife. As soon as the cavity is reached a pair of dressing or sinus forceps should be passed in, opened, and the pus allowed to escape freely. The drainage tube is then to be inserted and secured by a thread round the chest unless a special tube is employed. Possibly the dressings will be soaked and require changing in a few hours ; if, however, the cavity is fairly emptied and thick wood-wool pads are employed, this is not likely to be the case.

The special points to be considered are the position of the incision, the question of resection of a portion of rib, the drainage tube, the management of adhesions, and the washing out of the chest.

First, then the position of the incision. Where the empyema is local the incision must of course be made over it, and the lowest convenient spot for drainage should be chosen. Where the whole pleural cavity is filled with pus a difference of opinion exists as to the most suitable spot for the opening. Mr. Marshall advocated an incision in the front of the chest, others prefer the axilla. We think, however, on the whole, the best place is just behind and below the angle of the scapula in the eighth interspace—this spot affords good drainage when the patient lies on his back or side ; it is not quite so convenient for dressing, but it is nearly at the lowest point of the cavity, yet not so low as to risk injury to the diaphragm, which is liable to be drawn up to take the place of the shrunken lung.[1] Unless the incision is made too far back, there is no great thickness of muscle to cut through.

As to drainage, though in some cases where the chest is very full of fluid the intercostal spaces may be widened and bulging, yet much more often this is not so, and the ribs are so close together that it is difficult to get a tube into the chest, and when inserted it is liable to be nipped by pressure of the ribs. In such cases a piece of rib should undoubtedly be excised. The tube should not project far into the pleural cavity, but only just far enough to be clear of the thickened pleura, otherwise it will fail to drain the cavity,

[1] The objection that an empyema usually heals up at the back first, and that therefore a cavity is likely to remain unclosed in front, has not in our experience proved a valid objection to the posterior incision.

and may be blocked by pressure against the lung. A double tube, or two pieces of tubing fixed together side by side (Battams), are preferred by some surgeons ; the plan is useful if it is intended to wash out the chest, but in many cases it is open to the objection given above.

After opening the chest a finger should be passed in if possible to ascertain the size of the cavity and to break down any adhesions shutting in localised collections of pus,[1] as well as to remove any masses of lymph or solid material in the cavity. If the pus is foul or thick and flaky, as large a tube as possible should be put in, and all solid and offensive matter carefully removed after resection of a portion of a rib. Should any bleeding occur from the intercostal vessels, they may be picked up or secured by a catgut ligature passed round the rib including the vessel ; this is easily done with an aneurism needle. Bleeding from the granulating surface of the pleura after exploration soon ceases of itself, but all clots should be washed out.

During the operation careful watch must be kept by the anæsthetist that the child does not suffer from having to lie upon the sound side, and at any sign of failing pulse or respiration the child must be turned upon its back or towards the affected side. The after-treatment of empyema consists in keeping the cavity aseptic and well-drained ; obstruction of the tube is most likely to be due to flakes of lymph or to slipping of the tube if a rigid one is used, to nipping of the tube by the ribs if rubber is employed. As regards washing out the chest it must be remembered that there is a certain amount of danger in it ; cases of sudden death during the process have several times been recorded, possibly from irritation of cardiac nerves in the wall of the cavity, or from sudden dyspnœa ; this risk should deter us from washing out an empyema unless the discharge continues to be foul, and it should lead to caution and the avoidance of any distension of the cavity or the use of irritant lotions even in such cases. In free incision of the chest the opening is of course large enough to admit air readily, hence there is no obstacle to complete emptying of the cavity. The tube should not be left out until the discharge has nearly or quite ceased, and exploration with a probe has shown that the cavity is filled up ; often, though there is but little discharge, a good-sized cavity or a long sinus remains, and if the external wound is allowed to close, fresh collections of pus will take place. In a certain number of cases the empyema will be pointing externally when the case is first seen ; such pointing most commonly occurs in the front of the chest from the second to the fifth space, the matter sometimes pushing forward and pointing through the mamma. If the skin is already thinned the pus should be let out at this spot and the case managed as usual ; if, however, the cavity does not drain freely, a long probe should be passed through the anterior orifice, and cut down upon a more dependent spot, and a drainage tube inserted there. While admitting that the successful management of empyema is not simply a question of drainage as in other abscesses, we think a dependent opening is a highly important matter. A free outlet is absolutely essential.

Sometimes the pressure of the drainage tube causes ulceration of one of the ribs ; this is, however, a matter of little importance, since the rib usually recovers after removal of the tube.

[1] Dr. Fagge states that loculation is very rarely found *post mortem*.

In a certain proportion of cases, after drainage of the empyema, the cavity does not become obliterated, but remains as a pus-secreting sac; this is due either to imperfect expansion of the lung or insufficient compensatory falling in of the chest wall. Under such conditions the discharge may go on indefinitely and cause lardaceous disease and hectic fever; it is then necessary to find other means of allowing the surfaces of the abscess sac to come together. For this purpose resection of one or more ribs (Estlander's operation [1]) has been devised. Although in children, from the softness and flexibility of the ribs and spine, the chest generally falls in readily, this is by no means always the case, and the operation should be done as soon as it is clear that progress is not being made or the child's health is failing. Where there is an insufficient opening for drainage, it is also necessary in some cases to provide a larger orifice by removal of part of a rib; and, indeed, it is a good practice to excise a portion of rib in all cases where the child is not so feeble as to make even this slight addition to the severity of the operation undesirable. We practically always do so as a matter of routine. The operation is a simple one; to remove a single rib the lowest one in the cavity should be chosen, usually the seventh or eighth. An incision is made along it down to the bone, the periosteum is readily peeled back with a raspatory, and about an inch or more of the rib is cut out with bone forceps; the periosteum and pleura are then incised parallel with and avoiding the intercostal vessels; if the artery is wounded, however, it is easily secured now that the rib is gone. When the resection is done to allow collapse of the chest wall, from two to five ribs may have to be resected, two or three inches of bone being taken from each; in such case a quadrilateral flap of the soft parts should be turned forward and the ribs removed one after the other. Though it is perhaps better in such cases to remove the bones subperiosteally, the periosteum should be cut away before closing the wound, otherwise it often happens that ossification rapidly takes place and fills up the gap in the chest wall, and so prevents the desired collapse.

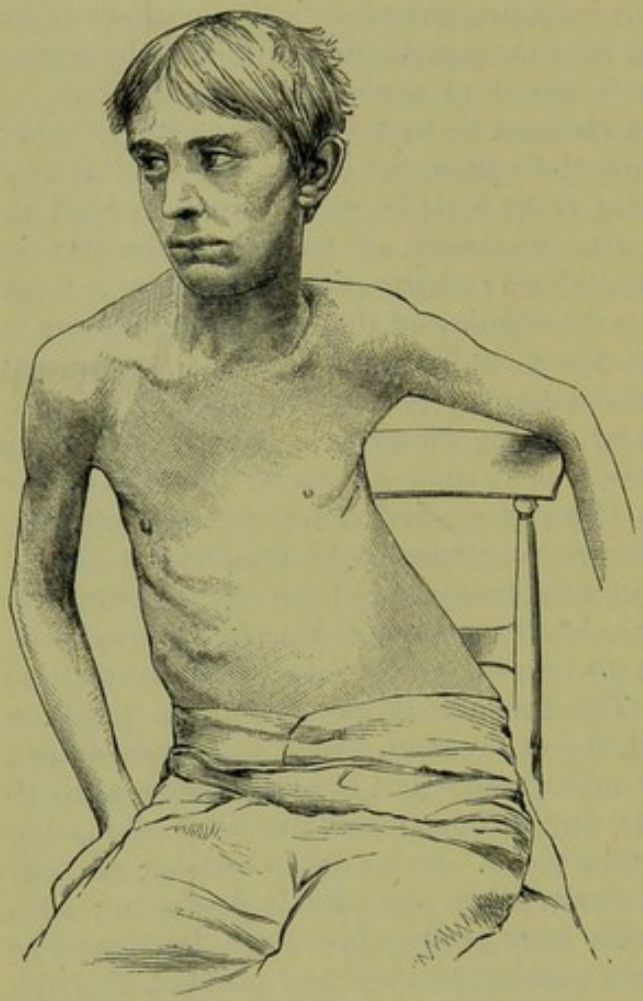

Fig. 81.—Deformity of Chest due to Empyema.

[1] Estlander's operation is strictly the removal of a sufficient part of the chest wall to follow a complete collapse.

We have sometimes found the intercostal vessels obliterated in these cases, and there has been no arterial bleeding at all. Marshall has divided the costal cartilages subcutaneously with the same object, but resection is the more complete operation, and it sounds and looks more formidable than it is. The subsequent management of the wound requires no description. Unless an empyema speedily recovers, more or less retraction of the side necessarily results, and from this a lateral, or rather, as Lane has pointed out, a true rotato-lateral curvature of the spine follows : this of course is largely irremediable, but some improvement may be obtained by treatment (*vide* Lateral Curvature). (Fig. 81.)

Inasmuch as the ribs are less yielding near the angles, it is better to remove the bone as far back as possible up to the edge of the erector spinæ. We have tried osteotomy of the rib at the posterior part at the same time as resection to allow more complete falling in of the chest wall, but found little was to be gained by this means, since the rib is held firmly in place by the surrounding soft parts.

Spasmodic Asthma

Spasmodic Asthma is a disease which perhaps ought to be classed with the 'neuroses,' but on account of its frequent association with bronchial catarrh and emphysema it is most convenient to discuss it under respiratory diseases. 'Asthma' or a condition of urgent dyspnœa occurs in renal disease, cardiac failure, pressure on the air-passages by tumours, and in hysteria ; but in these instances the dyspnœa is secondary, and need not be discussed here. The term asthma is popularly applied to chronic bronchitis, but it is needless to say that the dyspnœa of bronchitis is caused by bronchial tubes choked by thick mucus, and not by spasm of the bronchial muscles, as it presumably is in asthma.

True asthma appears to be related to 'cyclic' vomiting, recurring headaches, and epilepsy, and is due to functional disturbance of the respiratory centre brought about by some reflex irritation. It is a common disease in children, commencing in many instances about the second or third year, or later, but at times it begins even earlier. Dr. W. Ewart has published a typical case in an infant of 7 months old, and we have seen a case in an infant of 8 weeks, whose father and uncle suffered from this complaint. In some respects it resembles laryngismus, but as far as we know children who suffer from laryngismus do not exhibit any tendency to asthma. The disease is frequently hereditary, or at least runs in families.

The exciting causes of an attack are various, the commonest being a bronchial catarrh or bronchitis, nasal catarrh, especially where there are also 'post-nasal adenoids,' 'hay fever,' undigested food in the alimentary canal. The acute attack usually begins in the small hours of the morning, the child being seized with dyspnœa ; it sits up in bed and fights for its breath, the respirations are quick, the alæ nasi work, and the face is a dusky colour and the lips cyanosed. On listening to the chest, hissing and rhonchi are heard all over. The attack may last for several hours, then the dyspnœa becomes less urgent and a free secretion of mucus takes place. While such is the course of a typical uncomplicated attack, we constantly find there is

more or less bronchitis associated with it. Before the attack develops there is for some hours or days a certain wheeziness noted, and an acute exacerbation occurs at night time ; next day there is no distress, but rhonchus can be heard all over the chest, and any exertion causes dyspnœa. The child is a long time before its chest is normal, and then perhaps exposure to cold brings on another bronchial catarrh and another attack of asthma. As time goes on if the attacks follow one another with great frequency, the lungs become emphysematous and the chest constricted. Asthma is not dangerous to life, there does not seem to be any special tendency to tuberculosis in those who suffer, but the prognosis as far as the attacks are concerned is uncertain.

With regard to the treatment, diet is of great importance, as there can be no doubt that indigestion aggravates or in some cases starts the attacks. As a general rule the child should live largely on eggs, vegetables, and milk, using meat sparingly ; but fish, chicken, and soup may be allowed. Alcohol and all highly seasoned foods should be avoided. Care should be taken with regard to the clothing ; it is especially important that the under garments should be all wool so as to avoid chills. There must be no 'coddling' at one time and carelessness as regards colds at another time. Plenty of fresh air whenever possible, and no steamy, over-heated rooms during a bronchial attack. Climate is of great importance, but it is not easy to say what climate will suit. Some do best in climates like Falmouth, Sidmouth, or the South of France, during the winter, and Buxton, Malvern—in summer—or high lands which are breezy and bracing. Between the attacks the best medicine is cod-liver oil in some form ; both arsenic and iodide of potassium may be tried, and are sometimes of benefit. Carlsbad salts and citrate of lithia and potash are useful in aperient doses from time to time. During the attack the fumes of burning powder containing stramonium, nitre and tobacco unquestionably relieve the majority of cases. The drug which most quickly relieves is morphia subcutaneously, $\frac{1}{10}$ of a grain being the usual dose for a child of 7 to 10 years of age. Chloral is useful, but acts more slowly. Heroin has been used with some success in doses of $\frac{1}{20}$ to $\frac{1}{30}$ of a grain and repeated.

Nasal adenoids and hypertrophied tonsils should be removed, as they aggravate the attacks by obstructing the air passages, and they are moreover a source of discomfort to the patient. We doubt very much if spasmodic asthma is ever cured by their removal, but the general health and comfort of the child is improved.

Diseases of the Bronchial Glands

The tracheo-bronchial glands are situated in the middle mediastinum in close relationship with the trachea and bronchi ; they are some ten to twelve in number, and are arranged in three groups ; one set surrounds the trachea, another group is situated at the bifurcation, and a third around the right and left bronchi. The pulmonary glands are situated at the root of the lung and accompany the bronchi into the substance of the lung. These glands receive the lymphatics of the lungs and bronchi, and like other lymphatic glands readily become inflamed and swollen during attacks of bronchitis and

broncho-pneumonia, especially after measles and whooping cough, and are apt to remain chronically enlarged, and further to become **caseous** and to **suppurate.** During this inflammatory process more or less thickening and matting often takes place in surrounding parts, so that the glands may become adherent to the trachea or bronchi or œsophagus. The glands and connective tissue in the anterior and posterior mediastinum may also become affected, so that the antero-internal edges of the lungs and the whole contents of the mediastinum may become thickened and matted together.

Caseation of the mediastinal glands is exceedingly common in children, and they may be found in this condition in the bodies of children dying of various diseases, but they are almost universally caseous in those dying of pulmonary tuberculosis or chronic catarrhal pneumonia. In many cases of acute or chronic tuberculosis it is clear that the disease in the glands is older than the tubercle in the lungs, and has spread from the former to the latter. In such cases the glands have become enlarged secondarily to some bronchitis or pneumonia, have undergone caseation, and the lungs have been infected in consequence of caseating bronchial or pulmonary glands, the tuberculous disease spreading into the lungs from the root. (See TUBERCULOSIS, p. 245.)

Symptoms.—In the large majority of cases there are no distinctive symptoms of caseating mediastinal glands, which *per se* are not more likely to give rise to symptoms than caseating glands in the neck; but, inasmuch as they are so frequently associated with early or chronic tuberculosis of the lungs, the subjects of them are hardly likely to present the appearances of health. Not infrequently, however, they are found unexpectedly in the bodies of children dying of other diseases. With regard to physical signs, it must be clear from a consideration of the anatomy of the mediastinum that the glands lie too deeply to be detected by percussion unless they are enormously enlarged; this may take place in sarcomatous enlargement, but rarely in tuberculosis. It has been asserted that when enlarged they can be detected by a diminished resonance in the interscapular region, corresponding to the first three dorsal vertebræ; but, inasmuch as the thick posterior edges of the lungs, besides the aorta, œsophagus, and a mass of muscle, intervene between the glands and the surface, it is certain that the enlargement must be very considerable to modify the percussion note in this position. Enlarged glands are more likely to modify the resonance behind the upper part of the sternum and adjacent cartilages, but in infants and young children the anterior mediastinum is occupied by the thymus, which would mask any enlargement of the lymphatic glands; and in older children, where the thymus is small, lymphatic glands must be very much enlarged to come to the surface and give rise to any dulness, covered as they are by the anterior edges of the lungs. Error may easily arise from a dulness due to a past pleurisy and consequent adhesion along the anterior edges of the lungs. If the results of percussion are uncertain, those derived from auscultation are necessarily more so, except in considerable enlargement of glands. Of the pressure signs, the most reliable is weak breathing in one of the lungs in consequence of pressure on the right or left bronchus; this symptom is of undoubted value, but as there is usually some tuberculous lesion in the lungs, it may very easily be masked. Attacks of

paroxysmal dyspnœa, and cough with stridulous breathing, may also be present on account of the nerves being involved. Swelling of the face and distension of the jugulars have also been described, but these are far more frequently due to constant coughing than to any pressure on the large veins in the chest. A caseous gland not infrequently becomes adherent to the trachea or one of the bronchi, and ulcerates into it, and caseous matter may be coughed up ; in a few instances it has happened that this takes place suddenly and death results from plugging of the windpipe. In other instances the glands may form an abscess which points in one of the intercostal spaces close to the sternum, as in a case under the care of Dr.

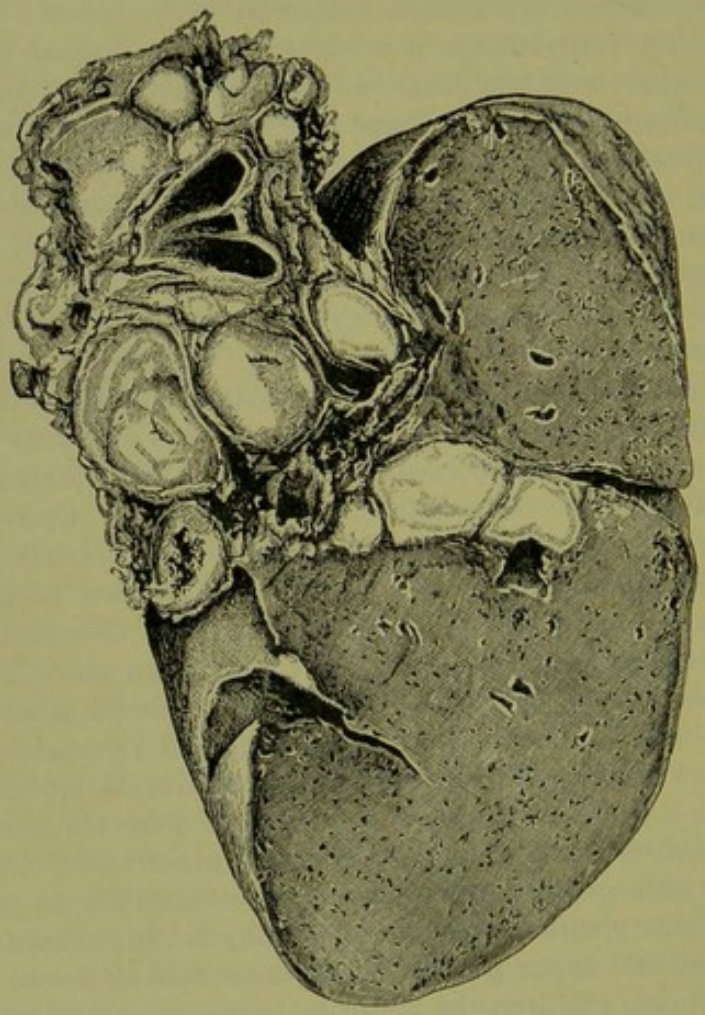

Fig. 82.—Section through a large mass of cheesy glands at the bifurcation of the trachea and extending along the bronchi into the lung. Two of the glands are beginning to show signs of softening at their centres. (After W. P. Northrup, M.D.)

Eustace Smith, or may open into the œsophagus. In one of our own cases a **mediastinal abscess** pointed near the left edge of the sternum, low down.

The pulmonary glands which accompany the small bronchial glands into the lungs may become caseous, soften, and form cavities, more especially in the lower lobes. It must be acknowledged that caseous glands can rarely be diagnosed during life with anything like certainty, partly on account of

their lying deeply, and partly from the fact that they are so commonly associated with chronic lung disease. They rarely attain any large size, and consequently do not modify the percussion note or press on the veins, bronchi, or nerves.

When, however, the mediastinal glands become the seat of a new growth, such as **lymphadenoma**, the case is different ; they may become enormously enlarged, surrounding the veins and bronchi, giving rise to marked dulness over the sternum and adjoining rib cartilages, and pressure signs from involvement of the vessels. Attacks of paroxysmal breathing are common on account of pressure on the recurrent laryngeal and other nerves. The course of the disease usually extends over a few months only, the patient getting progressively worse. Among the early symptoms will usually be those of disturbed innervation. There are attacks of paroxysmal cough, with a metallic ring and stridulous breathing and orthopnœa, so that the child has to be propped up to get its breath ; in the later stages the distress is often very great. The voice is altered, perhaps reduced to a whisper. The return of blood to the chest may be interfered with on account of the superior vena cava being compressed, giving rise to a distension of the jugular or axillary veins and swelling of the face or arms. Fluid may be present in one or both pleural cavities from pressure on the azygos veins. If the tumour is of any size, there will be dulness over the sternum or in the adjoining region, particularly to the left edge of the sternum in the upper intercostal spaces. Intense bronchial breathing may be heard here. Moreover, the lung may be pushed to the left by the encroachment of the tumour, which may bulge forward the sternum and ribs.

Chronic Tuberculosis of the Lungs

Infancy and Early Childhood.—No age is free from liability to be affected with tubercle ; thus Demme has found tuberculous disease of the intestine in an infant of twenty-nine days.

Tuberculous disease is not common in infants of a few months old ; at this period gastro-intestinal atrophy is exceedingly common, and is liable to be mistaken for tuberculous disease on account of the wasting which takes place. Tuberculosis in young children rarely begins as does the phthisis of adults by a growth of tubercle and a condensation at the apices of the lungs, and a gradual extension downwards taking place, but is apt to be far more widespread in its distribution both in the lungs and in the body. It is therefore far more difficult to diagnose by means of physical signs, which are less distinctive than are those of adults. It is needless to say that the same general appearances are found in the bodies of children as in adults dying of tuberculosis—grey tubercle, caseous masses, iron-grey infiltration and fibroid tissue in excessive quantity, and irregular cavities. The distribution, however, usually differs, one of the chief differences being that in adults the tuberculous processes appear to have a special affinity for the apices ; in early childhood there is no such predilection, the hilus of the lung or base being frequently affected before the apex. The bronchial glands are almost constantly found caseous, with also the small pulmonary glands which accompany the bronchi, the latter suppurating and forming small cavities near the root of

the lungs. In this way a tuberculosis may spread into the lungs from the hilus. Not infrequently one or both bases are semi-solid from caseating pneumonia with ragged cavities, at other times a similar state of things is found at the apex. In other cases both lungs are stuffed with clusters of grey or yellow tubercles surrounding the terminal bronchi. There may be tubercle on the surface of the pleura, with more or less pleurisy or small local empyemas. The abdominal organs are exceedingly apt to be affected: cheesy masses are frequently found in the liver, spleen and kidneys; cheesy mesenteric glands and ulceration of the intestines are very common in cases of general tuberculosis. Tubercles are not infrequently found on the peritoneum and other serous membranes, as the pleura and meninges of the brain. Tuberculous disease of bone may be associated with a general distribution of tubercle throughout the body. (See TUBERCULOSIS, p. 245.)

Symptoms.—If the diagnosis of phthisis in the early stages is difficult in adults, when it is possible to auscultate and percuss the apices of the lungs carefully, to examine the sputa for bacilli, and cross-question the patient concerning the symptoms presented, it is necessarily much more difficult in the infant or young child, where the symptoms are rarely definite and where the lesions are so widely spread throughout the body. The younger the subject the more likely are the symptoms to be wanting in distinctiveness and the diagnosis to be consequently difficult, frequently wasting and a family history of tuberculosis being nearly all there is to go by. The temperature is usually hectic, normal, or perhaps subnormal in the morning, and reaching 102° or 103° in the evening, though this may be reversed. There may be diarrhœa without apparent cause, and various dyspeptic troubles; cough, though this may be absent; perhaps enlargement of some external glands. An examination of the lungs may reveal very little: perhaps some want of resonance over the base or apex or in the interscapular region or axilla, with some ringing consonant râles or crepitation. There is progressive wasting, which in a child of over a year or eighteen months is more suspicious than in an infant a few months old, where wasting is more often due to chronic intestinal catarrh than to tuberculosis. In those cases where wasting and hectic follow measles, whooping cough, bronchitis, or bronchopneumonia, there is a strong suspicion of tuberculosis, even though there may have been a period of comparative health intervening between the acute attack and the hectic supervening; a family history of phthisis would make the case look still more threatening. In the later stages the symptoms become more decisive. The hectic continues, the wasting is progressive, the cough is troublesome, the diarrhœa perhaps is still present, parasitic stomatitis makes its appearance, the feet, hands, and face become œdematous, and the child is anæmic and very weak. Examination of the chest will now show some marked dulness or loss of resonance over some portion of lung, apex or base, with bronchial breathing and sharp consonating râles; often one is surprised to find how little can be detected in the chest, even when it is evident that the child is far advanced in tuberculous disease. The typical signs of a cavity can rarely be elicited, inasmuch as the cavities in the lungs of infants and young children are not often larger than marbles or walnuts; most frequently they have irregular and ragged walls. A cracked-pot sound may sometimes be elicited in front,

but on account of the yielding nature of the chest walls in an infant it is of no diagnostic value as regards a cavity.

Diagnosis.—Whenever wasting occurs as a prominent symptom during infancy and childhood, tuberculosis is certain to be thought of; wasting occurs in all dyspeptic diseases during infancy, and it may simulate the wasting of tuberculosis when it occurs in connection with empyema or broncho-pneumonia in young children. An empyema may readily be mistaken for tuberculosis of the lung if a careful examination of the lungs is not made, aided if necessary by an exploratory puncture, as there is wasting, hectic, and cough. The difficulty in deciding may be great without exploration if the empyema is localised or there is more than one. A chronic effusion in the pericardium may be mistaken for tuberculous disease. It is often difficult in cases of chronic broncho-pneumonia, the chronic condition following an acute attack, to decide if a tuberculous process is going on. There may be wasting and hectic, and yet after some weeks the temperature will gradually fall, the lung clear up, and the child perfectly recover. In most cases only the progress of the case will decide the question.

Older Children.—After the age of six years—in other words, after the commencement of the second dentition—chronic tuberculosis much more frequently resembles the chronic phthisis of adults than it does before this era. As the child gets older the resemblance becomes still more close. Children before this age rarely suffer from chronic tuberculosis of the adult type. The early symptoms are those of cough, loss of appetite, diarrhœa, wasting, night sweats, and hectic; progressive weakness; the symptom which we miss for the most part is hæmoptysis, which, though sometimes present, is much more frequently absent in children than in adults, and less blood is expectorated. An examination of the chest may perhaps disclose some loss of resonance at one apex (usually the right), with perhaps some rhonchus or moist sounds, or there may be no loss of resonance, only the signs of a chronic or subacute bronchial catarrh localised in the apex of a lung; or there may be impaired resonance only, due to the presence of a thickened pleura and adherent lung. In this stage children perhaps more often than adults improve under treatment and a careful hygiene, and may be restored to perfect health; there is abundant evidence to demonstrate this. If the disease progresses the hectic and wasting continue, the child becomes pallid and weak, the diarrhœa frequent and troublesome, especially following meals; the physical signs show an extended area of lung involved, the tuberculous infiltration travelling from the apex towards the base, and giving rise to caseous degeneration, fibroid changes, and cavitation. The progress of such cases is apt to be more rapid than it is in adults, a fatal result occurring in four to six months. In the last stages the emaciation is extreme, the feet œdematous, bed sores are apt to form, and while the patient may linger for a while if no intercurrent affection brings the end quickly, it must be borne in mind that such cases are exceedingly apt to be brought to a conclusion by tuberculous meningitis in any stage early or late. The abdominal organs are also apt to join in a more extensive spreading of tubercle than is the case later in life; mesenteric disease, extensive ulceration of bowels, peritonitis subacute or acute, are apt to be present, and necessarily influence the course of the disease. Hæmoptysis, which may be fatal almost immediately,

occasionally occurs ; in other cases blood may be expectorated in considerable quantities.

Sometimes an **acute phthisis** takes place without miliary tuberculosis being present ; the tuberculous process taking the form of clusters of grey tubercle surrounding the bronchi, the process beginning at the apex and travelling towards the base, the symptoms being those of a rapid phthisis, perhaps extending over a month or two.

On the other hand, a **fibroid phthisis** essentially chronic in its course may take place, appearing at times to be stationary, or the patient undergoes considerable improvement. In these cases there is much fibroid change and iron-grey induration of lung with retraction of chest. The physical signs develop slowly, there is dulness of an apex, which gradually becomes almost absolute, intense bronchial breathing, consonant râles and gradual retraction of the affected side. The child may fatten and appear to flourish, and present a normal temperature, but it is easily exhausted, suffers from dyspnœa on exertion, its face and lips are turgid, and the fingers become clubbed. In a few cases there is hæmoptysis, but this is the exception. It is possible that the process may become arrested, the lung being converted into fibroid tissue. In the majority of cases the disease is progressive, and the opposite apex becomes affected. The whole course may extend over several years unless bronchitis or some other intercurrent disease supervenes.

The principal clinical differences between chronic phthisis in older children and adults may be summed up as follows :

1. Frequency with which children in the first stage recover.
2. Frequency with which the disease is brought to an abrupt termination by some acute affection, as tuberculous meningitis, pleurisy, peritonitis, or acute miliary tuberculosis.
3. Comparative rarity of hæmoptysis in the early stages and of laryngitis in the latter stages.
4. Frequency of complication with abdominal tuberculosis.
5. Comparative rarity as compared with that of adults of extensive cavities in the lungs.
6. Rarity with which the larynx is affected with tuberculosis.

The *post-mortem appearances* are mostly similar to those found under similar circumstances in adults. Irregular ragged cavities, varying in size from a hazel nut to a walnut, most numerous in the upper lobes, with cheesy masses and fibroid indurations ; the same condition in the lower lobes in an earlier stage, with more or less crepitant lung. As a rule there is not much grey tubercle, but caseous masses, sometimes associated with peribronchial grey or yellow tubercles. There are not often cavities of large size, but these occur at times ; in one case, in a boy of 8 years, who had suffered for six months, there was a cavity in the upper two-thirds of the left lung as large as an adult's clenched fist. Pleurisy and small collections of pus are not uncommon. The bronchial glands are almost invariably enlarged and caseous.

Instead of the above, especially in the more acute cases, the lungs may be everywhere infiltrated with clusters of peribronchial tubercles, which crowd the upper lobes, where ragged irregular cavitation is commencing, while they are more sparely scattered through the lower lobes.

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In fibroid phthisis an extensive portion of one or both lungs is cicatrised and solid, bands of fibrous tissue run across, there is much grey infiltration, dilated bronchi, caseous glands, and perhaps small ragged cavities. Other portions of lung are hypertrophic or emphysematous, perhaps containing scattered clusters of peribronchial tubercles.

Cheesy tubercles are met with constantly in other organs than the lung, especially in the liver, spleen, and kidneys ; caseous mesenteric glands and ulceration of the intestines may also be associated with lung mischief.

Treatment.—The treatment of enlarged and caseous glands is necessarily the same in large measure as that of early tuberculosis. If a child, say one from three to six years of age, suffers from a hacking paroxysmal cough, is slightly feverish at night, remains in a condition of ill-defined malaise, especially if he has recently suffered from bronchitis, whooping cough, or measles, the suspicion will be raised that there is either caseation of the bronchial glands or an early tuberculosis of the lungs. There can be no certainty about the diagnosis, but if the family history points to tuberculosis there is only too much reason for anxiety. The indications for treatment which suggest themselves are to place the child under conditions in which there will be the least possible irritation of the lungs and bronchial tubes, and to supply him with nourishment in suitable quantities and in the most digestible forms. It is needless to say that these indications are fulfilled with difficulty or only partially. Residence in the smoke and dirt of large towns, or on damp clay subsoils, is alike bad, and if possible the child should be removed to some breezy moorland site or bracing seaside place. Fresh air when it can be taken without risk of cold is of the greatest possible advantage in bracing up the digestive organs. In winter, if it be impossible to seek a warmer climate, thoroughly warm and well-ventilated apartments free from draughts must be secured. A well-warmed but not 'stuffy' house is a great advantage, as the child may in such a case have the 'run' of the whole house without being exposed to cold passages and open windows. A nourishing, easily assimilated diet should be prescribed, a variety being introduced in order to tempt the capricious appetite often present. A cup of beef tea the last thing at night will often ease the cough and soothe the child to sleep.

Of special medicinal treatment, cod-liver oil, malt extract, mineral acids with cinchonine and the hypophosphites may be prescribed with advantage. Creasote or guaiacol is often prescribed. Counter-irritants are useful ; they are hardly likely to have much effect on glands which are actually caseating, but they undoubtedly favourably influence chronic catarrhs of the bronchial mucous membranes. Among the milder ones, the lin. pot. iodid. c. sapone may be rubbed into the chest every evening, a piece of 'swansdown' or layer of cotton wool being applied. A stronger application may be made by diluting lin. iodi with glycerine and water (F. 27), and applying it to the sternum or the subclavicular region every night and covering it over with a layer of cotton wool. Care must be taken not to render the skin sore by applying it too frequently on the same spot.

The more urgent symptoms present when the nerves are involved by a mediastinal tumour—and these are often very distressing—may be relieved in many cases by warm applications, such as fomentations, and small doses of

nepenthe or morphia. Relief will probably be obtained from opiates combined with ether or chloroform if the dyspnœa is due to spasm. Inhalations of chloroform, ether, or nitrate of amyl usually relieve. Small doses of morphia given subcutaneously may be tried.

Much that has been said applies to the early stages of all forms of chronic tuberculosis of the lungs. It is of the greatest possible importance to recognise the disease in its early stages, when there is a fair probability that it may be arrested or undergo a natural cure if the conditions are favourable. To this end an equable temperature, a pure bracing air, protection from cold and damp and rapid temperature changes are of the greatest importance. The

Fig. 83.—Actinomycosis of Lung, penetrating the chest wall.

presence of tubercle in the lungs naturally predisposes to catarrhs and local pneumonias, and exposure to unfavourable conditions likely to favour their development is certain greatly to aggravate the disease. Great care must also be taken in the food which the child takes and in treating any departure from a healthy condition of the child's digestive system. A condition of catarrh of the bowels is very often present in tuberculous diseases apart from any local lesion, and it is an important factor in producing the wasting which accompanies tuberculosis.

Actinomycosis of Lung

The only case we have met with was in a girl aged 7 years, who was sent to us by Dr. Kinghorn. There was a soft swelling on the left chest posteriorly, more or less fixed, cough, and bronchial breathing was heard in the neighbourhood of the swelling. The swelling was opened under chloroform and some thick pus escaped. It was difficult to drain and the pus found its way out at various openings, and much granulation tissue formed (see fig. 83). Dr. Walker Hall found the ray fungus in the pus and scrapings from the granulations. Various secondary abscesses formed with a chronic septic condition. After several months of hectic fever, during which time the wasting became extreme, she died of exhaustion. Symptoms had been present for nearly a year. It was ascertained she was fond of eating raw oatmeal, and had the previous summer eaten a good deal of corn plucked from the fields.

Post-mortem.—Left lung, lower lobe consolidated, and slate-coloured, infiltrated with purulent cavities, very friable and firmly adherent to the diaphragm and also to the chest wall. The pus-containing cavities in the lung had penetrated the chest walls (see fig. 83) and also the diaphragm, giving rise to a localised collection of greenish shreddy pus in the left hypochondrium. The spleen was involved in the peritoneal abscess and contained various small abscesses; weight 7½ oz. The heart, liver, right lung and kidneys were normal. (Notes by H. H. Rayner.)

CHAPTER XVIII

DISEASES OF THE CIRCULATORY SYSTEM

Diseases of the Heart

Physical Examination.—An examination of the heart includes an endeavour to determine its position, size, and the character of the cardiac sounds. It is needless to say that the younger the child, the more difficult it is to make a satisfactory examination. The first point to determine is the position of the apex beat, and as this gives us important information for making a diagnosis, it should never be neglected. If not visible its position may usually be felt by laying the extended hand on the cardiac area, and note must be made as to whether it occupies a larger space than normal, and whether it is accompanied by a thrill. The usual position of the cardiac impulse in adults is in the fifth interspace and well within the left nipple line. Symington has shown, by a number of frozen sections of the thorax at different ages, that during childhood the apex beat is apt to take a more external position as regards the nipple than in later years, a result due to the greater relative narrowness of the child's chest in the transverse diameter. As a matter of fact, it is usually well within the nipple line in most children according to our observations, but we must not hastily come to the conclusion that because we may find in a given case it is actually in a line with the nipple that disease is present. If external in position to the nipple we should always be suspicious that there is an abnormal displacement of the heart to the left, or there is some dilatation of the left ventricle.[1] If the impulse is raised it would suggest that it was displaced upwards by a distended stomach or other abdominal enlargement, or there is chronic lung disease of the left apex, or possibly pericardial effusion. If the impulse is displaced to the right there is in all probability fluid in the left pleura. Epigastric pulsation in a case of chronic heart disease generally means dilatation of the right ventricle. A heaving impulse lower than normal, the chest wall being lifted during systole, suggests hypertrophy of the left ventricle ; a diffused weak impulse implies dilatation.

In mapping out the size and position of the heart by means of percussion we necessarily take the 'deep dulness' as our guide, but as the cardiac dulness shades away laterally into the pulmonary resonance, great care must be taken in the determination. Let us bear in mind that the shape and elasticity of the chest walls may modify the percussion note, and this is

[1] Steffen comes to the conclusion that in most children the cardiac impulse is *in* the nipple line, and in some instances 1 cm. external, without indicating disease.

especially true in percussing over the lower half of the sternum. Some writers have laid down rules as to the limits of the cardiac dulness in children of various ages. We doubt very much the correctness of some of the statements which have been made, and we should recommend the student to bear in mind only the limits which he has been accustomed to observe in the wards of an adult hospital, not forgetting that a slight extension of dulness to the left does not necessarily mean a pathological condition. The upper limit of the heart is the upper edge of the third left costal cartilage ; dulness extending higher than this suggests fluid in the pericardium, an enlarged heart, or a lesion at the left apex of the lung. The left border of the heart should lie within a curved line drawn from the junction of the third left costal cartilage with the sternum, extending downwards and to the left to the fifth space just within the nipple line. The right border corresponding to the right auricle should lie within a line drawn from the above point curving downwards and outwards along the right edge of the sternum. Inferiorly the cardiac dulness cannot be distinguished from the hepatic dulness. In chronic disease the chest wall is frequently bulged over the cardiac area, while the dull area is extended both to the left and right, and may even measure as much as 6 inches across from side to side. We will defer reference to the cardiac sounds till later.

Congenital Heart Disease

The different forms of malformed hearts are exceedingly numerous and defy any attempt at classification, but as many of these, though of great interest to the anatomist as illustrating the various stages of development, are of little practical importance to the clinician, no detailed description is needed here. The principal causes at work in producing these malformations may be classified as follows : (1) Persistence of fœtal openings, more particularly the foramen ovale, in consequence of the lungs remaining in part in the fœtal state after birth ; there is obstruction through the lungs and overfilling of the right heart. (2) Endocarditis, occurring during fœtal life, affecting the pulmonary, the tricuspid, and less often the aortic or mitral valves, producing stenosis at the valvular orifice, and as a secondary effect the persistence of the foramen ovale, or ductus arteriosus ; or the septum ventriculorum may remain incomplete. (3) An arrest of development at some period of fœtal life or the results of a false step, as it were, as when a transposition of the aorta and pulmonary artery occurs. Congenital heart disease is in some cases associated with other developmental defects. It is not uncommon in Mongolian and other imbeciles.

Congenital heart disease not infrequently occurs in several members of the same family ; in one case coming under our notice, where there were four children, two sisters and two brothers were thus affected.

Symptoms.—Cyanosis and the presence of a bruit are the only reliable signs of congenital heart disease. Cyanosis is mostly, but not universally, present, and it varies considerably in intensity. It is most marked, and is sometimes only present, when the infant cries, the face being dusky, the lips and tongue and extremities becoming of a bluish tinge. We must, however, bear in mind that some cyanosis may be present in prematurely born infants

when the lungs are but partially inflated, and remain in the fœtal state, and often atrophic and feeble infants have blue and cold hands and feet. If, however, the cyanosis persists for many weeks, it is probably due to malformation of the heart. In a certain proportion of cases murmurs are heard. These are apt to be of a rough, rasping, superficial character, and the rhythm is often exceedingly difficult to determine, on account of the rapid action of the infant's heart.

The differential diagnosis is very frequently impossible, and only a sort of guess can be made. The position of greatest intensity should be determined ; but this is not always easy, as many of the murmurs are so loud that they are heard all over the chest. Note should be taken as to whether the bruit replaces or is only heard through, as it were, the heart sounds. A thorough examination cannot, perhaps, be made at first, as it is unwise to expose a weakly infant too much, and, moreover, the possibility of a pericardial friction sound in newly-born infants must not be forgotten. Any external congenital malformation would suggest that the heart defect was the result of some arrest of development or some abnormal development rather than due to endocarditis.

Children with congenital heart disease readily succumb to zymotic disease, as measles and whooping cough, or to attacks of diarrhœa or bronchitis. With a failing heart there may be orthopnœa, cardiac angina, and dropsy. In some cases we have seen, angina has been a marked feature, and only relieved by injection of morphia.

The *prognosis* is, of course, bad, but much uncertainty must necessarily exist, as the diagnosis of the exact form of lesion present often cannot be made. The more cyanosis present the worse is the prognosis, as, in infants at least, there is a great liability to meningeal hæmorrhage taking place, either slowly or during a fit of crying, vomiting, or coughing. Convulsions may at any time supervene and quickly prove fatal. The venous state of the blood interferes with the secretion of the digestive juices, and the whole system is worked at a disadvantage. In older children the amount of hypertrophy and dilatation must be taken into account in making a prognosis ; the greater it is, the nearer is the heart to the end of its tether. The extent to which clubbing of the fingers is present must also be considered. While it is always well to give a cautious prognosis especially in cases accompanied by cyanosis, yet it not unfrequently happens that bruits disappear in the course of months or years, and the bad prognosis is not justified by subsequent events. A certain number of rather unpromising cases manage to struggle through infancy and childhood to early adult life.

Patent Foramen Ovale.—The foramen ovale allows of the passage of blood from the right to the left auricle during fœtal life (see fig. 84), but closes up shortly after birth if there is no obstruction to the circulation of blood in the pulmonary system, and consequent increased blood pressure on the right side of the heart. If, on the other hand, the lungs are only partially expanded, remaining in part in the fœtal condition, a portion of the blood which under normal conditions would enter the pulmonary circulation escapes it by passing directly from the right heart to the left through the foramen ovale. Repeated attacks of bronchitis after birth may have a similar effect in preventing the closure of the foramen ovale. The further

history of such cases is uncertain, but there is reason to suppose that, if the child remains free from pulmonary trouble, the foramen ovale may close, or at least allow of but little mixture of the blood of the auricles, and be therefore of but slight detriment to the patient. It is not uncommon to meet

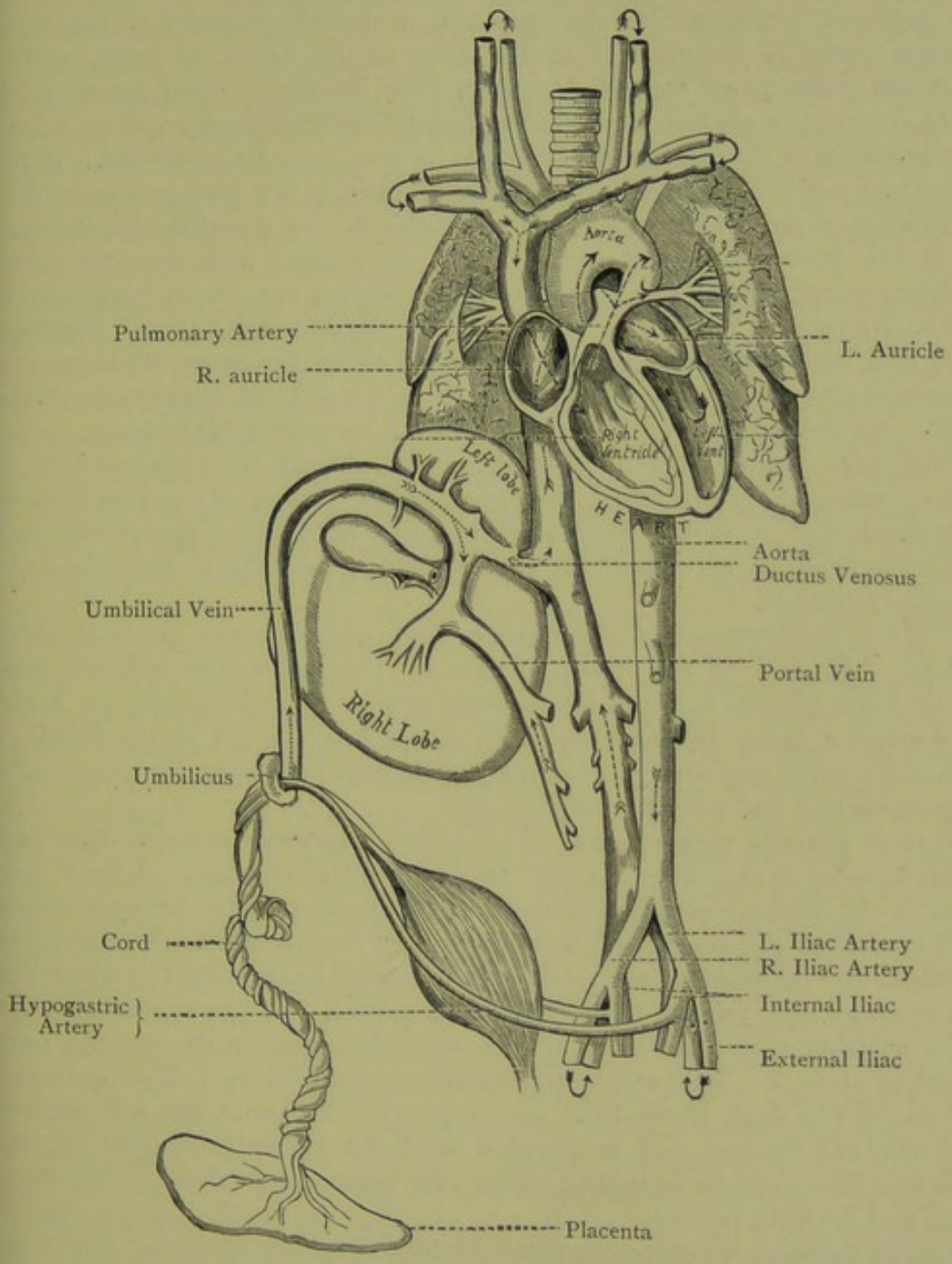

Fig. 84.—Plan of Fœtal Circulation (Gray's 'Anatomy').

with such cases in children a year or two old, who come under medical treatment for bronchitis, and in whom a loud systolic basic bruit is heard, which varies in intensity according to the amount of pulmonary trouble present. In one of our own cases, a child of 13 months, there was much bronchitis, anæmia, and œdema; the child recovered for a while, but died

of diphtheria nine months later. The *post-mortem* showed the foramen ovale to be the size of a shilling, partly closed by membranous bands crossing it; possibly these had produced the bruit heard during life. The pulmonary artery was dilated. An open foramen ovale is usually present in cases where there is stenosis of the pulmonary artery or tricuspid orifice. The murmur produced by the passage of blood through an unclosed foramen ovale is heard best at the base of the heart in front, with a maximum intensity on the left fourth or fifth interspace near the sternum. As the foramen ovale lies immediately behind the pulmonary valves, it may be impossible to decide at which orifice a bruit may be produced. If the bruit alters much in intensity from time to time, it is probably produced at the foramen ovale, and is also heard well behind. In position the foramen lies at the posterior aspect of the heart, on a level with the fifth costal cartilage, where it joins the sternum, being behind the sternum and somewhat to the right. Posteriorly it lies just in front of the seventh vertebra. There may be an open foramen and yet no bruit be heard, as, if there is no pulmonary obstruction, there may be little or no rush of blood through the orifice. As the passage of blood from auricle to auricle takes place during the auricular systole, presumably the bruit should be 'presystolic' in rhythm, immediately preceding the first cardiac sound. It can readily be understood that it is not easy to distinguish between a presystolic and a systolic bruit in an infant or young child, especially if there is some pulmonary trouble.

It is not uncommon to find a more or less open foramen ovale in older children. In one of our cases, a boy of 10½ years who suffered from chronic heart disease and had had several attacks of rheumatism, we found *post mortem* a large dilated heart with a much-thickened pericardium, an abnormally small aorta only admitting a little finger, an open foramen ovale, and a thickened and puckered mitral valve.

Patent Ductus Arteriosus.—The ductus arteriosus remains open (see fig. 84) in most of the cases of pulmonary and mitral stenosis. A bruit produced by the passage of blood through the open duct would be most likely heard loudest in the second left interspace near the sternum. According to T. Fisher, an 'undulating but continuous murmur,' heard over the second or third interspace, is present when the duct is patent. In some cases a patent ductus arteriosus and a more or less open foramen ovale are the only anomalies present. This was so in two cases reported by J. Thomson and Drummond; in both these loud murmurs were heard in the left second space near the sternum and propagated over the whole precordial region. There was no cyanosis in either case. In some cases there is an open ductus and no bruit heard.

Patent Septum Ventriculorum.—Unlike the inter-auricular partition, the septum between the ventricles becomes complete during fœtal life, usually during the third month. If, however, there is any obstruction at the pulmonary orifice, or any malformation which renders unequal the pressure of blood in the two ventricles, the ventricular septum remains incomplete and allows of the passage of blood from one ventricle to the other. The spot which remains open, or is the last to close up, is the so-called 'undefended spot' at the base, where the septum intervenes between the mitral

and tricuspid valves, and is normally the thinnest and most membranous. An incomplete septum is usually associated with pulmonary obstruction, or is found in cases where the aorta arises from both ventricles, or where there is transposition of the great vessels. In some few cases it appears to be a primary defect arising from arrest of development or some unknown cause. In such cases the child may live several years, the heart becoming enlarged, more particularly on account of the left ventricle undergoing dilatation and hypertrophy in its efforts to maintain sufficient tension in the arteries during the systole, while under the disadvantage of its contents being in part forced into the more feebly acting right ventricle. The murmur produced is loud and rough, replacing the first sound ; it is heard loudest over the lower part of the sternum, but is well conducted to the seat of cardiac impulse. It is also, if loud, heard both in the axilla and posteriorly.[1]

Stenosis of the Pulmonary and Tricuspid Orifices.—If an endocarditis occur during fœtal life, especially during the early period, it is apt to affect the pulmonary and tricuspid valves, the liability of the valves on the left side being greater towards the end of fœtal life, as more and more work is imposed upon the left heart. In some cases a complete stenosis of the pulmonary and tricuspid orifices takes place ; the heart is trilocular. Thus, in the case of an infant markedly cyanotic during life, but who lived for four months, it was found that the pulmonary orifice was completely closed, the tricuspid only admitted a crowquill, and the right ventricle was contracted and diminutive. There was an open foramen ovale, and the pulmonary circulation had been maintained by an open ductus arteriosus, the lungs being thus supplied by the aorta. In other cases, where the stenosis of the pulmonary artery is only partial, the patient may live for years or even reach adult life ; there is usually an open foramen ovale, or ductus arteriosus, or defective interventricular septum ; cyanosis is mostly present, of a more or less high grade ; the child easily gets out of breath, is backward in talking and getting on its feet, and is incapable of any great amount of exertion. The murmur present is usually loud, superficial, and rasping, being best heard in the pulmonary area, over the second left costal cartilage near the sternum. The pulmonary second sound is absent. There may be signs of dilatation of the right ventricle, such as epigastric pulsation.

This is the commonest form of congenital heart disease found in children who have survived infancy and early childhood. Such children may live to grow up, but are apt to suffer from tuberculosis or to be carried off by bronchitis or pneumonia. Post-natal endocarditis is sometimes superadded. The diagnosis is not easy between pulmonary stenosis, open foramen ovale, and patent ductus arteriosus, without other lesion, especially as the bruit heard may result from the presence of both lesions. In pulmonary stenosis there is more likely to be cyanosis and a dilated right ventricle, with the murmur confined to, and heard loudest in the pulmonary area. Cadet de Gassicourt has reported a case where a bruit was produced through enlarged glands pressing on the pulmonary artery.

Stenosis of the Aorta or Mitral Valve.—In some cases there appears to be a congenital smallness of the aorta and arterial system, though it most

[1] See case reported by Hutton in the *Abstracts*, Children's Hospital, Pendlebury, 1883, p. 45; and Keating and Edwards, *Arch. of Pædiatrics*, p. 134, 1887.

commonly is the result of undergrowth, being secondary to some other cardiac lesion, by reason of which the arterial system is imperfectly supplied with blood. An endocarditis occurring late in fœtal life sometimes affects the aortic valves, and an endocarditis may also occur after birth, and deform or pucker the valves. In such cases, if there is marked obstruction at the aortic valves, the ductus arteriosus may remain open, and some of the blood may pass, as it does during fœtal life, from the pulmonary artery into the aorta, without passing through the lungs ; the left ventricle becomes hypertrophied. When the stenosis is only moderate, life may be prolonged for many years. Stenosis of the mitral valves may also occur, but it is less common than aortic stenosis. In one of T. Fisher's cases, that of an infant of 15 months, the cardiac impulse was in the fifth space, just outside the

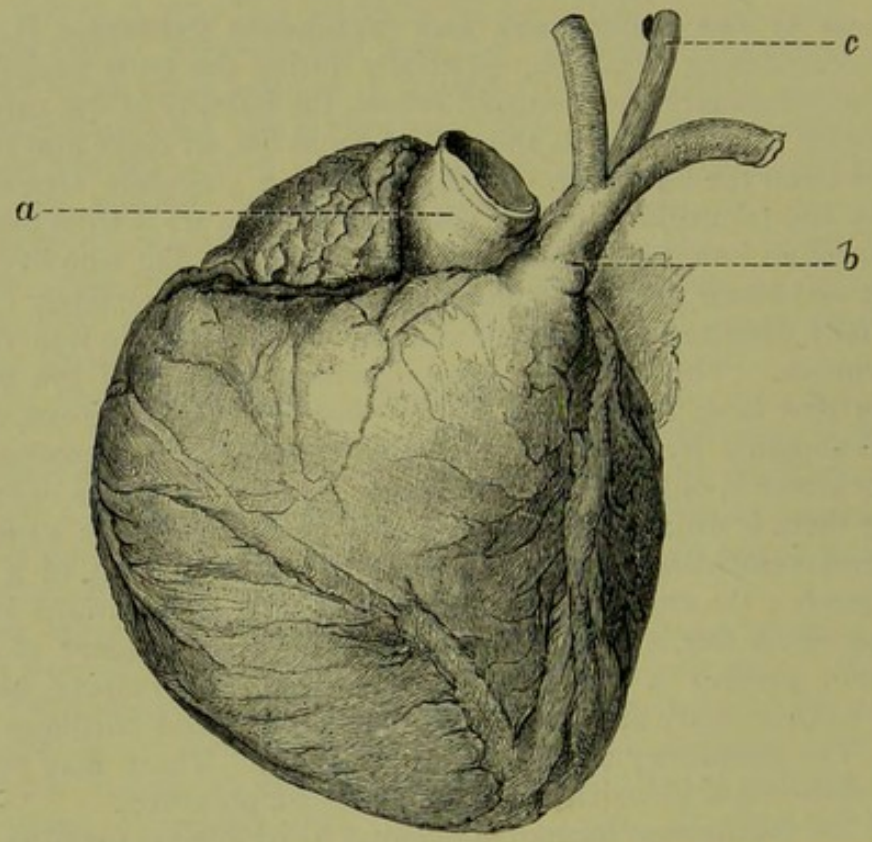

Fig. 85.—Congenital Heart Disease, from a child aged 19 months. Stenosis of the pulmonary artery. *a*, aorta ; *b*, pulmonary artery ; *c*, patent ductus arteriosus.

nipple line, and a high-pitched bruit was heard over the whole cardiac area, but not behind. The child was small and anæmic, but not cyanosed. At the *post-mortem* the heart was found to be much hypertrophied, weighing $4\frac{1}{4}$ oz. ; the mitral orifice was stenosed, being only $\frac{1}{10}$ of an inch in diameter.

Transposition of the Aorta and Pulmonary Artery.—This curious malformation is not uncommon ; the foramen ovale and ventricular septum remain open. Life is rarely prolonged for more than a few months ; there is much cyanosis, but no bruit is present. A diagnosis during life is hardly possible. Of the many other malformations or arrests of development, such as a heart consisting of single auricle and ventricle, or a three-chambered heart, it is unnecessary to speak.

Modifications of the Blood in Cyanosis.—Recent investigations by Vaquez, Widal, and Variot have demonstrated that the blood in chronic cyanosis shows marked differences from normal blood, the most striking being an increase of the number of blood corpuscles. In a recent case coming under our notice, Dr. Rayner found 8,000,000 red corpuscles per c. mill. ; often there is an excessive hæmoglobin index. The blood discs have been described as larger than normal ; the alkalinity and also the density of the blood is increased.

Diseases of the Pericardium

In a few cases a congenital absence of pericardium or some defect in the pericardium has been recorded. In some cases a hernia or diver-

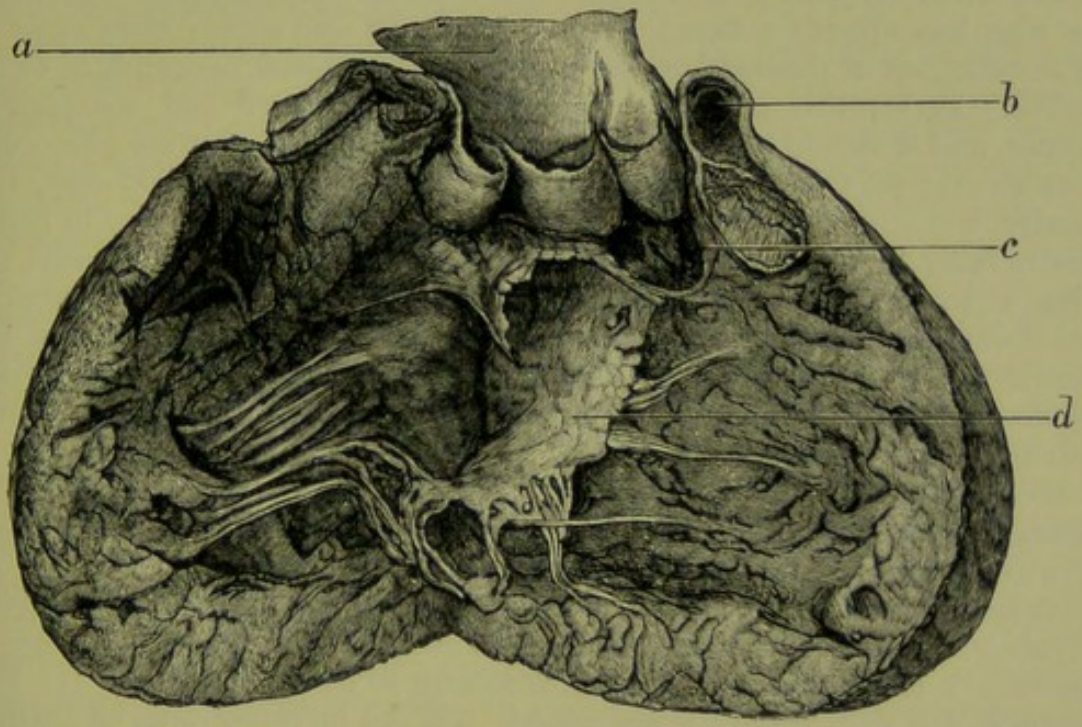

Fig. 86.—Same heart as fig. 85. Right ventricle opened. *a*, aorta arising from both ventricles ; *b*, pulmonary artery, valves adherent, only admits a large probe ; *c*, incomplete interventricular septum ; *d*, tricuspid valves.

ticulum has been present ; these congenital defects are of little practical interest.

Pericarditis

Etiology.—In children, as in adults, the most important association of pericarditis is with rheumatism, acute or subacute, as it arises more often during a rheumatic attack than under any other condition. An exception to this, however, occurs, for in children under three years of age rheumatism is an uncommon ailment, and pericarditis when present is most frequently the result of an extension of the inflammation from pleuro-pneumonia or empyema or arises in association with such attacks. It is by no means uncommon to hear a pericardial friction sound during an attack of pneumonia in young children, or perhaps to discover *post mortem* that a pericarditis has taken place in a case which was looked upon during life as one of simple broncho- or pleuro-pneumonia. In such cases, if they recover, a chronic

pericardial effusion, sometimes purulent, may remain after the pulmonary lesion has been recovered from.

Pericarditis occasionally occurs during an attack of scarlet fever, either associated with synovitis, or it may be in the absence of any joint complications. It occurs also during the course of post-scarlatinal nephritis, as a result of a uræmic condition, and under such circumstances must be looked upon as of extremely evil augury. It may occur during septicæmia, to whatever cause this may be attributed, or in periostitis and ostitis, and we have known it supervene in an attack of influenza.

Pericarditis occurring in a child over 3 years of age is most frequently associated with the rheumatic state. Not that it only occurs during an attack of acute rheumatism, for it may supervene when there is no joint pain whatever, or when the joint pain is slight ; but it occurs in a rheumatic individual, one who has already suffered from an attack, or who suffers from some of the associations of rheumatism, such as chorea, erythema nodosum, or endocarditis. Pericarditis is apt to crop up in an unexpected and unexplained manner, and it should be carefully looked for whenever indefinite precordial or epigastric pain is complained of. It must be borne in mind that, like pleurisy, it occurs in an extremely mild form ; a pericardial rub may be heard unexpectedly in the absence of any definite symptoms in children who are going about and make no complaint of pain or dyspnœa. These attacks pass away, and presumably leave more or less of adhesions between the visceral and parietal layers of the pericardium. Does pericarditis recur? No doubt it does, in spite of fibroid adhesions and damage to the serous layer by former attacks.

Cases of pericarditis occurring during fœtal life have been recorded by Billard, Bednar, and others. It also occurs in the septicæmia of the newly born, secondary to an inflammatory condition of the cord.

Symptoms.—The subjective symptoms are usually ill defined, especially in young children, and are of comparatively little importance as helps to diagnosis. The signs and symptoms mostly to be relied on are : (1) The presence of a pericardial friction sound. (2) An increased area of cardiac dulness proportionate to the effusion present. (3) The disappearance of the apex beat, or the position of the apex beat is raised and its area extended. (4) There is heart pain and perhaps tenderness on pressure over the cardiac region. A pericardial friction sound can hardly be overlooked if carefully listened for, and is not likely to be mistaken for valvular murmurs, except, perhaps, in the case of infants the subject of congenital heart disease, the murmur in such cases being often harsh and superficial. It must not be forgotten that the presence of a friction sound is not incompatible with a large amount of effusion into the pericardial sac. It mostly, however, disappears as effusion takes place, and reappears as the liquid becomes absorbed. As effusion takes place into the sac, the area of cardiac dulness is necessarily increased in proportion to the amount of fluid present. The pericardium of a healthy child (age 6-9 years) when fully distended contains, according to Sibson, about 6 oz.,[1] but much larger quantities than this are

[1] In enlarged hearts at this age, the pericardium may contain two or three times this amount.

often present: the effect of the distension of the sac with fluid is to increase the cardiac dulness laterally, and in an upward direction, the lungs, especially the left, being pushed on one side, so that the dulness extends to the second left costal cartilage, or even as high as the clavicle, and over a corresponding portion of the sternum. In lesser effusions the fluid tends to accumulate in the lowest part, and so modifies the dulness in a lateral direction. The cardiac impulse disappears and the sounds become faint if the effusion is large, as a layer of fluid is interposed between the heart and the chest walls. Instead of the apex beat disappearing, it may be diffused and raised so as to be palpable or visible in the third and fourth spaces, as pointed out by Sibson. Pericarditis may take place without any complaint of pain on the part of the patient, and hence may be easily overlooked in a mild case. In severe cases the pain is referred to the cardiac region, and pressure with the fingers or stethoscope causes pain.

The discovery of a friction sound is usually the first thing to call attention to the attack. There may be only a slight rub or a loud grating sound heard all over the chest. At this stage, where there is no fluid present, presuming there is no valvular disease or dilatation, there is no, or but little, dyspnœa, probably more or less pain in the chest, quickened pulse, and moderate fever. The amount of fever present is variable, seldom very high—101° F. to 103° F. in a severe case; the temperature usually falls by lysis towards the end of the week. The rub may disappear in a few days in consequence of adhesions being formed. On the other hand, the friction sounds may entirely or in part disappear in consequence of effusion taking place; as the effusion increases dyspnœa becomes more marked: at first it is slight, but if the effusion becomes large the dyspnœa increases, coming on in paroxysms accompanied by cyanosis, and there is perhaps a small, irregular pulse. It must not be forgotten that a considerable effusion may be present and yet a loud friction sound be heard caused by a small portion of the roughened layers of pericardium coming in contact. Death may be sudden at this stage, especially in those cases where pericarditis supervenes on old heart mischief, and the cardiac walls have become degenerated. In other cases the fluid is gradually absorbed, the friction is again heard more or less intensely, and finally disappears as adhesion takes place.

No inflammatory affection differs more in intensity than rheumatic pericarditis. There is little doubt that slight attacks occur which are overlooked, for a pericardial friction sound is heard at times when least expected, and disappears again without producing any symptoms of importance, or without the child having been ill, or it may be discovered during an intercurrent attack of scarlet fever or pneumonia. On the other hand, acute pericarditis, or 'acute carditis,' as Dr. Sturges has called it, is a severe and dangerous affection, especially when it supervenes in patients whose mitral valves have been damaged by attacks of endocarditis, and dilatation of the heart cavities has occurred. The damaged heart has, when surrounded by lymph and fluid, to struggle with an increased load, and no wonder the prominent feature of the attack is cardiac failure. In these severe cases there is a quickened and perhaps irregular and intermittent pulse, orthopnœa, vomiting, with an anxious and worn expression of face. In the worst cases, when the effusion of fluid is great, the patient has an ashen or cyanotic look,

he sits up in bed leaning forward, and bringing all the extra muscles of respiration into play in the struggle for breath. Oedema of the extremities, ascites, and pleural effusion may be present.

In the slighter cases of pericarditis, loose adhesions or attachments may take place between the two layers of the pericardium. The result of a single attack may be unimportant, but if there are repeated attacks, and they are severe, tough and thick adhesions are formed. The heart is thus surrounded by a thick fibrous coat, perhaps one-eighth to a quarter of an inch in thickness, which clogs and impedes the systole of the ventricles. Gradual dilatation of all the cavities takes place, with thinning of their walls. This condition of things is naturally made worse by an endocarditis, which thickens and deforms the mitral and perhaps the tricuspid valves. Thus, as an illustration of these results, we may refer to the following case : A girl of 12 years, who had suffered from chronic heart disease for some years ; at the *post-mortem* the heart with the attached pericardium and containing clot weighed 22 oz., the pericardium was thick and adherent and leathery, all the cavities were dilated, the mitral valve had suffered from old and recent endocarditis, the tricuspid orifice and the pulmonary artery were abnormally wide, the aorta was small, just admitting the little finger, and indeed the aorta and its branches were no larger than those of a child of 3 years. No doubt in this case the aorta had failed to develop normally on account of the small amount of blood which passed through it. In these cases it is possible that the dilatation is really an acute and rapid process occurring during attacks of rheumatism, and not entirely the result of an adherent and thickened pericardium.

There can be little doubt, as both Dr. O. Sturges and more recently Dr. D. B. Lees have pointed out, that what often passes as pericarditis is in reality acute carditis or myocarditis—that is, the changes are not confined to the pericardium, but the muscles of the heart walls may suffer severely from the effects of the rheumatic toxins, and, as a consequence, the muscular walls are weakened and the cardiac cavities become dilated. This dilatation is an active process in acute cases, and is not dependent upon mitral regurgitation, the result of endocarditis. Dr. Lees also points out that acute dilatation may take place during a rheumatic attack without the assistance of pericarditis, though it is much more pronounced if pericarditis is present. A first attack of rheumatism may lead to an acute dilatation of the heart if the attack is a sharp one, and if it does not prove fatal it may leave a much-dilated condition and perhaps adherent pericardium.

An effusion into the pericardium, like an effusion into the pleural cavity, may be chronic. It sometimes happens, as we have already pointed out, especially in young children, that a pericardial and pleural effusion takes place, the latter becomes absorbed, and adhesions form while the pericardium remains distended with fluid. If the child is seen for the first time when this has occurred, an error in diagnosis is very easy, as the dulness caused by a distended pericardium shades away into the impaired resonance given by a compressed and adherent left lung. We have several times seen in young children fluid aspirated from the pericardium by a needle passed into the axilla, when it was believed the fluid was being drawn from the left pleural cavity. In these cases, it was found at the *post-mortem* examination

the needle had passed through the compressed left lung and entered the distended pericardium.

A chronic pericardial effusion is sometimes present in tuberculous subjects, after the manner of a peritoneal effusion: this may be of long standing, and the diagnosis may be difficult, as the effusion may be associated with a mediastinitis and may suggest the presence of mediastinal tumour. It was so in the following case:

Chronic Pericarditis and Peritonitis, Contracted Mitral, General Miliary Tuberculosis.—John Hy. P., aged 7 years. Mother states he has always been a healthy boy till four months ago, when he had bronchitis; has been wasting ever since; his belly has been swelling since. Admitted August 27, 1885. Is an anæmic, flabby boy, with distended abdomen, evidently containing much peritoneal fluid; right side of chest is normal; the left is quite dull in front, reaching to the clavicle above, and shading away in the stomach resonance and axilla, which is also resonant; the whole cardiac area is included in the dull area, the dulness extends to the right just beyond the right sternal line; posteriorly the percussion note is normal; over the dull area there is bronchial breathing both with ex- and inspiration; there are no moist sounds; the cardiac impulse is not visible or palpable; cardiac sounds normal; the veins on the chest are enlarged and tortuous; there is marked ascites; the liver is enlarged; the spleen not felt; urine not albuminous. September 24.—Boy continues much in same state; less ascites; the temperature continues normal or subnormal; he does not appear ill or in any way uncomfortable; the glands in the neck under the jaw are enlarging. November 11.—Went home for a while. Readmitted December 10, 1886. Has been fairly well at home, except he has bad cough and his belly has swollen more; physical signs in chest much the same; there is, however, more dyspnœa; the face has a bluish tinge, and the superficial veins on chest more distended; exploration of chest in dull area with a hypodermic syringe; some straw-coloured coagulable fluid like serum was withdrawn. January 22.—Has been getting worse for some weeks past; temperature has since December 13 been 99°–101°–103°; the physical signs have not materially altered, except there is some impaired resonance now at base of left lung behind. January 24.—Has been vomiting; pulse 96; irregular and intermittent; temperature 98°–102°. January 25.—Continues to vomit; the ascites has much diminished. Died January 27.—*Post-mortem.*—Some emaciation; some bulging over cardiac area; on opening chest it is seen the pericardium is distended, pushing the left lung away to the left out of sight, the edge of the right lung partly overlapping pericardium; there is a complete matting together of the pericardium and mediastinal glands with excess of fibre tissue; the mediastinal glands are enlarged, containing miliary tubercle; some are shrunken and pigmented; the right lung is normal; the left is compressed, surrounded by old adhesions and recent miliary tubercle; on section it is condensed; recent pulmonary apoplexy; the pericardium is adherent to the parts around; on cutting into it its walls are nearly ¼ inch thick, it contains 2 or 3 oz. of serum and much loose granular lymph; heart somewhat small, lymph on the surface; mitral valve only admits forefinger; tricuspid, 2½ fingers; edges of mitral valve hard and sclerotic; left auricle wall thickened; left ventricle cavity small; right ventricle dilated; a few ounces of fluid in peritoneum; omentum indurated, covered with recent miliary tubercles; large and small intestines covered with miliary tubercles; no ulcers internally; liver adherent to the diaphragm and covered with miliary tubercles; section fatty; kidneys, a few cheesy tubercles; spleen normal; brain, lymph in Sylvian fissures, around cerebellum, and in interpeduncular space; fluid in ventricles; tubercle on the vessels.

Chronic pericardial effusions are apt to become purulent, and in rare cases the pus may find its way to the surface after the fashion of an empyema; this happened in one of our own cases, a child of 18 months, the abscess pointing near the tip of the sternum; after the abscess was opened the child died of exhaustion, and the diagnosis was verified *post mortem*. In such cases there is difficulty in deciding as to the origin of the pus, as to whether

the abscess is a collection of pus finding its way out from the mediastinum or from the pericardium. A collection of pus in the pericardium is most likely to be overlooked in an infant or young child, just as a localised empyema is sometimes found for the first time on the *post-mortem* table. There is perhaps during life a somewhat extended area of dulness over the heart encroaching on the left axillary region, which has not attracted much attention during life. The infant wastes and is perhaps thought to be tuberculous ; at the *post-mortem* the pericardium is found full of pus and lymph.

Complications.—In rheumatic pericarditis, endocarditis is exceedingly likely to occur during the attack. Pleurisy or pleuro-pneumonia may be present ; more rarely peritonitis and meningitis.

Diagnosis.—A pericardial friction sound is not likely to be confounded with anything else, unless, perhaps, it is an exo-cardiac sound, such as is produced by the external surface of the pericardium rubbing against a roughened pleura ; but this latter is heard only, or at any rate more loudly, during inspiration. The difficulty most likely to occur is, in a case in which there is admittedly old cardiac mischief, to distinguish between dulness due to the presence of fluid and that due to a dilated heart. To anyone who has carefully watched a case from the commencement of the heart disease this difficulty may be small ; but in cases which are suffering from great dyspnœa and distress, in which pericarditis and dilated ventricles exist together, it is often difficult to decide when the child is seen for the first time what amount of fluid is present and what share it takes in the production of the cardiac distress. It must be borne in mind that if the amount of fluid is excessive, there is dulness as high as the left second intercostal space. In a large dilated heart there will be bulging of the chest walls, and an extended area of pulsation in part outside the left nipple line. It has been pointed out by several writers (Rotch, Dickenson) that dulness extending to the right fifth interspace is probably due to fluid ; this, however, is not by any means always the case, but may be due to dilated right heart.

Endocarditis

Inflammation of the membrane lining the heart, more especially that part which covers the valves, occurs at all periods of life. It may attack the fœtus and then usually affects the pulmonary or tricuspid valves ; but if it occur in the last few weeks of fœtal life it may affect the mitral and aortic valves. It may also occur during the two or three years succeeding birth ; it is, however, less common at this period than later, though it is probably often overlooked. It is common during the later periods of childhood and youth. Like pericarditis, its usual association is with the rheumatic state, not that there is necessarily marked tenderness of the joints and high fever, but the patient exhibits some of the symptoms or associations of rheumatism, such as chorea, or erythema nodosum, or he has suffered from undoubted joint troubles in the past. During an attack of rheumatism, children are especially prone to suffer from endocarditis, and the proportion of those who do suffer is greater than in the case of adults, being in the case of children perhaps 75·80 per cent. ; in adults the proportion must be far less than this.

Endocarditis also occurs in scarlatinal synovitis ; the heart does not, however, so often suffer here as in simple rheumatism. In nephritis, in pyæmia, and during attacks of any of the zymotic fevers, especially diphtheria, endocarditis may occur. In all febrile conditions a difficulty may arise in the diagnosis, in distinguishing murmurs due to organic disease from hæmic murmurs. During fever the circulation is disturbed and the cardiac beats increase in number, the first cardiac sound being wanting in sharpness, or there may be a 'murmurish' sound heard ; if this disappears during convalescence we are hardly justified in saying that an endocarditis has existed. That endocarditis does occur at times during an attack of scarlet fever or during convalescence is certain ; it is, however, rare to find the valves affected in a fatal case of scarlet fever.

Malignant or ulcerative endocarditis arises in some instances in connection with the rheumatic state, being engrafted on to an ordinary rheumatic endocarditis ; it occurs in connection with acute nephritis, suppurative periostitis and osteomyelitis. It appears sometimes to follow scarlet fever.

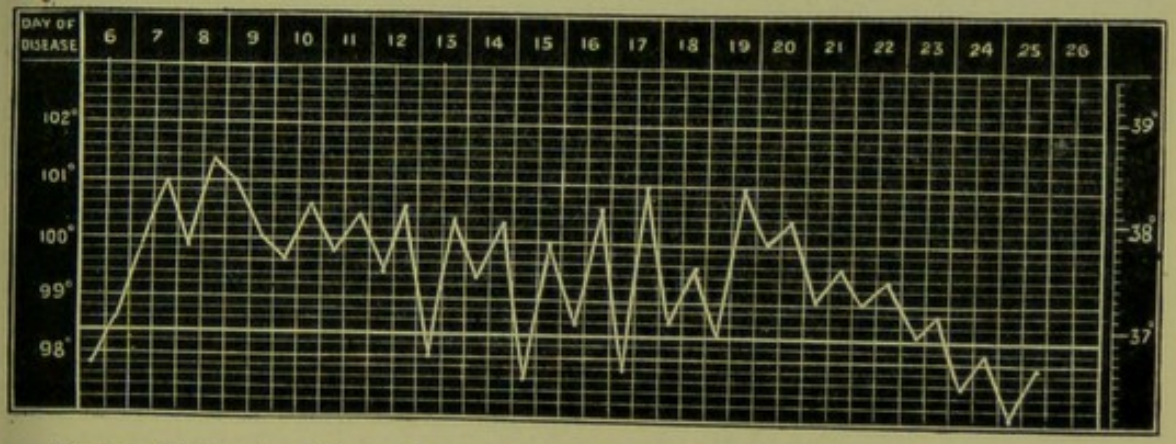

Fig. 87.—Temperature Chart of a case of Endocarditis supervening on the sixth day of a mild Scarlet Fever ; there were no joint lesions, the bruit persisted, and dilatation of the left ventricle followed.

Recent observations have shown the presence of septic micro-organisms, such as streptococci, staphylococci, and Fränkel's pneumonia diplococci on the valves in malignant endocarditis, and it would appear as if a simple endocarditis afforded a suitable soil for the development of these pyogenic micro-organisms. We have several times got cultivations of streptococci on gelatine from blood drawn from the finger in cases of malignant endocarditis.

The symptoms of simple endocarditis, such as occurs during rheumatism, are not distinctive. There is often precordial pain, perhaps some dyspnœa, usually some fever of an intermittent type (see fig. 87), though this, in some instances, may be due to the rheumatism present ; indeed, the only symptom upon which any reliance can be placed is the presence of a bruit : it is certain, however, that endocarditis may exist without a bruit being present. It sometimes happens that during an attack of rheumatism or chorea the most careful examination may fail to detect a bruit, and yet, if the patient is examined a month or two after, a bruit is detected, which comes rather as a surprise. In the vast majority of cases it is the mitral orifice which is

affected, a murmur being heard which replaces or accompanies the first sound at the apex. Dr. O. Sturges points out that in some cases a faint murmur heard at the top of the ensiform cartilage, indicating regurgitation at the tricuspid orifice, precedes the mitral bruit, the tricuspid regurgitation being due to back pressure through the lungs. The constitutional disturbance is but slight, or at least it is impossible to separate the symptoms produced by the endocarditis from those produced by the rheumatism. When a recurrent attack of endocarditis takes place in a case of old heart disease, where there is mitral regurgitation and a bruit present, it is rarely possible to make a definite diagnosis.

When the endocarditis is of the malignant or 'ulcerative' variety, the constitutional symptoms are usually much more marked, and are those of septicæmia engrafted on to heart disease. It may supervene in a subject already suffering from rheumatic heart disease, post-scarlatinal nephritis, or periostitis. In some cases the symptoms are very like those of acute tuberculosis, and in one case which came under our notice a death certificate to that effect was given, a subsequent *post-mortem* showing the real nature of the disease to be acute endocarditis. In such cases the bruit may be of a musical character and accompanied by a thrill ; the aortic valves may also be affected and be the seat of a bruit. There is usually precordial pain, often pain in the left shoulder ; a hectic temperature rising to 103° or 104° in the evening and falling in the morning, an enlargement and often tenderness of the spleen. The urine is usually albuminous, often highly so. There may be joint pain and some of the phenomena of embolism. In one of our own cases there was aneurism due to embolism of the middle cerebral artery ; in another embolism of the lenticular-striate artery.

In any case of undoubted heart disease with intermittent pyrexia, malignant endocarditis should be suspected, especially if there is enlargement of the spleen and albuminuria. The aortic, tricuspid, and pulmonary valves are often affected in malignant endocarditis ; the fact that an aortic bruit is heard in a case of acute cardiac disease may help us to decide in favour of malignant endocarditis. The following case of malignant endocarditis may be taken as an example :

Malignant Endocarditis—Embolism of Brain and Spleen.—Sarah E. C., aged 11 years. Mother has had rheumatic fever. Four children have died of wasting and convulsions. Last Christmas child had chorea for three months and also rheumatism. A month ago child complained of pains in limbs. She has a cough and is short of breath, but has been going to school up to a fortnight ago. Admitted August 20, 1891. *Heart.*—Apex beat in sixth space, outside nipple line, no thrill, musical systolic murmur at apex, does not replace the first sound ; second sound accentuated, no bruit. *Lungs*, normal. *Urine*, trace of albumen. August 27.—Child has improved. There is a presystolic as well as a systolic bruit ; slight presystolic thrill. Temperature goes to 100° at night. September 9.—No presystolic murmur now ; rough systolic at the apex well conducted into axilla. Temperature 99° to 103°. At 7 P.M. last night child complained of pain in right arm and leg. An examination this morning shows complete hemiplegia, the right arm and leg are paralysed ; there is also facial paralysis of the same side ; knee jerk diminished ; plantar reflex present ; slight œdema of right eyelid ; hemi-anæsthesia of the same side. Child not unconscious ; tongue protruded to right ; speech indistinct and thick ; no certain loss of memory for words ; she will give the names of common objects ; no optic neuritis ; spleen much enlarged, no albumen. November 24.—Patient has been getting weaker since last note, and more anæmic, her face becoming quite pallid. Temperature has varied

from 99° to 103°; the paralysis is much the same, except that contracture has become more marked during the last few weeks, and the knee jerk more pronounced. Early on the morning of November 24 she became unconscious, the breathing stertorous; she lingered a few hours in this state and then sank. *Post-mortem.—Lungs.*—Both lungs studded with pale infarcts, hypostatic pneumonia at bases of both lungs. *Heart.*—Much enlarged, extending from nipple to nipple; some two ounces of fluid in the pericardium; no pericarditis. Left ventricle dilated and containing much dark clot; mitral valve covered with large warty granulations which can be readily detached; posterior surface of left auricle is the seat of numerous granulations; there is also a small patch on the surface of the ventricle, where there has been friction or where a flap of the mitral valve has impinged. All other valves are normal. *Liver.*—Congested, nutmeg, and much enlarged. *Kidneys.*—Right kidney contains an infarct of some standing; left also. *Spleen.*—Very large; contains two large infarcts. *Brain.*—Brain appears firm and healthy. There is an embolus at the junction of middle and anterior cerebral arteries on the right side; there has evidently been embolism of one of the branches of the middle cerebral of the left side in the Sylvian fissure, as it is white and apparently plugged. Making horizontal sections through the brain, the first section shows some surface softening of the left ascending parietal convolution. Section made through the roof of the lateral ventricle shows softening of the convolutions of the island of Reil and caudate nucleus. Section through internal capsule shows a patch of softening involving the lenticular-striate artery, which is plugged with clot and impervious. The softened parts are of a rusty colour. The hemiplegia was no doubt due to an embolus in the left lenticular-striate artery, and the softening on the surface to embolism of branch of left middle cerebral (see fig. 120).

There are other cases of acute endocarditis, however, which end in recovery at any rate for a time. We have seen several cases, where there has been pyrexia of an intermittent type for many months, gradually improve, and finally the temperature has become normal; they were able to get about and appeared quite well, but doubtless had damaged mitral valves.

Chronic Heart Disease

The immediate result of endocarditis is to cause a swelling and roughness of the endocardium which prevents the complete closure of the valves and thus allows of regurgitation (see fig. 88); puckering and thickening of the valves take place as time goes on, especially if there are recurrent attacks, and the valves become permanently damaged. In children it is the mitral which almost constantly suffers. In some chronic cases the valves become adherent at their edges, and thus stenosis is produced. Gradually other and compensatory changes take place; if the regurgitation occurs at the mitral orifice, the left ventricle gradually dilates and becomes hypertrophied. At first the compensatory changes which take place are sufficient to prevent the patient from feeling any inconvenience, and both he and his friends may be ignorant of the existence of valvular disease; but sooner or later dyspnœa on exertion and precordial pain are complained of, which direct attention to the heart. Such patients often suffer from bronchitis—a result of the constant congestion of the lungs which is present in mitral regurgitation. If a physical examination of the heart is made at this period, a bruit is detected, heard loudest at the apex, but well conducted into the axilla and to the angle of the scapula; the click of the pulmonary valves is accentuated, while the aortic sounds are weak. The apex beat is diffused and situated outside the nipple line, the cardiac dulness is increased to the left and frequently also to the right, as the right ventricle is apt to be dilated on account of the congested state of the lungs. In some cases the heart becomes enormously

enlarged, so that the area of cardiac dulness extends from nipple to nipple, and the apex beat occupies perhaps the fifth, sixth, and seventh spaces outside the nipple line, while the whole of the precordial region is bulged forward by the hypertrophied heart. Often the left bronchus is pressed upon and the lower lobe of the lung becomes collapsed. During the last stages, which may be short or prolonged intermittently for many months or even years, the liver becomes congested and enlarged, there is albuminuria from congested kidneys, while the belly, scrotum, and legs become dropsical. Attacks of dyspnœa with pain resembling angina pectoris are not uncommon towards the last. Such cases may be very chronic, and even repeated attacks accompanied by much orthopnœa, cardiac distress, bron-

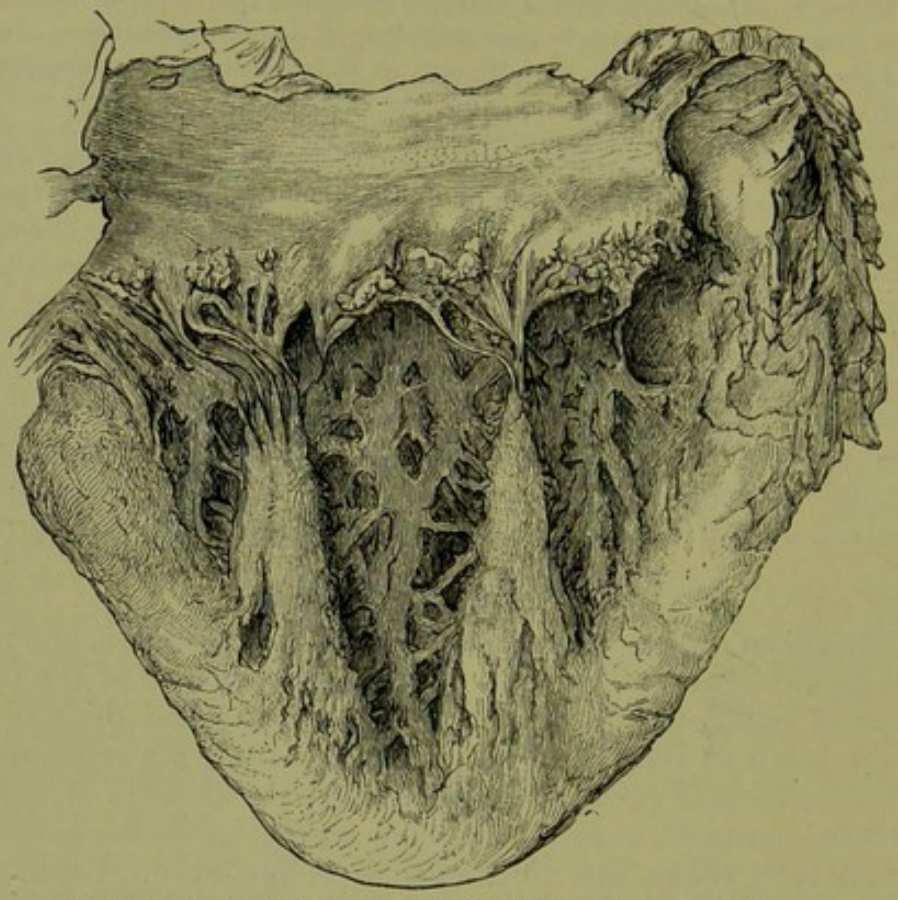

Fig. 88.—Acute Endocarditis of Mitral Valves in a case of Chorea.
(See Fatal Case of Chorea.)

chitis, and dropsy may be recovered from and the patient once more be patched up. In such cases, however, probably no fresh endocarditis occurs, and the attack is due more to the engorged state of the lungs and a temporarily overworked heart, the latter recovering by rest in bed, and the symptoms disappearing as the bronchitis passes off. Should, however, pericarditis occur in a case of old-standing heart disease, the end is not far off, as the muscle becomes damaged and further work is imposed on an already burdened heart.

In order to illustrate the lesions most commonly found in chronic heart disease in children, we have analysed the results of forty-one *post-mortems* made at the Children's Hospital, Manchester, during the last few years, on patients who have been under the care of our colleague Dr. Hutton or one

of ourselves. The youngest was 3 years and 8 months at the time of death, and the oldest 14 years. With one exception all died from the results of chronic heart disease—that is, the heart disease was primary, those cases dying with pericarditis or endocarditis accompanying septicæmia or other fatal disease being excluded. They may be divided into the following groups :

1. **Malignant 'ulcerative' endocarditis** with embolisms in various organs. Pericarditis mostly absent . . 5 cases
2. **Acute pericarditis** occurring in a heart already more or less dilated from the effects of mitral disease, and perhaps old pericarditis. Recent endocarditis mostly slight, coincident with the pericarditis . . . . 20 cases
3. **Adherent pericardium.**—Former attacks of pericarditis which had given rise to thick leathery adhesions around the heart, and in connection with old mitral disease had given rise to extensive dilatation and gradual heart failure. A small aorta usually present and dilated pulmonary artery : mostly bronchitis and hypostatic congestion of the lungs . . . . . 10 cases
4. **Chronic valvular disease without pericarditis.**—Mitral incompetency, dilatation of both ventricles, bronchitis and hypostatic congestion of the lungs . . 6 cases

In the above forty-one cases the pericardium had been affected thirty times ; in the remaining eleven no inflammatory lesion of the pericardium had taken place, but clear fluid without lymph was present in several of these. In several cases of acute pericarditis the amount of fluid was excessive, amounting in one case in a girl of 9 years to 20 oz., the heart with the distended pericardium measuring $6\frac{3}{4}$ in. from right to left ; in another the pericardium contained 14 oz. In other cases the cavity of the pericardium was obliterated by old adhesions forming a thick layer one-eighth to one-quarter inch thick, which had evidently played an important part in bringing about the fatal result.

The **mitral orifice** was affected in every case : in the malignant variety of endocarditis there were the usual luxuriant vegetations present, mostly extending along the posterior wall of the left auricle where the regurgitant stream of blood had impinged. In the slighter forms of endocarditis the lines of contact of the valves were simply roughened, having lost their shiny surface. In other cases there was evidence of old endocarditis, the edges of the flaps were thickened, the chordæ tendineæ were thick and short, and in one case several chordæ had ruptured. As a result of this and also of the dilatation of the ventricles, the mitral orifice was incompetent, the valves not meeting during systole, or if coming in contact the roughened surface allowing blood to regurgitate into the auricle. In only two cases was there any stenosis of the mitral orifice, mostly the orifice admitted two fingers side by side, or it was wider still. In one of the cases of stenosis the mitral orifice only admitted one finger ; the boy had not had rheumatism ; he died of tuberculous pericarditis and peritonitis (see case, p. 431). In the other case the patient was a boy of 13, who had been in the hospital five times

with chorea, and finally with chronic lung trouble. At the *post-mortem* there were caseation and small cavities in the lungs, no definite tubercle anywhere, a puckered and funnel-shaped mitral orifice, and recent and old endocarditis of the tricuspid valves.

The **aortic valves** were affected in twenty, that is, in about half the cases, but the lesions were of a far less advanced or serious nature than in the case of the mitral. In most of the cases the valves were competent, and in no case had regurgitation apparently occurred to any great extent. Six times the note was made, 'The aorta only admits the little finger'; this was due not to the effects of valvular disease but to undergrowth in the aorta, which has already been referred to.

The **tricuspid valves** were affected thirteen times, or in about one-third of the cases, either by recent or old endocarditis. Probably the tricuspid valves were incompetent in the majority of cases in consequence of the dilatation of the right ventricle. The note often occurs that the tricuspid orifice was abnormally wide, and on one occasion it admitted four fingers side by side.

The **pulmonary valves** in two cases had slight vegetations on them along the lines of contact. In most cases the pulmonary artery was dilated from the effects of back pressure.

The **murmurs** heard during auscultation in the case of children are in some ways more puzzling than those heard in adults. This is due in part to the more rapid action of the heart, and this is especially the case in trying to time a murmur present in the case of congenital heart disease in an infant. In chronic heart disease in children the hearts are larger and occupy more space in the chest as compared with adults. Exo-cardial sounds are commoner in children, and may be mistaken for murmurs.

In acute febrile diseases like scarlet fever or influenza, a murmurish first sound may often be heard, and inasmuch as endocarditis does occasionally occur in these diseases, we may at times be in doubt as to whether the abnormal sound is due to endocarditis or not. In these cases even an experienced ear may be deceived and an endocarditis is suspected, when the sequel proves this to have been a mistake. The bruit may disappear as the pulse and temperature fall. Certainly, murmurish first sounds are heard during scarlet fever, which disappear during convalescence; but, on the other hand, an endocarditis occurring during scarlet fever is apt to be overlooked. In acute rheumatism or chorea a slight endocarditis may be overlooked, inasmuch as it may not give rise to a murmur, the tiny swellings along the line of contact of the valves being too minute to allow of regurgitation, and it is only perhaps after some weeks, it may be during convalescence, that the murmur is heard.

Regurgitation through a damaged mitral valve gives rise to a murmur accompanying or replacing the first sound at the apex. *Post-mortem* evidence shows that if heart disease exists, there is regurgitation through the mitral orifice or damage to the mitral valve in practically all the cases, though other valves, as also the pericardium, may share in the damage. In the vast majority of cases there is regurgitation and no stenosis. In a considerable proportion of cases of chronic heart disease in children, especially where there is dilatation of the cavities, there is a **double** or **treble**

murmur at the apex, there being either a presystolic or a diastolic in addition to the mitral systolic. The presystolic is generally heard as a 'churning' or 'rumbling' sound preceding the systolic bruit and running up to it. Is the presystolic under these circumstances diagnostic of a contracted mitral? The result of our *post-mortems* lends no support to this view. In the two cases in which a contracted mitral was found *post mortem* there was no bruit at all heard during life in one, and a systolic bruit in the other. In the cases in which a presystolic and systolic were heard there was no stenosis found *post mortem*, but in one case ruptured chordæ, and in others thickened and puckered valves. No bruit is more perplexing than the so-called **diastolic mitral.** This apex diastolic is common enough in the later stages of chronic heart disease when there is much dilatation. In some cases there is a banging or intensified second sound at the apex, produced presumably at the pulmonary orifice, and perhaps the diastolic bruit may be what Dr. G. Steell has called 'the murmur of high pressure in the pulmonary artery,' which is well conducted to the apex. It can hardly be produced at the aortic orifice, as in some cases where it has been heard the aortic valves were normal and could not have allowed of regurgitation. We have noted this murmur in cases in which the pericardium was adherent and in cases in which it was normal. On several occasions we have noted the presence of a diastolic bruit, and on a later occasion have described it as being presystolic, and this has been confirmed by others.

Murmurs produced at the tricuspid orifice are best heard at the tip of the sternum; probably they are often masked by the presence of a loud mitral murmur. A double bruit at the base indicating stenosis and regurgitation at the aortic orifice is not common in children, though a systolic bruit is common enough. Often the mitral systolic is so well conducted to the base that a doubt may be raised as to whether there is aortic stenosis or not. In some cases in which a double bruit has been best heard over the pulmonary area we have found disease of the aortic valves *post mortem*, while the pulmonary have been healthy.

Dilatation of the cavities of the heart takes place in children apart from valvular disease, under two circumstances—an excess of blood pressure, as in acute nephritis, the force acting from within and bulging the heart walls as it were; a chronic pericarditis, with adherent pericardium interfering with the systole, and so tending to dilatation, or a carditis with or without pericarditis damaging the cardiac walls. Acute dilatation of all the cavities rapidly takes place in some cases of acute nephritis following scarlet fever; the apex beat becomes diffused, and is seen outside the nipple line; in a few cases there is a bruit, due to the imperfect closure of the mitral valves, and symptoms of cardiac failure, and perhaps sudden death may take place. Dilatation of the left ventricle may occur in anæmia. Dilatation due to chronic pericarditis is a cause of chronic rather than acute heart disease; a pure case of this is rare, as endocarditis mostly occurs also; but sometimes cases may be found in which the heart is enlarged and the cavities dilated, with a thick pericardial attachment outside; the valves are normal or perhaps more or less thickened, and have evidently been incompetent during life. In these cases, as already pointed out, the dilatation has probably taken place during one or more rheumatic attacks. We have noticed signs of

dilated heart with a muffled first sound in growing delicate boys towards puberty, especially if they are given to violent exercises.

Acute Myocarditis.—Acute myocarditis, apart from rheumatic pericarditis, is not a common affection at any time of life, and much difficulty exists in stating what it consists in, as any general acute process affecting the heart must quickly bring a fatal issue. Changes in the cardiac muscles of a coarse description do occasionally occur. In rare cases children have been attacked with an acute illness, with fever and delirium, and at the *post-mortem* an unsuspected abscess has been found in the muscle of the heart ; such cases are probably septicæmic, as also are those where minute abscesses are found. Acute myocarditis appears also to occur in diphtheria ; there is a general dilatation of the heart, more or less local pain, and dyspnœa, followed by a fatal issue, changes being found in the muscular fibre of the heart, the muscular fibres being distended with fine granules of fat obscuring the striæ. It is well known, however, that sudden death may occur in diphtheria from paresis of the respiratory muscles, as well as from disturbed innervation of the heart, so caution is required in coming to a conclusion that a myocarditis exists. Steffen has described a form of local myocarditis occurring in the course of typhoid, accompanied by symptoms of cardiac failure during life. Such cases must be rare. Myocarditis or a degeneration of the cardiac muscle may accompany both pericarditis and endocarditis. Steffen has also recorded cases of myocarditis with dilatation in some cases of purpura.

Prognosis.—Acute pericarditis or carditis occurring in association with rheumatism is a dangerous affection, especially in young children. The younger the child, the worse is the prognosis. A rheumatic pericarditis occurring in a child 4 or 5 years of age is exceedingly likely to end fatally or leave behind a much-dilated and damaged heart. A sudden cardiac syncope may at any time take place. In less acute cases of pericarditis or peri-endocarditis, especially in older children, the immediate danger to life is not great, but the outlook in the long run is serious. Pericarditis occurring in a heart which is hypertrophied from old-standing valvular disease is an exceedingly dangerous and fatal affection, and generally marks the beginning of the end. Death may be sudden at the last. In endocarditis occurring in the course of rheumatism there is, of course, great danger that permanent damage may be inflicted on the valves and the patient be handicapped for life. On the other hand, there is abundant evidence to show that bruits due to endocarditis, occurring either in connection with chorea or rheumatism, may disappear, and there is no reason why the endocardium may not return to its normal condition without crippling the valves ; there is, however, the constant fear of a fresh attack at the old spot. The prognosis in malignant endocarditis is eminently unfavourable, though cases which apparently belong to this category occasionally recover. In chronic heart disease the amount of hypertrophy and dilatation present may be taken as an index of the damage the heart has suffered. The prognosis in dilated hearts secondary to nephritis is favourable if the nephritis subsides and no valvular disease remains.

Treatment.—The treatment of pericarditis and that of endocarditis have so much in common that they may be taken together. It is needless to insist

that the child should be put to bed and religiously kept quiet, all exertion and excitement being zealously guarded against. Too much stress cannot be laid upon the importance of this, and of maintaining rest in bed long after the acute symptoms have passed away. To keep the heart as quiet as possible, and to impose the lightest work on it, during and after the attack, are points of the highest moment. The diet given must be suited to the rheumatic state ; if peri-endocarditis is associated with it, milk and fluids will form the principal part. Of the local treatment during the acute stage, applications which soothe are better than counter-irritants. Ext. of belladonna moistened with glycerine may be spread on lint or flannel, and applied to the precordial region and covered with a layer of cotton wool ; or spongio-piline wrung out of hot water and sprinkled with laudanum may be applied. If there is much pain, a light mustard poultice (one in four or six) kept on for some hours so as to redden the skin will usually relieve. Lin. aconiti and lin. iodi, equal parts, may be painted over the precordial region. Local blood-letting by applying one or two leeches over the sternum is often useful in appropriate cases. Dr. D. B. Lees has highly extolled the effects of an ice bag applied to the precordial region. We have seen cases where this method has been useful, but some patients rebel against it. Of medicines, salicylate of soda, with liq. ammon. acet. if the inflammatory lesion is dependent on the rheumatic state, may be prescribed, tinct. digitalis being substituted and given in 3 to 5 minim doses every four hours if there is much dyspnœa or sign of cardiac failure. Small doses of opium are usually required, and are often of the greatest use in relieving pain and quieting the heart's action. Half to two grains of Dover's powder may be given at night, and repeated once or twice in the twenty-four hours, according to circumstances. (See also F. 75, 76, 77, 78, 81, and 82.)

In pericardial effusion, if extensive, tapping of the pericardium may have to be resorted to, to relieve the pressure on the heart. Before this is done as accurate a diagnosis as possible must be made, to ascertain how much the symptoms present, dyspnœa, orthopnœa, and cyanosis, are due to pressure of fluid, and how much to a dilated or hypertrophied heart ; as many, perhaps most, of the cases of children with which we have to deal are in reality cases of pericarditis supervening on chronic heart disease. In the latter case, if there is much cardiac dilatation and comparatively little fluid, paracentesis cannot relieve to any extent, and the cardiac walls may be wounded, though if a *fine* exploring needle be used no great damage can be done.[1] The spot selected for paracentesis is usually the fourth or fifth interspace, half way between the left nipple line and the left edge of the sternum, but care should be used to ascertain the position of the apex beat as nearly as possible. Having by the cautious use of an exploring syringe with a fine

[1] On one occasion we tapped the pericardium with an exploring syringe armed with a large sharp-pointed hollow needle, and withdrew some two ounces of serum ; this was followed by pure blood. After the needle was withdrawn the child became rapidly worse, and died in a few minutes. The *post-mortem* showed the pericardium full of blood, and a puncture wound through the right ventricular wall close to the interventricular septum. The wall was very thin at this spot and almost fibroid. Had a trochar and cannula been used, the trochar being withdrawn on entering the pericardium, this accident could not have happened. The needle had entered the pericardial sac in the first instance, and then entered the right ventricle.

needle ascertained the presence of fluid, a trochar and cannula may be used to draw it off, care being taken to withdraw the trochar as soon as the cannula is well inside the cavity of the sac. As a matter of fact paracentesis pericardii is rarely of much use, though it may postpone the fatal result a few hours, and bring temporary relief.

In chronic pericardial effusion the inunction of blue ointment or counter-irritation by flying blisters may be tried. In chronic purulent effusion, aspiration should be first tried; if this fail to prevent re-accumulation, incision and drainage by an india-rubber tube should be resorted to; this is occasionally successful, as in the case recorded by Dr. S. West. Symptoms of cardiac failure should be treated by digitalis, ammonia, ether, or alcohol. Ether may be injected subcutaneously or a few drops may be inhaled. The treatment of malignant or ulcerative endocarditis is unsatisfactory, and no drugs appear to influence its course. The most likely to be useful are quinine, digitalis, and the sulpho-carbolates. The treatment of congenital or chronic heart disease must be directed to saving the heart all unnecessary work and to strengthening it as much as possible. Children with chronic heart disease need to be guarded most carefully against the effects of cold, as bronchitis is easily contracted in such, and a little bronchitis adds materially to the work of the heart, which is, perhaps, at best labouring under great mechanical disadvantages. The parents and friends of such children must be cautioned against allowing the child to over-tire itself; it is no uncommon thing for such a child to go for a while to the sea-side or convalescent home and come back worse, for the simple reason that it has been on its legs all day, enjoying the novelty of its new-found pleasures; whereas a moderate amount only of exercise, insufficient to over-work the heart, would have secured an improvement, All active exercise should be forbidden, rough games, riding, 'cycles,' and gymnastics. The medicines of most use to control and regulate the cardiac contractions are digitalis, belladonna, iron, and strychnine. Digitalis is of the greatest value, but must not be too continuously given; any intermittency in the beat should be the signal for its omission. When dropsy sets in, digitalis with diuretics like iodide of potassium, acetate of potash, and squills will be required. (F. 79 and 80.) In excessive dropsy Southey's cannula may be used with advantage.

Mediastino-pericarditis, Pleuro-pericarditis

An inflammation of the serous membrane which is reflected over the anterior edges of the lungs and surrounds the pericardium sometimes takes place, mostly in association with a more general pleurisy or with peri-carditis. At times the pleurisy appears to be local, being confined to the serous membrane covering the pericardium and lung adjoining it. The symptoms of such inflammation are necessarily indefinite, almost the only definite sign being a pleuro-pericardial friction sound—that is, a rubbing sound which is synchronous with the cardiac beats, and which is more intense during inspiration as the lung expands and its edge passes in front of the heart. The rub may disappear entirely during expiration. The deeper the inspiration the more intense the friction sound becomes. As a result the edge of the lung becomes adherent to the pericardium, the space

between the two becoming obliterated. In some cases a subacute or chronic inflammatory process goes on in the mediastinum, involving the serous membrane, connective tissue, and perhaps the mediastinal glands, so that a matting of all the parts takes place, the edges of the lungs, pericardium, and great vessels being firmly bound together. The pericardium may be adherent to the walls of the heart, there may be extensive pleuritic adhesions of one or both lungs, and the adhesions in some cases are tough and firm and of almost cartilaginous hardness.

The etiology of these cases is uncertain. Many cases are associated with chronic tuberculosis of the lung or with caseous mediastinal glands ; in

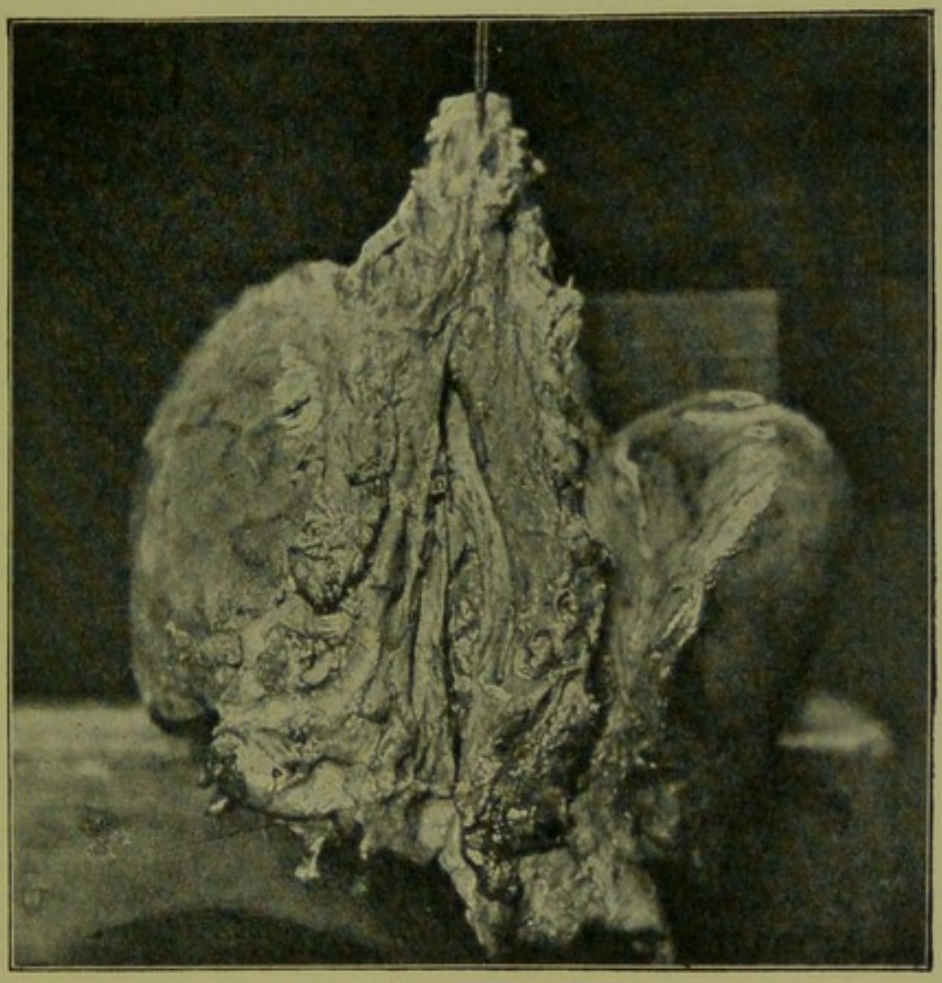

Fig. 89.—Chronic Mediastino-pericarditis. Boy 13 years (see case, p. 444). The anterior edges of the lungs were adherent ; in front there were indurated adhesions in the anterior mediastinum.

others no evidence of tubercle can be found, a simple chronic inflammation of the connective tissue going on, ending in cicatrisation. The immediate result of this process is to hamper the action of the heart, preventing its complete systole, to interfere with the filling of the lungs during inspiration, and to compress the large veins entering the chest. The liver becomes constantly engorged, the hepatic system of veins dilated, and a perihepatitis results.

Symptoms.—The course of this curious affection is very chronic. In well-marked cases the symptoms are those which are likely to be caused by an obstruction to the flow of blood into the chest. Dyspnœa on exertion,

cyanosis of the face, clubbing of the fingers, distension of the veins of the neck, chest, and abdomen during inspiration, and, later, œdema of the face, arms, feet, and abdomen. There may be signs of pulmonary tuberculosis The 'pulsus paradoxus'—i.e. the pulse becoming smaller during inspiration—may be present, but certainly it is absent in some cases. In other cases the most marked symptom is ascites, with an enlarged liver, suggesting a primary cirrhosis of the liver; such cases are exceedingly chronic, and they improve if the fluid in the abdomen is removed by tapping, and will go on for months or even years; gradually the portal obstruction becomes greater and the patient dies of exhaustion. The spleen does not appear to enlarge in these cases as it does in primary cirrhosis of the liver.

The following case may be taken as an example of this affection, running an acute course:

Mediastinitis, Ascites.—John E., aged 2 years. Admitted September 9, 1891. Mother states that her first five children are dead. No history of syphilis; patient had convulsions at six months of age. Last May he had a cough and was attended by a doctor. A month later his abdomen began to swell, and soon after his feet; this has gradually increased. On admission his face is puffy, the abdomen is distended with fluid, his legs are much swollen. Temperature 101°, pulse 130, respiration 40. *Lungs.*—There is some diminished resonance over the right upper lobe in front; over both lungs there are fine bubbling râles. *Heart.*—Apex beat in third interspace sounds normal. *Abdomen* is greatly distended, dulness in both flanks and in epigastrium, thrill plainly felt. *Liver.*—Edge not readily felt, spleen cannot be felt. September 10.—Temperature is 103°, varies from 99° to 103°. Crepitation in lungs on both sides. September 14.—Child evidently dying; abdomen relaxed; edge of liver, both right and left lobe, felt below umbilicus; a nodule about the size of a marble felt in the left lobe. Temperature 105°–106° before death. *Post-mortem.*—*Lungs* not adherent; right lower lobe semi-solid with pneumonia; upper lobe of left solid with *graines jaunes*, but no tubercle. Much yellow fluid in abdomen and some lymph on liver, spleen, diaphragm, and great omentum. *Heart* not enlarged; pericardium thick and adherent, but can be peeled off, leaving a granular surface adherent to the diaphragm. In the middle and posterior mediastinum there are enlarged glands and much fibrous tissue. The glands are enlarged and caseating, one the size of a filbert, several with putty-like contents. *Abdomen.*—Lymph and tubercle between liver and diaphragm, some lymph on surface of liver. *Liver* much enlarged and granular, one boss the size of a marble on the anterior surface of right lobe near broad ligament, creaks when cut, section nutmeg appearance. *Spleen* enlarged, distended with blood. *Kidneys* pale.

Chronic indurative Mediastinitis.—James R., aged 13 years. Admitted October 29, 1896. History imperfect. Mother states he has had an enlarged abdomen for a year, which she attributes to scarlet fever. When admitted the boy was suffering from dyspnœa, cyanosis, and ascites. The abdomen was tapped and 251 oz. of fluid removed. An examination of the chest showed dulness at both bases behind, and weak breath sounds, much dulness over region of the sternum, the heart's impulse could not be seen nor felt, but the sounds, which were faint, but normal, were best heard just outside and below left nipple line; dulness extends ¾ in. to right of the sternum. Edge of liver felt 2½ in. below the ribs; spleen not felt, enlarged veins in the neck. Pulse diminishes during inspiration on both sides. Much relief to all the symptoms by tapping. November 14.—Fluid has been re-accumulating, dyspnœa urgent, 280 oz. removed by tapping. February 24.—Fluid has been slowly accumulating, boy keeping better on the whole. To-day there is a purpuric rash on body and limbs, and a swelling, apparently a periosteal hæmorrhage, over both forearms (? ulna). February 26.—Synovitis of both wrists and finger-joints, and also shoulder-joint, with temperature of 99°–100° F. March 2.—Joints better, much dyspnœa, friction sounds over bases of lungs, more dulness than when admitted. Dyspnœa urgent. Death March 9. *Post-mortem.*—*Lungs.*—Old adhesions, especially right along the anterior edges, fixing them to the anterior mediastinum, bases adherent to

diaphragm, but both bases behind pleura thickened and white, resembling 'porcelain'; the thickened pleura has contracted the lungs. Some recent pleurisy. Section tough and gorged like 'heart' lung. *Heart.*—Much fibroid material in anterior mediastinum (fig. 89). *Pericardium* thickened and adherent to surrounding parts, adherent to heart walls. Heart small, wall thin, no dilatation, no endocarditis. Muscle easily tears. Aorta admits forefinger, valves healthy. Superior vena cava dilated, but surrounded and fixed by indurated tissues in the mediastinum. *Peritoneum.*—Much ascites, no lymph. *Liver* capsule thickened, adherent to diaphragm, but can be separated. Capsule looks like 'porcelain,' with a number of holes through it showing liver surface. Section of liver shows the thickened capsule has rounded off the edges of the liver, tying it up into a ball. Hepatic veins dilated, section like 'nutmeg,' no cirrhosis. *Spleen* enlarged, capsule thickened and 'porcelain'-like. *Kidneys* normal. No tuberculous disease anywhere.

Raynaud's Disease—Paroxysmal Hæmoglobinuria

About one-fourth of the cases of Raynaud's disease reported occurred in children under 10 years of age (J. E. Morgan). Concerning the etiology of this disease nothing is known; in some cases there is a history of malaria, but certainly in many of the reported cases there was no such connection. In some cases hæmoglobinuria has been a prominent symptom, and it is believed by some (Dickenson, Abercrombie) that paroxysmal hæmoglobinuria is a part of the more general disorder which may or may not be present. Like migraine, epilepsy, and the so-called functional diseases, Raynaud's disease is a clinical, not a pathological entity (Purves Stewart). It chiefly occurs in neurotic individuals.

The first symptoms of Raynaud's disease may appear as early as the end of the second year, the friends noticing that the child's hands or feet after exposure to cold become numb and blue; the ears and cheeks also may readily be affected. Before an attack comes on, there is shivering and perhaps crying, with pain or discomfort. In more severe cases the hands and feet are swollen and of a dark-blue colour. In some of the cases after the attack is over the child passes urine containing albumen and hæmoglobin (J. Abercrombie). In other cases no abnormal urine is noted. The exciting cause of the attacks in all these cases is exposure to cold; they are commoner in the winter, and when occurring in the summer follow a cold bath or a chill of some sort. In mild cases an attack does not last long; if warmth is applied the blueness and numbness pass off in the course of half an hour or less.

While such is the common type of attack in Raynaud's disease, it happens at times that the numbness or blueness of the extremities ends in gangrene. A typical case of this kind is recorded by Harold (*Lancet*, February 9, 1895) of a weakly boy of 4 years of age; both hands and feet were affected. The hands and feet were blue and numbed; the hands recovered, but the feet, beginning at the toes, became gangrenous, and a spontaneous amputation of both feet gradually occurred. The boy eventually made a good recovery. In these cases there is no doubt a stenosis or narrowing of the arteries to the limb or the capillary arteries are affected. All children who are liable to these attacks obviously require the greatest care in the avoidance of cold, and possibly during cold weather have to be confined to bed, or at any rate to one room. The treatment is the treatment of symptoms.

CHAPTER XIX

DISEASES OF THE CIRCULATORY SYSTEM—*continued*

Nævus.—Nævus is perhaps the commonest congenital disfigurement met with in children[1]; usually it is nothing more than a blemish, though occasionally it becomes more serious, either from danger to life or serious interference with its subject's welfare. Nævi are probably always congenital, though not always noticed at birth, since they may not be large enough to be conspicuous until some time later.

Nævi belong to the class of the angiomata, and are defined as 'tumours consisting of newly formed blood-vessels,' though it is obvious that they are not always tumours in the sense of there being any definite mass of tissue—e.g. 'port-wine stains'; still this is merely a question of a diffuse as contrasted with a circumscribed growth.

These growths may be classified as—

I. (a) *Simple angioma*, telangiectasis, congenital nævus, mother's mark or port-wine stain. The vessels composing the new formation are identical in structure with normal arteries, veins, and capillaries. (b) *Cavernous angioma*, lacunar or erectile angioma. The blood circulates in a lacunar system as in normal erectile tissue. (Cornil and Ranvier.)

II. Nævi may be considered as (1) arterial, (2) venous, (3) capillary, (4) lacunar, blood vascular growths.

III. Or, considered from their locality, the nævi may be divided into (1) cutaneous: (a) a mere staining or port-wine mark, (b) a distinct mass with larger vessels. (2) Subcutaneous. (3) Mixed—i.e. both cutaneous and subcutaneous. The different forms of nævi are readily distinguishable.

Stellate Nævus.—The so-called 'stellate' or 'spider' nævus, which is a doubtful new formation, and very probably only a dilatation of pre-existing vessels, resembles in appearance the venæ stellatæ on the surface of the kidney of a carnivore. It is most common in the face, disappears on pressure, and is closely allied to the mere weather marks of those exposed to wind and cold; it is sometimes seen about the faces of children.

Port-wine marks consist of a diffuse stain, varying much in size, form, position, and colour; usually there are no obvious dilated vessels, though these can be made out on more minute examination. These marks occur, perhaps,

[1] Depaul is quoted by Cornil and Ranvier as saying that one-third of the children born at the Clinic of the Faculty of Medicine in Paris have nævi, and these mostly disappear spontaneously during the first few months of life.

most commonly on the face, often on the hands, and occasionally elsewhere ; they may cover very large surfaces, such as the whole side of the face. There is no elevation of the growth above the level of the skin, only the superficial layers of which are involved, and pressure completely obliterates the stain for the time.

Cutaneous Nævus.—The common cutaneous nævus is usually small, not covering more than a square inch of surface at most ; it is somewhat raised above the level of the surrounding skin ; the individual vessels can often be distinctly made out, though not always ; the colour of the growth is usually vivid red, and on pressure the colour and much of the swelling disappear, but a slight thickening remains and the skin is 'granular.'[1] These growths lie in the corium, and are usually sharply defined, but not encapsuled.

Subcutaneous Nævus.—The growth lies entirely beneath the corium, and forms a distinct tumour ; the skin over it is natural in colour, or only shows a faint bluish tint ; the swelling does not entirely disappear on pressure, and is often encapsuled more or less perfectly.[2]

Mixed Nævus.—This is a commoner form than the last ; it has the characteristics of the cutaneous and subcutaneous varieties combined—i.e. there is a subcutaneous nævus with a cutaneous patch on its surface ; corium and subcutaneous tissue are both involved. It is seldom that the cutaneous part is as extensive as the subcutaneous, and in this and the last form there is often some cavernous formation.

Fig. 90.—Extensive 'Mixed' Nævus of the Face, involving the lower lip and both cheeks up to the ears.

After removal from the body and escape of its blood, a subcutaneous or mixed nævus consists of a tough, spongy, or stringy mass, often somewhat lobulated and always much smaller than might be expected from its size before removal. If encapsuled, it will be found that only a small number of vessels, and those of considerable size, feed the growth and enter it at various parts—a very important fact as regards the treatment of these cases.

Simple Nævi consist of newly-formed vessels having the structure of capillaries, and presenting ampullar or cirsoid dilatations ; the vessels are supported by a framework of connective tissue, and often fat.

Cavernous Nævi consist of an irregular network of fibrous tissue, inclosing freely intercommunicating spaces like the channels in a sponge ; there

[1] Sir J. Paget.

[2] A good account of the structure of nævi will be found in Cornil and Ranvier's *Histology*, to which we are indebted for part of our description.

is occasionally unstriped muscular fibre developed in the septa, as well as vessels and nerves. The endothelium lining a nævoid lacuna is exactly like that of a vein. These nævi are formed by dilatation of newly developed capillaries and subsequent absorption of their barrier walls, so that free openings are made between adjacent vessels.

Importance of Nævi.—Usually nævi are simply disfigurements ; sometimes, however, they may give rise to serious bleeding from rupture of vessels by injury or ulceration, as in a case of our own where the soft palate and uvula were the seat of a large nævoid growth and frequent bleeding occurred ; similar trouble has been met with in the case of rectal nævi. Internal nævi may possibly be dangerous from hæmorrhage, or from extravasation of blood setting up peritonitis, &c. ; but this must be very rare. Some very extensive nævi are of importance from interference with the action of the muscles or the growth of bones, or from producing unwieldy hypertrophy of skin. We have seen fracture of the thigh due to weakening of the femur from an extensive nævoid growth in the limb.[1] Unwieldy overgrowth of limbs may occur also from the presence of nævi ; and in the case figured (fig. 91) the man was unable to obtain work on account of his disfigurement. We have seen a case of pyæmia having its origin in a suppurating nævus, and another where pyæmia followed puncture and partial removal of a nævoid growth.

Fig. 91.—Nævus of the face in a man of 50. The growth was steadily but slowly increasing. The whole skin of that side of the face was deep crimson, the lip and tongue were involved, and the lower jaw distorted and everted by the weight of the enormous lower lip. The man died of aortic aneurism. The specimen is in the Owens College Museum.

Changes occurring in Nævi.—Nævi sometimes grow rapidly from the first and spread over considerable areas ; in many cases, however, they grow very slowly, alternately grow and remain stationary, or disappear altogether, the last result being especially common in the cutaneous form. As Mr. Holmes and others have pointed out, and as we ourselves have seen, an illness, especially apparently whooping cough, often seems to bring about the cure of a nævus ; possibly the straining in coughing may produce extravasation and thrombosis in the nævus, and so obliteration.

Nævi undergo spontaneous cure by fibroid change, the vessels becoming obliterated and shrinking into fibrous cords. Such result may follow treatment or accidental irritation by friction of the clothes, or pressure in lying, and so on. In other instances calcareous degeneration or thrombosis takes place. Cystic change in nævi is very common ; the cysts contain serum,

[1] The patient was under the care of our late colleague, Mr. T. Jones.

more or less deeply coloured, and arise from the shutting off of a lacunar space or dilated vessel from the blood stream ; the cystic is often combined with the fibrous and fatty degeneration, and we have met with fibro-myxomatous change in a nævus.

Suppuration and ulceration of a nævus is an important condition ; for, on the one hand, it may produce a cure by obliteration of the vessels, or, on the other hand, as already pointed out, septic absorption or bleeding may result ; happily obliteration is the common termination. Various combinations of these changes may be found going on in a nævus at the same time ; pigmentary changes are also found, and sometimes an overgrowth of hair, especially in the lipomatous form (*vide* p. 453). Mere pigmentary maculæ are sometimes called nævi, but it is better to restrict the name to the vascular growth.

Sites of Nævi.—Nævi may be found almost anywhere over the body, but there are certain markedly favourite positions. External nævi are most common on the head, and of all places we should say the most frequent is over the anterior fontanelle ; the lips, nose, cheeks, eyelids, or any part of the face may be involved. The trunk and limbs are less commonly affected than the face, but perhaps this is partly to be accounted for by the mothers being less anxious about nævi on the body ; the labia are not uncommonly affected. We have seen a case in which most alarming growth of the nævus took place during pregnancy ; subsidence of the swelling followed delivery. Different forms of nævi often occur in the same patient—e.g. a port-wine mark on the face or hand and a mixed nævus on the scalp. Nævi occurring inside the mouth, in the cheeks, tongue, or inner surface of the lip, more rarely in the palate, are of course more serious than external ones ; they are also much less common.

Visceral nævi are often seen on the liver, and less often on the kidneys, spleen, and other organs ; the muscles and bones are also sometimes affected It is common to see nævi on the skin of meningoceles both cerebral and spinal—a fact noticed by Mr. Holmes, and one of some importance from a diagnostic point of view.

Several cases of rectal nævi are on record, among others one mentioned by Mr. Barker which caused death by hæmorrhage.[1] We have met with a case which exactly simulated piles, and was cured by ligature. The extent of tissue involved is sometimes very great, as already stated ; thus we have seen the whole lower extremity nævoid, and Mr. Barker has recorded a case of the whole upper extremity being so affected [2] (*vide* also fig. 91).

Treatment of Nævi.—It should be a rule of practice not to interfere with nævi unless they are growing or have been stationary for some time, since, as already pointed out, very many disappear of themselves. The important points to consider for each nævus are whether it is cutaneous, subcutaneous, or mixed, and what is its relation to important adjacent structures, which may be endangered by treatment or by the resulting scar. It is unnecessary to mention all the methods proposed for treating these growths ; only the most efficient will be described here. Stellate nævi may readily be cured by puncturing the centre of the star with a hot needle. Port-wine marks

[1] *Brit. Med. Jour.* 1883.

[2] *Clin. Soc. Trans.* 1884.

require careful consideration as to whether the resulting white scar will not be as disfiguring as the red mark, and it must be remembered that in cases where a large surface is involved a long course of treatment is required to remove the mark.

Linear scarification, multiple puncture, the actual cautery or a caustic such as fuming nitric acid, and in some cases electrolysis, will succeed. From five to twenty or more cells of a Stohrer's or Weiss' battery should be used. If large, the patch should be treated in sections, so as not to have too large a sore surface at once. The utmost caution must be used not to leave a scar which is more disfiguring than the nævus, and treatment should be prolonged over years if necessary.

Cutaneous nævi are best treated with the actual cautery ; if small, a heated needle is sufficient ; in larger growths Paquelin's cautery is the most useful instrument. Narrow lines may be scored across and across the nævus, or multiple punctures employed ; after using the cautery once, as soon as the wound is healed, it will often be found that little patches remain unobliterated : these should be watched for some weeks before reapplying the cautery, as they often shrink subsequently without further operation. The cautery should be at a dull red heat, and should be applied deeply enough to reach through the nævus. Ethylate of sodium is fairly efficient, but usually requires several applications, and is not, we think, better than the cautery ; it has the advantage of not requiring the use of an anæsthetic, though it is followed by a good deal of temporary smarting. For port-wine stains the ethylate may be applied every two or three days according to the effect produced, and then, if required, fresh applications may be made after two or three weeks. Vaccination on a nævus is not a good plan. For subcutaneous or mixed nævi we cannot recommend injections of any kind ; they are often efficient, but always dangerous, extensive thrombosis or embolism, causing immediate death, having followed their use ; if they are employed, a temporary ligature should be put round the nævus and removed a few minutes after injection. Ligature of nævi is uncertain, as well as tedious and troublesome. We think treatment by excision, by multiple puncture with the cautery, and in suitable cases by electrolysis, are the most generally useful methods.

Excision is applicable to well-encapsuled growths of small or moderate size, not involving important structures. There are certain essential points in the operation : first, the incisions must be carried well wide of the growth and not within its capsule ; there will then be only a few well-defined vessels to secure, and not a freely bleeding cavernous tissue, as is the case if the growth is cut into ; next, the skin in a mixed nævus, if the cutaneous part is very small, should be removed as far as it is involved, provided always the edges of the wound can afterwards be brought together easily so as to obtain primary union. If the skin is widely involved, it should not be taken away, but, as suggested by Mr. Teale, dissected off the nævus and preserved ; this, however, necessitates opening up the nævoid tissue, and complicates the operation ; sometimes also the cutaneous nævus continues to grow afterwards.

A bloodless method of excising nævi is that of passing long needles or harelip pins beneath the base of the growth crosswise, then winding an elastic thread round the needles and excising the growth after dissecting back

skin flaps; the needles are then withdrawn and the vessels are secured. There is no bleeding until the elastic is removed.[1] Degenerated nævi should nearly always be excised if they are treated at all; in some instances, where there is cystic degeneration, a seton passed through the cyst causes it to shrink; but there is a certain amount of danger in this plan if any part of the nævus remains undegenerated.

The little galvano-caustic apparatus devised by Mr. Golding-Bird for enucleating lymphatic glands we have used with good effect for large mixed nævi not removable by excision.

In using the actual cautery the fine or middle-sized point of the Paquelin's cautery is entered through the skin and made to traverse the nævus in several directions from one puncture; if the nævus is large, this is repeated at another spot, and so on; a little boric acid ointment is then applied to the cauterised surface and the effect is watched; after all contraction has ceased another portion is, if necessary, attacked, until the whole mass has shrunk.

Pressure is occasionally successful as a means of treating nævi, but is chiefly applicable to cases where other treatment is impracticable, as in very extensive nævus of a limb;[2] it may be employed successfully sometimes in nævus of the scalp, where the underlying skull forms a firm basis; especially if combined with subcutaneous breaking up of the nævus with a tenotome. In cases of ulceration of nævi, and in some severe cutaneous forms, scraping away the growth with a sharp spoon will sometimes do good.

Fig. 92.—Orbital Nævus. The growth extended deeply, causing exophthalmos and ectropion, and spread upwards upon the forehead.

Importance of Nævi in special Localities.—Nævi occurring in certain localities have more than ordinary importance, either from the difficulty of their treatment or diagnosis or from the risk attaching to them. Nævus of the lip is often found involving the whole thickness of either lip, and is usually either of the mixed or subcutaneous variety; the surface is somewhat prone to ulceration in the mixed form from constant irritation, and the growth is often very unsightly. If degenerated and cystic, or if there are large cavernous spaces in the nævus, it may be mistaken for a labial mucous cyst or for lymphatic macrocheilia. Puncture from the mucous aspect with the Paquelin's cautery is usually the best mode of treatment,

[1] A plan devised, we believe, by Mr. Davies Colley.

[2] A good case of the effects of pressure under such circumstances is recorded by Hardie, *Lancet*, May 1885.

but in some cases it is a good plan to excise a segment of the lip and bring the edges together as after a harelip operation. Orbital nævi are usually associated with similar growths upon the face: they may cause exophthalmos and ectropion; the nævoid character of the growth is indicated by the spongy feeling and the possibility in some cases of pushing back the protruding eyeball and so emptying the growth of blood. Treatment by electrolysis is the only serviceable method in these cases.

Nævus of the tongue may give rise to macroglossia and cause protrusion of the organ, or may be limited to a small part of its surface; it is liable to be mistaken for lymphatic macroglossia or for a mucous cyst. The colour will usually serve to distinguish it from the former, though the two conditions seem to be sometimes combined, and the compressibility of a nævus will mark it off from the latter affection; in doubtful cases a grooved needle will clear up the difficulty. The actual cautery, or in rare cases excision, of a part of the tongue is the treatment required. In one child we excised the anterior third of the tongue by a ∧-shaped incision, and brought the sides of the wedge together with sutures; the result was good and repair was rapid. A similar condition may be met with on the gums or inner surface of the cheeks. Sometimes large blood lacunæ are met with beneath the tongue, looking like ranula; the soft palate and uvula are also occasionally affected; in one instance where both conditions existed the sublingual nævus was cured by the actual cautery, and the uvula removed by the galvanic écraseur; the patient was attacked by pyæmia, but ultimately recovered completely.

Fig. 93.—Arterio-venous Varix.

Nævus of the eyelids must be treated with great caution to prevent any subsequent distortion; it is best usually to attack small portions at a time with the actual cautery and wait until cicatrisation is complete before a second application. The same rule applies to nævus of the nose, where too vigorous treatment may produce an unsightly sharp-pointed, beak-like appearance if the skin is too much destroyed. In some instances excision is the better plan.

Nævi around the orbit are sometimes very difficult to diagnose, especially if they are degenerated, and consequently have lost their colour; dermoid cysts, meningoceles, simple serous congenital cysts, and fatty growths should be borne in mind as sources of fallacy. In one instance (fig. 92) there was a cyst with none of the appearance of a nævus; on tapping it, altered blood escaped, and on incision it was found that the growth was loculated and in part solid (i.e. degenerated). A seton was passed through it at last after failure of incision and drainage, excision being out of the question, and the mass suppurated freely, but unfortunately erysipelas occurred and the child died. At the *post-mortem* the orbit and cavernous sinus were found full of more or less degenerated nævoid tissue; the nævus spaces were mostly full of blood, and minute abscesses were seen with the microscope in sections of the growth.

Speaking generally, most nævi can be recognised by the presence of the remains of some superficial nævoid tissue, by the possibility of reducing the size of the growth by pressure—this point must not, of course, be allowed to mislead in swellings about the head or spine—and by the peculiar spongy feeling. This sensation is sometimes to be felt in a growth where solid masses are also perceptible. The fact that the tumour is congenital or has been noticed in very early life, and occasionally the presence of extravasation of blood in the skin, as well as, of course, the results of tapping, will usually clear up a doubt.

Certain rare forms of vascular deformity are occasionally met with in children. In a case of our own the condition may be best described as arterio-venous varix, all the vessels being dilated and pulsatile; the facial, orbital, and intracranial vessels were involved as well as some of the cerebral sinuses, the straight sinus being converted into a pouch as large as a thrush's egg and its walls calcified [1] (fig. 93).

Aneurism by anastomosis is also occasionally met with in children, and sometimes ligature of a main vessel, such as the carotid, may be required, as also in some cases of arterial varix. St. Germain relates three cases of cirsoid aneurism cured by the use of chloride of zinc arrows. (*Vide* 'Chirurgie des Enfants,' 1884.) Excision is usually the best treatment.

Nævus lipomatoaes is the term applied to a form of degenerated nævus in which there is much development of fatty tissues forming masses which often hang in pendulous folds; there is commonly pigmentation and hairy overgrowth. The condition is rare, and appears to be associated with idiocy, as in the typical case under our care, from which fig. 94 was taken. No treatment is called for in such a case.[2] We saw in 1895 a female infant a few weeks old with an almost exactly similar condition. Occasionally, however, where merely a local mass is found, it should be removed by excision. This was the treatment adopted for the child shown in

Fig. 94.—Nævus Lipomatodes. The darkly pigmented pendulous masses were composed of fat and degenerated nævus tissue, and the whole surface was thickly overgrown with hair. As usual in these cases, the child was idiotic.

[1] A full report of the case here alluded to will be found in the *Abstracts* of the Children's Hospital for 1882–83. *Vide* also T. Smith, *Clin. Soc. Trans.* 1882.

[2] Hyde, of Chicago, has recorded a very similar case in the *Lancet*, August 1, 1885.

fig. 95, where the pendulous hairy mass, closely resembling the so-called 'pachydermatocele,' was excised with a good result.

Lymphatic Nævi.—Lymphatic nævi are much rarer than blood nævi, but many of the so-called congenital cystic growths should be classed as cystic lymphangiomata. Instances of this condition are seen, as shown by Virchow, in macroglossia, described at p. 188.

Hygroma and one form of so-called 'giant foot' are similar conditions (fig. 96). Sometimes in giant foot the cutaneous lymphatics are clearly visible as transparent, dilated, tortuous canals running in the skin : the part is greatly enlarged, and spongy on pressure. The disease is a rare one, and probably pressure or cautery puncture would be the most successful mode of treatment. Treves has recorded a case in which ulceration has occurred, and quotes Busey that congenital giant foot is commoner in females, and

Fig. 95.—Degenerated Nævus of Scalp.

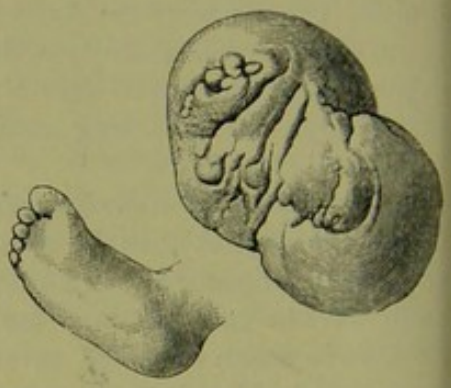

Fig. 96.—Lymphatic Nævus of the Foot. The soles of the two feet are seen, and in the affected one the extremities of the toes can just be made out, embedded in the mass of nævus tissue. Dilated and varicose lymphatics were visible in the skin.

most frequent in the right leg ; the temperature of the part may or may not be raised. Ulcers, if they occur, readily heal.

Occasionally in macroglossia, as in a case of ours, the superficial lymphatics form minute transparent cysts on the surface of the tongue ; here removal of part of the tongue might possibly be required to prevent suffocation, since these growths are liable to rapid increase in size. A large tumour of the thigh, of congenital origin, that we removed a short time ago from a child of 2½ years, was made of spongy tissue exactly like a nævus, but the spaces were filled with lymph instead of blood ; other similar cases have been recorded. (*Vide* also chapter on TUMOURS.) Hoggan has described multiple lymphatic nævi of the skin, a condition believed commonly to accompany blood nævi, and to be much more frequent than is supposed ; these

growths are not conspicuous by their colour, and are therefore commonly overlooked; they are of little clinical importance, unless probably as an early stage of elephantiasis. We have also met with instances of these nævi.[1] Cases of probably congenital lymphatic varices of the limbs have been described by R. W. Parker; he thinks they have a tendency to become locally inflamed.[2] We have recently met with a case of lymph nævus of the conjunctiva and supra-orbital region, causing an unsightly deformity; the nævus varied much in size, and sometimes 'puffed up' and became painful.[3]

Large multilocular cystic swellings may be met with in the neck, resembling in external appearance the hygromata which are associated with lymphatic macroglossia, but differing from these lymphatic tumours in that

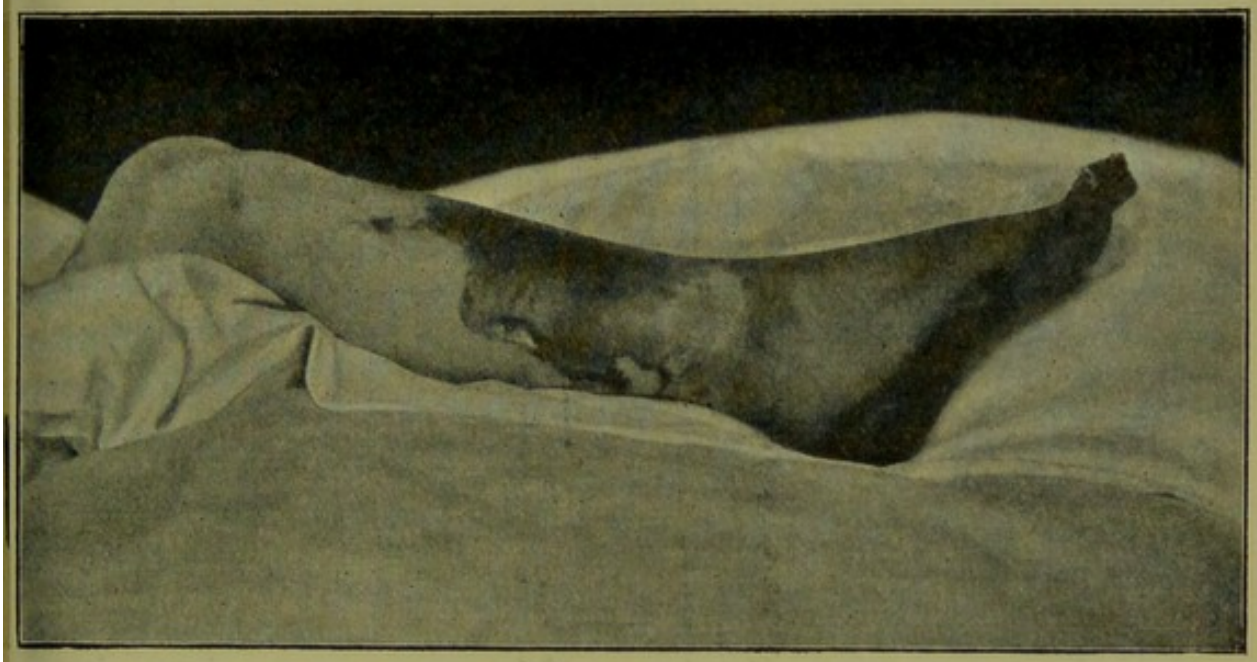

Fig. 97.—Gangrene of the Leg secondary to embolism of femoral artery. Boy, aged 7 years, with mitral and aortic disease.

some of the cysts are found filled with blood either coagulated or more or less altered and become 'laky.' In the same swelling cysts may contain fluid clear or only tinged with blood. It is difficult in such cases to be sure whether the growth is a blood nævus which has undergone cystic degeneration, or a lymph nævus in which hæmorrhages have taken place. Such a case which we saw with Dr. McNicoll, of Southport, occurred in a child of 7 weeks old; and as the tumour was growing and threatened to cause dyspnœa, it was treated by laying open and partly removing the larger cysts. The operation, though extensive and formidable for so young a child, had a satisfactory result.

[1] Hoggan, *Jour. of Anat. and Phys.* April 1884. *Lancet*, 1882, vol. ii. p. 891.

[2] *Vide* also chapter on TUMOUR GROWTHS IN CHILDHOOD.

[3] The case, with a drawing, has been published by Dr. Mules in *Trans. Ophthalm. Cong.*, Heidelberg, 1888. For an account of various rare abnormalities of the blood and lymph vascular systems (also *Nerven-Naevus*, &c.) the reader is referred to Esmarch and Kulenkampff's monograph on *Elephantiasis*.

Excision of the greater part of the cyst wall with subsequent drainage is, we have found, the best treatment. If the drain is removed too soon and insufficient irritation is set up, the lymph cavity is apt to refill.

Aneurism in children is extremely rare; only a few cases have been recorded, and these appear all to have been either traumatic or the result of embolism, the embolus giving rise to softening of the arterial coat, and consequent formation of the aneurism. A paper on this subject by R. W. Parker in the 'British Medical Journal,' 1884, may be consulted. We have only met with one case of aneurism, in a child aged 7 years, who was suffering from ulcerative endocarditis; the aneurism, which was situated on the left middle cerebral artery, was no doubt due to an embolus; it finally ruptured and gave rise to extensive meningeal hæmorrhage. Dr. A. Jacobi has reported several cases of aneurism in children, due to atheromatous degeneration, one case of the descending aorta in a girl of 7 years. Sanné has reported four cases, one in a fœtus and three in children of 2, 10, and 13 years respectively.

Embolism occurs not infrequently during early life in children suffering from acute or malignant endocarditis; it may occur in any form of valvular heart disease. Embolism of a cerebral artery may give rise to hemiplegia and softening (see p. 434). Embolism of the spleen is found not unfrequently *post-mortem*. In a patient of our colleague Dr. Hutton, who was suffering from mitral and aortic disease, embolism of the femoral artery occurred, followed by gangrene of the leg. The leg was amputated by Mr. Collier and the boy made a good recovery as far as the stump was concerned.

CHAPTER XX

DISEASES OF THE BLOOD AND BLOOD-MAKING ORGANS

Anæmia

CHILDREN of all ages are liable to suffer from anæmia, from causes both known and unknown. Some children are habitually pallid, without, perhaps, being in any way out of health; and this peculiarity seems to run in families. In the majority of cases anæmia means ill-health, the poorness of blood being due to one or other of a great variety of ailments. It is unnecessary for us to describe the anæmia which is due to obvious causes, such as tuberculosis, heart disease, syphilis, malaria, or the anæmia which is the result of some acute disease. We will chiefly confine our remarks to certain forms in which the anæmia is often profound and the pathology by no means certain. Thus we have anæmia accompanied by great enlargement of the spleen, and an anæmia in which no such enlargement is present. We have the so-called Pernicious Anæmia, which appears always to go on to a fatal issue. In some cases there is a tendency to purpura, and while in all forms of anæmia hæmorrhages are common when the anæmia becomes extreme, yet in some cases purpura is an early symptom, and makes its appearance without the anæmia being very great. The groups into which we divide these cases are selected rather for convenience of description than because they actually form independent or 'self-standing' forms of disease.

It is unnecessary to say that an examination of the blood gives important information with regard to the nature of the anæmia, and is therefore of use as regards prognosis and treatment. For the details of the methods of this examination we must refer the reader to the various clinical manuals.

The examination includes (1) The estimation of the amount of hæmoglobin present as measured by Fleischl's hæmometer. In healthy children there may be 85 to 95 per cent., in profound anæmia as little as 30 to 35 per cent.

(2) Counting the number of the red and white corpuscles, by means of the Thoma-Zeiss apparatus. In round numbers, in healthy children there are 5,000,000 red corpuscles to the cubic millimetre; in some forms of anæmia the number may sink nearly 1,000,000. The number of white corpuscles varies from 8,000 to 9,000 (Limbeck) in children, and from 12,000 to 13,000 (Gunrobin) per cubic millimetre in infants under a year.

(3) A microscopical examination of the red corpuscles to determine their shape, size, and colour. In certain forms of anæmia abnormally large red blood corpuscles (**megalocytes**), or small ones (**microcytes**) may be present, or there may be a variation in their shape (**poikilocytosis**). The red cells are abnormally pale—i.e. their colour index is low, and they may fail to form rouleaux.

(4) A film of dried blood is stained with eosin and methyl blue in order to distinguish between the varieties of red and white corpuscles present, and to determine their relative proportion.

Nucleated red corpuscles (normoblasts) are seen in fœtal blood and in the blood of infants a day or two old; they are not present in health in older children. In some forms of anæmia, **normoblasts, megaloblasts** (large nucleated), and **microblasts** (small nucleated) are present. The following forms of leucocytes may be distinguished in normal blood in varying proportions:

(*a*) **Small lymphocytes,** consisting of small cells with a large blue nucleus and narrow zone of clear protoplasm; they are supposed to derive their origin from lymphatic gland tissue. (*b*) **Large lymphocytes,** consisting of cells with a large oval or indented nucleus, and a large zone of surrounding clear protoplasm. They are believed to be derived from the marrow of bone and spleen. (*c*) **Finely granular** or **polynuclear** (**neutrophile**) cells. The nucleus is multipartite, and lobed. The protoplasm is filled with granules which stain with eosin. The number of these cells is increased in febrile conditions: they are in normal conditions in adults the most numerous of the white corpuscles present. (*d*) **Coarsely granular eosinophile** cells: they have a single round or horseshoe nucleus, the protoplasm has coarse granules which stain strongly with eosin. (*e*) **Myelocytes** are absent from normal blood, but are found in large numbers in myelogenous leukæmia; a few are seen in splenic anæmia.

As regards the relative numbers of these in the blood of healthy adults and infants, the following numbers may be taken as approximately true. Small lymphocytes: adults 20 per cent., infants under 1 year 59 per cent. Large lymphocytes: adults 6 per cent., infants 6 per cent. Finely granular neutrophile cells: adults 75 per cent., infants 31 per cent. Coarsely granular eosinophile cells: adults 2 per cent., infants 3 per cent. (Uskoff), (Gunrobin). From this it would appear that in early life the small lymphocytes are increased at the expense of the finely granular or neutrophile cells.

Anæmia with Œdema.—In all cases in which the anæmia is great there is a tendency to the accumulation of serum in the serous cavities, and a liability to subcutaneous œdema. In the out-patient department of hospital practice it is common to meet with infants or children under 2 years of age who are anæmic and at the same time œdematous, the back of their hands and feet readily pitting. Such cases are often looked upon as suffering from nephritis, but the urine is mostly free from albumen and casts. There is usually no enlargement of the spleen. These cases are commonly seen in the autumn in children who have suffered from acute diarrhœa or some other exhausting disease which has given rise to great anæmia. The anæmia is due to the great drain on the system during acute or long-continued disease, or possibly it may be the result of the action of toxic albumens or peptones absorbed into the blood from the alimentary canal. We must also remember that the arterial pressure in young children is normally very small, and easily reduced by acute disease. (See Nephritis.)

Simple Anæmia—Chlorosis.—There is a class of cases mostly occurring in older children which resembles the chlorosis of adults. There is no enlargement of the spleen, no purpura or any evidence of organic disease.

The children are markedly bloodless, languid, and easily get out of breath ; murmurs may be heard at the base of the heart, and in the veins and arteries of the neck. Both girls and boys may be affected this way about puberty. In one instance coming under our notice, two brothers and a sister, aged 8¼, 7, and 5¾ years, suffered in this way ; their mother was also anæmic. They were intensely pale, drowsy, and lethargic ; they were fairly well nourished as far as fat was concerned ; there was no splenic enlargement, no albumen in the urine, and no hæmorrhages. In all three there was an irregular pyrexia, a rise of a degree or two taking place most evenings. An examination of the blood showed a diminution of red blood corpuscles, a low percentage of Hb and no striking excess of white corpuscles. They all three improved considerably during their stay in hospital. It is well to bear in mind that such cases are exceedingly apt to be tuberculous.

Idiopathic or Pernicious Anæmia is a rare disease in children ; out of 102 cases published by Dr. Pye Smith in the Guy's Hospital 'Reports' for 1882 there were six between the ages of 7 and 15 years. It has been met with in children of all ages. Kjellberg has recorded a case in a boy of 5 years, Elben in a girl of 3 years, and W. Steffen in a girl of 16 months. It is always fatal.

No cause can usually be assigned for the anæmia ; in one case coming under our notice the child had been much neglected and badly fed. Schapiro reports a case of a girl of 13 years who was supposed to suffer from pernicious anæmia, but began to improve after passing a tapeworm—*Bothriocephalus latus*.

The symptoms and course are exactly the same in children as in adults. The first symptoms are those of weakness, breathlessness, and pallor, coming on without cause. The anæmia becomes extreme, the skin is blanched and of an earthy tinge ; the conjunctivæ and mucous membrane of the mouth are pallid, and the muscles weak and flabby. Usually there is no great loss of flesh. Vomiting is not uncommonly a marked symptom. In some cases there appears to be a slight rise of temperature at night, 101° or 102° ; in this respect pernicious anæmia resembles other forms of anæmia. Purpuric spots are sometimes present on the skin, and retinal hæmorrhages and optic neuritis may develop (S. Mackenzie).

An examination of the blood in an advanced case shows a very marked diminution of the red blood corpuscles, their number being reduced to 1,000,000 or even less, the Hb is reduced in quantity but not in the same proportion as in chlorosis. The red cells vary greatly in size and their Hb is increased ; the Hb often undergoes a change with the formation of methæmoglobin. Megaloblasts are mostly present in large numbers. The leucocytes are usually diminished.

The course is often acute, usually varying from one month to three months.

Morbid Anatomy.—All the organs are in a bloodless condition, the muscles are in a state of fatty degeneration, and minute hæmorrhages are found on the surfaces of the organs. There is no further alteration found in the spleen or other viscera.

The following case illustrates many of the above points :

Pernicious Anæmia.—Walter H., aged 11½ years, has been getting pale and weak for six months, no cause known ; has had hollow cough and frontal headache ; for two

months has had frequent epistaxis, and for some time has had fainting fits, and spots 'like bruises' have appeared on thighs and shins; no bleeding from lungs or bowels noticed. Mother strong, father said to have been phthisical in early life; brothers and sisters all rickety and anæmic, four of them now in hospital with scarlet fever; all recovering. Admitted August 30. Large, well-formed, well-nourished, and muscular boy, dark brown hair and eyes, height 4 ft. 7 in., intelligent; intensely anæmic, tongue furred, pale and fissured, fauces pale, tonsils large; respiration 34, fairly deep; pulse 146, regular and full; temperature 103°; both bases dull, with weak respiratory sounds, no crepitation, heart's area normal, impulse heaving and visible over second to fifth spaces, sounds indistinct, spleen and liver not felt in abdomen, blood watery and pale; red corpuscles, generally normal in shape and form characteristic rouleaux, a few are elongated; white corpuscles only slightly increased relatively, vary much in size, most of them being smaller than usual; urine 1016, pale, no albumen, no excess of urates or phosphates; ordered citrate of iron. August 31.—Temperature now between normal and 100°. September 6.—Temperature still below 100°; respiration 32; pulse 148; no cough, no night sweating, has attacks of syncope on attempting to sit up, has vomited twice to-day, no cardiac murmur. Died September 7.

Post-mortem.—Forty hours after death body well nourished, intensely anæmic, rigor mortis persists, a few ounces of serum in each pleural cavity, patches of emphysema along margins of lungs, no consolidation, abundant sub-pleural ecchymoses; about 2 oz. clear serum in pericardium, no pericarditis, no endocarditis, abundant sub-pericardial ecchymoses, tricuspid orifice admits three fingers, muscular fibre pale; much 'tabby-cat' mottling of endocardium. Spleen 3½ oz., soft and friable; liver 34½ oz., very anæmic; kidneys 4½ oz., very soft, intensely anæmic, capsules peeled off readily.

Borderland cases may be met with in young children, of which the following case of Dr. E. M. Brockbank's is an example:

Eric C., aged 1 year 7 months, very pale since 10 months old; vomits off and on, hæmatemesis on one occasion. Is very anæmic, gums spongy and bleeding. Blood examination by Mr. H. H. Rayner, result as follows: Red corpuscles 880,000, Hb 20 per cent., leucocytes 9375. Red corpuscles stain deeply with eosin, vary in shape and size; many pear-shaped. Numerous normal nucleated red corpuscles and a few large ones. White corpuscles normal, except decrease in polynuclear leucocytes. No enlargement of the spleen. Child became very feeble and lost weight, developed ecchymoses and epistaxis, and died six weeks after admission. Orange juice and fresh food had been freely given. At the *post-mortem* the stomach was dilated, evidence of rickets; spleen not enlarged; no other naked-eye changes.

Treatment.—The medicines most likely to be of service are iron and arsenic. Phosphorus and cod-liver oil have been used with some success. Bone marrow and raw meat juice should be given. In the majority of cases the progress is from bad to worse.

Enlarged Spleen

The spleen is a very vascular organ, is functionally more active in childhood than in after life, and is more apt to become temporarily engorged and enlarged. The best method of determining the enlargement during early life is by palpation rather than by percussion, as the lesser rigidity of the abdominal walls during early childhood usually readily permits of this. Palpation of the spleen is effected by standing at the patient's right side and gently pressing two or three fingers of the right hand into the left hypochondrium beneath the costal arch, when the lower and inner edge of the spleen, if it is enlarged, can be readily felt as a movable tumour which can be pressed upwards. It can hardly be said that the spleen is enlarged unless

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its lower edge extends below the costal arch. Enlargement is very common during childhood, and accompanies various conditions. An enlarged spleen is most frequently associated with an anæmic condition, though exactly what the relation between the two is is uncertain (see *infra*). An enlarged spleen is also met with when the portal system is obstructed, as in cirrhosis of the liver. In two cases coming under our notice the spleens were greatly enlarged, and in these cases it is quite possible to overlook the cirrhosis of the liver and look upon the case as one in which the splenic enlargement is due to Hodgkin's disease or some anæmic condition (Banti's disease). It is enlarged in many cases of rickets and syphilis, though certainly not in all cases ; it is chiefly so in those cases in which pallor and anæmia are marked symptoms. It is enlarged and hard in ague, and also when lardaceous and in association with leucocythæmia and Hodgkin's disease. It is also enlarged in various acute diseases, such as typhoid fever, acute tuberculosis and pyæmia, and in some other febrile states, such as ulcerative endocarditis.

Anæmia Splenica. Anæmia Infantum Pseudoleukæmia (Von Jaksch).—In an ill-defined group of cases, occurring mostly in children between 6 months and 2 years of age, the anæmia is often profound, and the spleen strikingly enlarged. Sometimes mothers will bring such children for treatment, as they have already noticed the large spleen as well as the paleness of the child. There is usually a history to be obtained of ill health, more especially of aggravated indigestion, or some acute illness, and nearly all of them exhibit evidence of rickety deformities. In a well-marked case, the anæmia strikes the observer at once as being much out of the common ; the lips are a pale pink, and the face is white or of a slightly yellow tint ; on placing the hand on the abdomen, the edge of the spleen is distinctly felt (it can sometimes be seen), and the tip can be traced downwards on a level with, or below, the umbilicus. There may be enlargement of the liver. Jaundice has been noted in one or two cases. No enlargement of the lymphatic glands takes place. The urine is free from albumen, and, except quite at the termination of the case, there are no hæmorrhages and no œdema. There is often irregular and intermittent pyrexia. The course is essentially chronic ; the patients usually improve slowly under treatment in hospital with careful diet and tonic medicines. They readily succumb to intercurrent diseases, such as measles or pneumonia. In the worst class of case the anæmia becomes more and more profound, and they die exhausted ; in the later stages there may be hæmorrhages, purpura, and œdema. On the other hand, we meet with 'borderland' cases, where there is a moderate degree of anæmia and splenic enlargements, with perhaps well-marked signs of rickets. The etiology of these cases is uncertain. Syphilis produces anæmia and also splenic enlargement in more or less degree, and some believe (Fox and Ball, G. Carpenter) that it plays a predominating *rôle* in these pseudoleukæmic cases. On the other hand, there is a very close connection between this condition and rickets, as almost all such children exhibit evidence of rickety changes in the bones, and this disease occurs at an age when rickets is most common.

We are inclined to agree with Carr in believing that, while both syphilis and rickets may play a *rôle* in producing this condition of splenic anæmia, they are neither of them the sole or efficient cause, but that congenital

weakness, chronic dyspepsia, bad feeding, and insanitary conditions are largely to blame. The anæmia is the result of some form of toxin formed n the alimentary canal and absorbed into the circulation. Fowler believes that the splenic enlargement precedes the anæmia, and the greater the enlargement of the spleen the more profound the anæmia.

Changes in the Blood.—During the last few years many observations have been made upon the blood in this disease, among others by L. Gulland, Fowler, G. Carpenter, and C. H. Melland. The latter has been good enough to examine the blood of some of our own cases. We can only give a summary of the chief changes noted. The number of red corpuscles is diminished, varying from 1,150,000 to 5,000,000; the colour index varies from ·3 to ·7; the Hb equals 20–60 per cent. The red corpuscles vary to some extent in size and shape; normoblasts and a few megaloblasts are present. The leucocytes vary in number from 10,000 to 100,000, though the latter figure is exceptional, 20,000 being a rough average, but great variations occur. The ratio of whites to reds may be as low as 1–31 (Fowler); normally it is 1–500. The lymphocytes preponderate in numbers over the polynuclear, but the question of differentiation of the leucocytes is a very difficult one. A few myelocytes are sometimes present.

While in a vast majority of cases the children who suffer in this way are under 2 years of age, yet occasionally we meet with older children who are affected in a similar manner, as in the following fatal case:

Anæmia, Enlarged Spleen.—Thos. Arthur C., aged 5 years. Up to four months ago quite healthy; no serious illness. Has lived always in Manchester. Father and mother healthy. Four months ago had a fall, not confined to bed; abdomen painful and swollen ever since; two months ago had severe epistaxis, with no known cause; very much blanched ever since, feet sometimes swollen; has had occasional pain and twitchings in left arm for an hour at a time, and slight twitchings of the body also. On admission, December 29, 1881, plump, with marked pallor, a few purpuric spots on thighs and feet; superficial glands generally enlarged, face œdematous, no œdema of feet; abdomen prominent in epigastric and hypogastric regions, liver and spleen much enlarged, heart and lungs nil. Urine 1020; no albumen. Temperature 103° P.M. January 2.—Loud systolic murmur over whole cardiac area, no mediastinal dulness; heart's area increased, apex beat felt outside nipple line. Blood thin and watery, with some increase of white corpuscles; spleen rather tender. Temperature irregular, 98° to 101° and 102°. January 13.—Constantly moaning; temperature still high and irregular. January 14.—Died 5 A.M., unconscious all night. *Post-mortem.*—Twelve hours after death; great pallor, some œdema of extremities; blood very fluid, liver uniformly enlarged, pale with fine yellow points (hepatic vessels). No perihepatitis, spleen 5 in. by 3 in.; smooth, firm, purple on section. Retroperitoneal glands very slightly enlarged; kidneys firm and very pale. No peritonitis, no ascites, no staining of organs with iodine. *Heart.*—Left ventricle hypertrophied; right ventricle dilated, subpericardial ecchymoses, valves normal. Lungs emphysematous, with abundant ecchymoses on surface and in substance. No enlarged mediastinal glands; brain firm, intensely anæmic, otherwise apparently healthy. No venous congestion, no fluid in ventricles.

Treatment.—Iron and arsenic are the drugs most likely to be of service in anæmia; cod-liver oil is also good, but the treatment must necessarily be modified according to the cause. The cachexia produced by syphilis must be treated by a combination of iron and mercury, with quinine if malaria is suspected. Care must be taken to see that the bowels are acting

normally. Raw marrow of bone, raw meat juice, orange juice, peptonised milk should be given.

Hodgkin's Disease—Anæmia Lymphatica.—This disease is characterised by an enlargement of various groups of lymphatic glands and also of the spleen ; there is progressive anæmia, and more or less intermittent fever. According to Gower's statistics, 16 out of every 100 cases occur in children under 10 years of age. The earliest symptom which calls attention to the disease is enlargement of some lymphatic glands, usually the cervical, though the axillary or mediastinal may be early affected.

The glands just behind, or in front of and beneath, the sterno-mastoid are frequently the first to be enlarged, or the group at the angle of the jaw ; the glands at first are firm and movable, varying in size from time to time as if the vessels were gorged at one time and normal at another. With the glandular enlargement there is usually a marked increase in size of the spleen, and the child becomes weak and pallid. A prominent feature of the disease is the occurrence of attacks of pyrexia ; the temperature at times continues elevated for some days, or it may assume the intermittent type. Other groups of glands may become affected ; there may be an extension into the mediastinum, and the glands may exert pressure on the trachea or large veins, so that there is orthopnœa, œdema, or ascites. The axillary and inguinal glands may also become affected. In some cases the external lymphatic glands may be but little affected, but the mediastinal or retro-peritoneal glands and the spleen may be much enlarged. The course of the disease is very chronic, but the prognosis is unfavourable, and sooner or later the child dies exhausted. At the autopsy the spleen is found enlarged and infiltrated with an adenoid growth, while other organs, as the lungs, liver, and kidneys, are also infiltrated, only in less degree. Examination of the blood does not show characteristic changes. The number of red corpuscles are slightly if at all diminished ; the Hb is also diminished. Moderate leucocytosis, chiefly lymphocytes.

Diagnosis.—The diagnosis of Hodgkin's disease in an early stage is often extremely difficult where the patient is brought with a mass of enlarged glands in the neck or other part. If the glandular tumours vary in size from time to time, if there is intermittent pyrexia or enlarged spleen, Hodgkin's disease may be suspected. If the glands suppurate they are probably tuberculous. We have frequently seen enlarged tuberculous cervical and axillary glands mistaken for the enlarged glands of Hodgkin's disease. Possibly tuberculous disease and Hodgkin's disease may co-exist.

Treatment.—Arsenic and phosphorus are the medicines most likely to be useful, but the disease generally progresses to a fatal termination.

Leukæmia.—Leukæmia is a rare disease during childhood, but the possibility of its being present should be borne in mind when the patient is a pallid child with a large spleen, especially if on examination of the blood there is marked leucocytosis. It occurs at all ages : babies at the breast have been affected, and also older children ; it cannot be said that anything certain is known about its etiology, though poor living, various depressing conditions, and malaria have been credited with producing it. The earliest symptom to call attention to the disease is abdominal distension, which is found to be due to a greatly enlarged spleen ; with this there is dyspepsia,

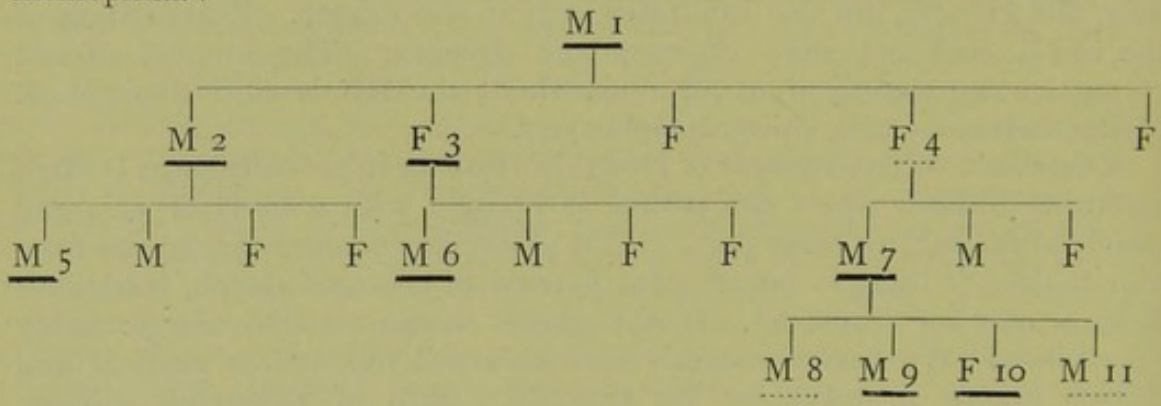
perhaps abdominal tenderness, and marked anæmia. The disease is a chronic one, and the prognosis unfavourable. Like Hodgkin's disease, there may be enlargement of lymphatic glands and intermittent pyrexia. Later in the disease the anæmia becomes profound, œdema of the subcutaneous tissues takes place, and often there are hæmorrhages.

Two forms of leukæmia are distinguished, the mixed form in which the spleen and marrow of the bones are mostly involved, and the lymphatic variety in which the lymphatic glands are enlarged. In myelogenous leukæmia the chief feature is the number of myelocytes, eosinophile cells, and polynuclear leucocytes ; in lymphemia the white cells are lymphocytes, while myelocytes are absent.

The Hæmorrhagic Diathesis

During early life a disposition to bleed arises under many different conditions. In some cases the disposition to bleed is hereditary, in others it is the result of many different forms of illness. We will consider the hereditary variety first.

Hæmophilia.—This term is applied to a disposition to bleeding which is hereditary ; it affects males more often than females, but the females often appear to transmit this tendency to their sons. This tendency to bleed may only appear in one or two members of a family, the rest escaping, but those who thus escape may transmit the diathesis to their children. Dr. A. Goodall records the following exceptional hæmophilic genealogy. The males are noted by the letter 'M' ; the females by 'F.' The letters are underlined in the case of the bleeders. The dotted lines indicate a slight tendency to hæmophilia :



M 1 lived till over 80 years, though suffering severely all his life from epistaxis and other hæmorrhages ; M 6 died of hæmorrhage ; M 7 suffered as a boy and outgrew the tendency ; F 10 has suffered severely.

Hæmophilia does not usually appear at the time of birth, the disposition usually first manifesting itself after the end of the first year of life. It is true that newly-born children are apt to bleed from the navel or suffer from hæmatemesis, but this is the result rather of some disease than from inherited tendencies. Children who exhibit this diathesis seem to exhibit it in different degrees at different times ; sometimes they appear to bruise on the slightest injury, while at other times there is hardly any tendency in this direction. Purpura or 'bruising' is the most common manifestation ; slight pressure

or a slight knock on a limb, such as might take place by the nurse catching firmly hold, will suffice to bring out a well-marked bruise, which is many days in fading. Sometimes a number of hæmorrhagic spots make their appearance spontaneously, and in the same way extensive subcutaneous bleedings may take place. A slight scratch or cut may ooze blood for some time before it stops; cracks or fissures in the skin of the lips may ooze in the same way. Of the mucous membranes perhaps the gums most often bleed—friction with a tooth brush may be enough to start a hæmorrhage. Epistaxis is also very common, and may be very difficult to stop, and in rare cases goes on to a fatal termination. There may be hæmorrhage from the stomach from straining when vomiting, or blood may appear in the stools.

Hæmaturia also takes place at times. Hæmatomas of the scalp are liable to follow slight falls, or injuries and bleedings of considerable amount may take place beneath the muscles and other deeply situated structures. Bleedings may take place into the joints, especially the knees, as the result of injury. The joints appear swollen and tender, and contain fluid. The fluid gradually disappears with rest; but if repeated bleedings occur much thickening of the synovial membrane with overstretching of the ligaments and nodular swellings, resulting in distortion and more or less permanent crippling of the joint, may result. A joint into which hæmorrhage has once taken place is apparently likely to suffer again.

We have also met with a case in which, in addition to hæmorrhage into joints on several occasions, bleeding took place beneath the palmar fascia, causing great pain, and a somewhat alarming appearance of the hand. The blood was, however, slowly absorbed, and no serious ill result followed. The history of the patient is as follows:

Hæmophilia; Effusion in Knee Joint.—L., a boy of 14, was first seen in September 1890, with Dr. Massiah. There was no history of hæmophilia in the family. At Christmas 1889 he sprained his left knee, and it at once filled with blood, and has never been well for any length of time since. When seen in September the left knee was enormously distended with fluid blood, and was a good deal hotter than the other. His brother, who was seen at the same time, had numerous bruises, and one ankle contained fluid blood, which was becoming absorbed and giving rise to discoloration of the adjoining parts. On examining the knee thirteen days later it much resembled a joint the subject of chronic osteo-arthritis; there was thickening of bone and crackling of the joint, with occasional 'locking.' The limb could not be fully extended, and there was ½ inch shortening. In April 1892 he was seen again; the knee was again swollen after an injury, though not to the extent of the former attack. See also chapter on Joints.

Perhaps the most serious complication of all is a cerebral hæmorrhage. This may be the result of a blow or a knock, or it may apparently occur spontaneously. Thus a girl of 3¾ years, who had had from time to time bruise marks on her skin, suddenly developed symptoms of paralysis of the respiratory muscles, and she died asphyxiated in three or four days. At the *post-mortem* a hæmorrhage into the medulla was found. (See case under Medullary Hæmorrhage, p. 538.)

Examination of the blood shows diminution of red corpuscles and Hb in proportion to the bleedings which have taken place and the rouleaux formation may be impaired. The most important point is delayed coagulation of the blood (A. Goodall).

The prognosis in all cases of hæmophilia is necessarily uncertain. Some are carried off in many instances by intercurrent disease, to which they fall an easy prey, or as the result of some accident, or from repeated attacks of epistaxis or other form of bleeding. Some reach adult life, as examples of this condition are not uncommon among adults, and indeed old men.

The diagnosis is not difficult in a well-marked case, but there may often be a doubt as to whether the disease is hereditary or whether it has supervened on some form of disease, but in the hereditary form the history of bleeders in the family will necessarily be of help. We have known a large hæmatoma mistaken for an abscess and opened, to be followed by continual oozing, and finally septicæmia.

Very little is known for certain about the pathology of hæmophilia. It has been supposed that there is some congenital affection of the arteries or the capillary vessels, which allows the blood to ooze easily through their walls, but this has not been substantiated. The essential pathology seems to consist in a greatly delayed coagulability of the blood which progresses with progressing anæmia (A. Goodall).

No children require so much care or are greater causes for anxiety than habitual bleeders. No operation, however slight, can be permitted in these cases. Gum-lancing, excision of tonsils, drawing teeth, opening abscesses, must be avoided. They must be carefully watched and guarded in every relation of life. When bleeding is going on chloride of calcium internally and solution of suprarenal gland locally are likely to be of most service; later Blaud's pills. When bleeding has taken place into a joint, the child should be kept in bed with the affected joint fixed in a splint and cooling lotions applied. After a week of rest, if no recurrence of the bleeding takes place, very gentle movement and rubbing should be employed to prevent stiffness and favour absorption of the blood as perfectly as possible. All violent exercises must be avoided by these children; they are, in consequence, a source of constant uneasiness to their friends.

Purpura simplex, Purpura hæmorrhagica.—These terms are applied to conditions in which the hæmorrhagic diathesis has been acquired, that is, is not hereditary. The name P. simplex is applied when the bleeding is subcutaneous only, as in petechia, flea-bites, and bruises; that of P. hæmorrhagica when the bleeding takes place from various sources besides the skin, such as kidneys, mucous membranes, &c.

Purpura hæmorrhagica occurs under a number of different conditions. Thus it occurs (1) in malignant smallpox and measles, typhus, scarlet fever, acute ileo-colitis, erythema nodosum, and especially in diphtheria—in these cases it is due to the presence of albumoses in the blood; (2) in various anæmic conditions, especially towards the later stages, when the anæmia is severe, such as scurvy, pernicious anæmia, leukæmia, &c.; (3) it occurs at times without being associated, as far as can be made out, with other diseases; but it may be doubted if it is ever an independent disease.

The term **Henoch's purpura** is usually applied to a variety of purpura which is characterised by sudden onset of colicky pains in the abdomen and the passage of blood, often in large quantities, by the bowel. There is often vomiting of blood either black or red, petechiæ and purpuric spots and patches on the skin. There may be joint or muscular pains, and in some

cases a hæmorrhagic nephritis. Recovery is the rule, but relapses are common and death may take place in one of the relapses. The cause is quite uncertain, nor is it known if the colic precedes the hæmorrhage or is caused by a purpuric condition of the mucous membrane of the bowel. We must also bear in mind that in some cases with very similar symptoms evidence of inflammation, as for instance membranous exudation, may be present as well as submucous hæmorrhage (see Ileo-colitis).

Cases have been recorded by G. A. Sutherland and also by H. Burrows in which laparotomies were performed on patients suffering from Henoch's purpura, under the belief they were suffering from obstruction of the bowels due to intussusception. On p. 103 we have recorded a similar mistake. In all doubtful cases the gums should be examined for any oozing of blood or fœtor, and the surface of the skin carefully searched for purpuric spots. Fisher records a *post-mortem* of a case of this nature in a boy of 3 years and 11 months, who died in a second attack ; he found the mucous membrane of the small intestine, cæcum, and ascending colon intensely congested and thickened from interstitial hæmorrhage.

Other types of hæmorrhage are also met with ; thus we have seen cases in which the first symptoms were drowsiness and irritability, so that tuberculous meningitis was suspected. Then bleeding gums and petechiæ made their appearance, and later quantities of what looked almost like pure blood without clots passed per urethram. Then, when the child seems moribund, the hæmorrhage ceases, and much to the surprise of the medical attendant uninterrupted recovery takes place.

In other cases, again, there is what Henoch has called **Purpura fulminans,** in which there is extensive ecchymoses covering the skin, hæmorrhages from various organs and death in a few days. These cases closely simulate malignant smallpox.

Sometimes purpura accompanies a type of disease which resembles scurvy more than anything else, and yet there has been no deprivation of fresh food or hardship of any sort. As an example of this we may relate the following case :

Purpura Hæmorrhagica.—Guy F., aged 6 years. Was always a fairly healthy boy till August 1889, when he had a severe attack of diarrhœa, with collapse, at the seaside. He never completely recovered himself, being pale and weak. At the end of the following January he suffered from spongy gums, occasional vomiting of dark blood, and frequent bruise marks on his body. He continued much in the same state for the next month, when (February 14) he tripped and fell, striking his head against the edge of a table. A hæmatoma of the scalp quickly formed on the right side of his forehead ; during the same night the fingers of the left hand twitched continuously, and the grasp on that side was feeble. Next day the grasp of his left hand was very weak, and there was some difficulty in flexion and extension of the wrist. Four weeks after the accident the hæmatoma and bruising had nearly disappeared, and power had mostly returned in the left hand. He, however, continued to go downhill ; there was pain in the stomach and frequent vomiting, oozing of blood from the nose, and purpuric spots appeared on the trunk and limbs. A loud, rough bruit was heard over the whole heart area, he became more and more anæmic, and there was marked wasting. He was unconscious for 20 hours before death, which occurred at the end of March. *Post-mortem.*—Excess of clear fluid in the serous cavities ; punctiform bleedings on surface of heart and lungs ; no valvular lesion ; muscle of heart pale, left ventricle dilated. Stomach much dilated ; walls of stomach and also of intestines very thin. Spleen enlarged and soft. Extensive subarachnoid hæmorrhage over

surface of the brain ; some red fluid between dura and arachnoid. On the right ascending frontal convolution is a hæmorrhage, circular in shape, involving the width of the convolution, extending an inch into brain substance. The bleeding has involved the hand centre.

The ecchymoses which occur vary much in size and number ; in rare cases the greater part of an arm or thigh is of a dark purple colour from hæmorrhage beneath the cutis. In other cases the purpuric patches vary in size from mere points like hæmorrhagic flea-bites thickly scattered over the skin to patches the size of the palm of one's hand. In erythema nodosum the nodes, which are first of a rosy tint, become in a day or two purple from capillary hæmorrhage. In rare cases patches of subcutaneous hæmorrhage become gangrenous. Sangster has recorded such a case. A girl of 5 years had several purpuric patches on the extremities and cheeks ; one of these on the arm ended in gangrene, recovery eventually taking place. Steffen has collected several more cases, in which multiple skin gangrene occurred after purpura ; the cases proved fatal.

In a number of cases hæmorrhage occurs either on the surface or into the substance of the brain. We have already referred to two such cases coming under our notice, one in which there was medullary hæmorrhage, and the other in which a small bleeding occurred in the Rolandic area. Grosz records a case where there was a hæmorrhage the size of a nut in the substance of the right lobe of the cerebellum, and also beneath the pia mater.[1] Steffen has collected four fatal cases in which meningeal hæmorrhage or hæmorrhage into the brain substance was found *post mortem*. In some cases there has been evidence of brain hæmorrhage, in which recovery has taken place. Hæmorrhage has also been found in the substance of the spinal cord.

Steffen reports cases in which a myocarditis occurred in the course of purpura leading to dilatation of the left ventricle ; and a consequent inefficiency of the mitral valves. In such cases a mitral murmur will be heard during life. (See case, p. 467.) Hæmatemesis is not uncommon. Indeed, vomiting is frequent, the vomited matter being streaked with blood, probably from punctiform bleedings taking place in the stomach. Blood in the stools also occurs in these cases, and punctiform bleedings are frequently found *post mortem*. Hæmaturia is a frequent symptom ; in some cases there is albuminuria and no blood present.

The association of purpura with rheumatism is an interesting one. Schonlein gave the name of **Peliosis rheumatica** to a form of purpura in which the joints were affected. Probably Steffen is right in altogether dropping the name, inasmuch as the so-called Peliosis rheumatica is purpura in which there has been bleeding into the joints or the muscles or tissues around the joints.

As a rule an attack of purpura is feverless, but in some cases there is moderate fever, especially before the appearance of a crop of petechiæ. In the acute cases, such as have been described by Henoch, Pye-Smith, and others, in which there is vomiting, hæmatemesis, hæmaturia, petechiæ, delirium and coma, there may be a high temperature.

An examination of the blood during an attack shows a diminution of the hæmoglobin and of the red corpuscles. The leucocytes may at first be in

[1] See Grosz, *Ueber Purpura im Kindersalter : Archiv für Kinderheilk.* Heft. i. u. ii. 1894.

slight excess, but they also diminish in number. Micro-organisms have been found, but as yet bacteriology has shed but little light on the pathology of this disease. Experimentally, it has been shown that the presence of peptones and albumoses in the blood gives rise to hæmorrhages and many of the symptoms of purpura.

Concerning the *prognosis* in purpura little can be said. Purpuric small-pox is well-nigh always fatal, and purpura occurring during the course of diphtheria is an extremely bad omen. In malignant scarlet fever and also in malignant measles the rash is at times said to be purpuric. We have never seen such cases, but on several occasions we have seen the rash in both diseases assume a purpuric appearance, and recovery take place without a bad symptom. In some forms of anæmia with wasting, the appearance of purpura marks the beginning of the end. Purpura simplex is always of less grave import than those cases in which hæmorrhages occur from internal organs.

The *treatment* of purpura is the treatment of hæmorrhage generally. Among the most valuable hæmostatics are calcium chloride (gr. v–gr. xv), solution of adrenal gland (♏v–♏x), ex. hamamelis liq. (♏v–♏xx), ex. ergotæ liq. (♏v–♏xx), ergotine by subcutaneous injection, gallic acid (gr. v–gr. x), and acetate of lead (gr. $\frac{1}{4}$–gr. i).

CHAPTER XXI

SYPHILIS

INFANTS and children may suffer from syphilis acquired in various ways after birth, or they may be the subjects of hereditary syphilis, the virus in this case being received from one or both parents at conception or during intra-uterine life. The infant may be inoculated with the syphilitic germ at the time of birth.

Acquired Syphilis.—Can a healthy infant be syphilised by means of the milk of a wet-nurse? This is an important question, and one which is often asked by parents before a wet-nurse is employed. There is no evidence that we know of to show that it can, and there is a strong probability that even if the virus was present in the milk it would not inoculate the infant unless introduced directly into the blood. That the infant can be inoculated if it has an abrasion on the lips and it draws blood from a sore nipple of a nurse suffering from secondary syphilis is certain, and it may, of course, be inoculated by the discharges from the genitals of the nurse conveyed to it on the nurse's hands. It need hardly be said that in selecting a wet-nurse the most scrupulous care should be exercised in ascertaining that the would-be nurse is not suffering from any specific disease; a careful inquiry must be made as to her health and the health of any children she may have had, especially with regard to any symptoms of syphilis.

Children of various ages may be seen in dispensary practice, suffering from chancres on the lips and genitals, who have been inoculated from their parents or others having specific sores, the virus being perhaps conveyed on the fingers. It is important to bear in mind that not only are the discharges from a primary sore liable to inoculate, but the discharges from various secondary lesions both in acquired and hereditary syphilis may also infect. Thus infants suffering from coryza or specific ulcerations about the mouth may inoculate the breast of a healthy wet-nurse, though they apparently never do that of their mother. No syphilitic infant should be wet-nursed by any one except its mother. It must, however, be stated that, while Colles relates instances of syphilitic infants inoculating their foster-mothers, many recent writers doubt the infectiousness of hereditary syphilis, and in many foundling hospitals on the Continent wet-nurses are allowed to suckle syphilitic infants apparently without harm resulting.[1]

The symptoms of acquired syphilis in children are the same as those seen in adults. There is a chancre followed by sore throat and a roseolous rash.

[1] See R. W. Parker, 'Is Inherited Syphilis Contagious?' *Edin. Med. Jour.*, June 1896.

But, as Coutts has well pointed out, the rash is apt to be scanty and evanescent, and may be easily overlooked, while subsequently there is a marked tendency to the growth of condylomata.

Syphilis has undoubtedly been on rare occasions inoculated by means of **vaccination:** abundant evidence of this exists in some epidemics of syphilis which have occurred, though such an accident is exceedingly rare. It may often happen that when vaccination is performed it is followed in a few days or weeks by symptoms of secondary syphilis, such as a roseolous rash, coryza, &c., but in the absence of a primary sore at the seat of vaccination these syphilitic manifestations cannot be accepted as evidence of vaccino-syphilis, and evidence may most probably be obtained of syphilis in the parents or in some of the brothers or sisters. As the first symptoms of hereditary syphilis most frequently make their appearance at from six weeks to three months after birth, and as this is the usual time for vaccination, it is highly probable that vaccination and the secondaries will often exist together and yet have no connection. If syphilis has been inoculated by vaccination, a month or six weeks later—during which time perhaps the vesicles have imperfectly healed—an induration makes its appearance at the seat of one or more of the vesicles, or there is an ulcer with an indurated base which has the characters of a hard chancre; this remains indolent, crusts over, and is followed in the course of a few weeks more by a specific eruption and other specific phenomena. In any case where vaccino-syphilis has taken place a well-marked scar is left at the seat of the puncture where the hard chancre has formed.

It is important to remember when investigating any case of supposed vaccino-syphilis that an interval of a month or six weeks elapses between vaccination and the formation of a chancre at the seat of inoculation (Hutchinson), and the diagnosis of syphilis cannot be accepted unless this is the case.

Hereditary Syphilis.—In hereditary syphilis the germ-plasm may be infected or the fœtus receives the poison at some period during intra-uterine life, and may be born with the evidence of syphilis upon it; or it is born healthy, the specific symptoms making their appearance within a few weeks or months of birth. In these cases, unlike acquired syphilis, there is no primary sore. The part played by the father in transmitting syphilis to his progeny does not admit of a doubt: the more recently he has suffered, the more likely is he to transmit it in a severe form, though for many years he is liable to beget children who suffer from hereditary syphilis. The most usual way in which he transmits it is by means of the spermatozoa at the time of fertilisation of the ovum; or during the intra-uterine life of the fœtus the mother may become infected by the husband, and she may infect the fœtus through the placental circulation, though this appears to be rare during the later months of intra-uterine life. The mother may transmit the disease to the ovum or the fœtus in utero, but this, as just stated, is rare after the seventh month of fœtal life; or she may infect it during the act of birth. The mother, on the other hand, may apparently be infected from the fœtus, though often she appears to escape; that is, a syphilitic father infects the ovum, the child is born and suffers from syphilis, the mother apparently escaping; but the escape of the mother is more apparent than real, inasmuch

as such women appear to be insusceptible to syphilis, and there is reason to believe that they do not escape, though the attack must certainly be slight. This was very definitely laid down by Colles, and is generally known as his law. He states that he had never known a syphilitic infant, although suffering from ulcerated mouth, infect the breast of its mother, whereas very few instances had occurred to his knowledge of a hired wet-nurse escaping under the same circumstances. Recent writers, namely, Parker, Coutts, Ogilvie, have brought forward evidence to show that at any rate Colles' law is not universally true. They assert that inherited syphilis is but slightly or not at all contagious, that wet-nurses are not affected; and if this is true, it will explain how the mother escapes without assuming that she is protected by a previous attack. A very few cases have been recorded in which a syphilitic infant has apparently infected its mother. It would certainly seem that while acquired syphil is in infants is virulently contagious, inherited syphilis is but slightly so.

The following is a summary of the modes of infection in hereditary syphilis.

1. The ovum may be infected by the spermatozoa of the father (paternal heredity).
2. The ovum may be infected by the mother (maternal heredity).
3. The ovum may be infected by both (mixed heredity).
4. The fœtus may become infected by the mother becoming infected during pregnancy.
5. The mother may become infected by the fœtus (syphilis by conception).

The mixed infection is the most serious, and the more recently the parents have suffered from syphilis, the more severely will the infant suffer. In four-fifths of the fatal cases of hereditary syphilis, the infants have been born within three years of the parents being syphilised (Fournier). Syphilis derived from the mother alone is more serious than syphilis from the father alone.

Effects of the Poison on the Fœtus.—The mother may miscarry at any time during fœtal life, a result due to disease of the fœtus or placenta; this is especially likely to happen if the father and mother are suffering from the disease in an active form. The exact nature of the lesions is uncertain; the placenta and internal organs, as the liver, lungs, &c., have been found diseased. The infant may be born at term, but dead, or may survive its birth but a short time; in the latter case it is puny, shrivelled, with blue extremities and a feeble hoarse cry. It may suffer from various skin eruptions, the most common (in the newly born) being pemphigus; various internal lesions may be found, such as interstitial hepatitis, and there may be gummata, perhaps breaking down, in the thymus, heart, or lungs. It may exhibit a tendency to bleed (see p. 35).

Though as a rule each successive child of syphilitic parents is likely to have the disease in diminishing severity, this is not always so, and a markedly syphilitic infant may be born after a previous apparently healthy child, the condition depending probably upon the health of the parents at and after conception. Cases of one twin being affected and the other not are on record.

Symptoms and Course.—The first definite symptoms usually make their appearance during the second month of life. These are often preceded by more ill-defined symptoms, such as restlessness, fever, peevishness, diarrhœa, and dyspepsia. The infant suffers from what appears to the friends to be a cold in the head : the nasal passages are obstructed by excessive secretion and the infant 'snuffles' during inspiration ; in the more severe cases the breast is taken with difficulty, as respiration is impeded during sucking on account of the nose being blocked, and the infant has to stop to breathe through its mouth. The coryza is followed by a characteristic rash, which usually consists of an erythema or erythematous patches of various sizes, the favourite places being about the anus, genitals, thighs, and forehead. These patches or plaques have sharp cut edges, are dull red in colour, and

Fig. 98.—Fissures around the Mouth in a case of Congenital Syphilis. The whole appearance of the face is characteristic.

shiny. Instead of an erythema the rash may be papular. When the eruption appears first it is a bright red, the vividness fades in a day or two, and the skin desquamates, and becomes of a dull red or coppery hue. As the disease progresses the secretion oozing from the nose dries up and forms scabs; the entrance to the nostrils becomes sore, and perhaps a sanguineous purulent secretion escapes from time to time. The upper lip may become excoriated and scabbed over. The corners of the mouth, which are constantly moist from the excess of saliva, become raw and perhaps ulcerated, and fissures and scabs may form which heal but slowly, leaving radiating scars (figs. 98, 99).

At this time a multiple epiphysitis frequently occurs. The infant cries when it is handled, and the ends of some of the bones, especially the lower ends of the humeri, the wrists and ankles, are found swollen and tender (see fig. 102). Coryza, rash, and epiphysitis are the three important symptoms occurring during the first three months of life.

The mucous membrane of the larynx may be affected, becoming swollen, and perhaps ulcerated, and the child in consequence has a hoarse cry ; there may be marked anæmia and wasting, so that the child emaciates and is reduced almost to a skeleton.

Infants occasionally die at this period, apparently from the intensity of the poison. This seems to have been so in the following case—our *post-mortem* notes are as follows (the child was not seen during life by any medical man).

The mother states that the infant, which was 7 weeks old, 'snuffled' a week before its death, and three days before a reddish rash appeared on the buttocks and around the mouth. It was found dead in its cot. At the autopsy the infant was found to be fairly well nourished ; a purulent discharge issued from its nose, the skin around the mouth and nose

Fig. 99.—Hereditary Syphilis, showing flattening of bridge of nose, scars around mouth, and keratitis.

was excoriated, apparently from the nasal secretion, and there were some excoriations and redness around the anus. The whole of the mucous membrane of the nose was in a foul, almost sloughy condition, the surface being dark-coloured and covered with muco-pus. On one tonsil there was a deep ulcer ; there was no laryngitis ; all the other organs in the body were healthy.

While in the more severe forms the infant is the colour of *café au lait*, wizened and wasted, other infants may be seen who are plump and ruddy, yet who are undoubtedly syphilitic, and who subsequently develop a typical rash. In some who suffer later from syphilis no history can be obtained of coryza or rash, and we are driven to the conclusion that the secondaries are sometimes so slight as not to attract the attention of the friends, and may even deceive the medical practitioner. The mortality of syphilitic babies is

high ; not only is the effect of the poison depressing, but the blood seems to be profoundly altered, the digestive organs are interfered with, and the infant wastes and dies. '*Congenital syphilis*,' '*mal-nutrition*' is written on the death certificate of many syphilitic babies.

On the other hand, those who suffer in a less severe form and come under treatment early rapidly improve, gain flesh, and for a time at least all symptoms disappear. While such cases may apparently be entirely cured, yet, like the secondaries which occur in adults, the symptoms are very apt to reappear, especially during the second and third years. This relapsed syphilis may make its appearance in children in whom the symptoms following birth are slight, and consequently what is really relapsed syphilis is very apt to be mistaken for acquired syphilis. This recurrence usually takes the form of condylomata or ulcerations about the anus or tongue, and chronic fissures about the corners of the mouth and nose ; various rashes may also be present. Convulsions or eclampsia of the Jacksonian type, especially if one-sided, suggest brain syphilis.

During the next few years the child may remain fairly well, but on the approach of puberty symptoms which correspond to the *tertiaries* of adults may make their appearance. Children at this period often bear the marks of past lesions, and if seen for the first time there may be no difficulty in recognising them as subjects of congenital syphilis, as their flattened noses and the linear scars at the angles of the mouth, and typical pegged teeth, give them a characteristic appearance (fig. 99). They are apt at this time to suffer from periostitis, caries of bone, chronic ulcerations, ulcers of the mucous membrane covering the hard palate, which may involve the bone ; ulceration and destruction of the soft palate ; various affections of the eye, as iritis, keratitis, choroiditis ; various skin diseases, as ecthyma, rupia, &c. ; gummata in the superficial structures, and also in the liver and other internal organs. Deafness and partial dementia may be present, the latter accompanied by syphilitic arteritis of the brain. In the worst cases the child may suffer for years from disease of one or other of the bones (figs. 100, 101).

Fig. 100.—Complete Destruction of the Nose, Upper Lip, and part of the Jaw in Congenital Syphilis, in a boy aged 10 years.

Having sketched the course of the disease, we may now proceed to describe some of the phenomena presented by congenital syphilis more in detail.

Skin.—Pemphigus is one of the most characteristic of the syphilitic rashes, and when present at birth may be taken as certain evidence of hereditary syphilis. The seat of the blebs in syphilitic pemphigus is the

palms of the hands and soles of the feet, but they may be present also on the extremities and trunk ; their contents are purulent or sanguineous ; they may be succeeded by deep ulcers. According to Roger, non-specific pemphigus is rare before three years of age and most common after six years ; the blebs are rarely numerous, do not occur on the palms of the hands or soles of the feet, and contain serum rather than blood or pus. The prognosis is bad in syphilitic pemphigus if the infant is born with the rash ; as a rule, the later it appears, the better is the prognosis. The most characteristic rash in hereditary syphilis is a *roseola*, making its appearance during the second or third month of life, and which takes the form of a bright-red diffuse rash with a sharply defined edge surrounding the genitals, with perhaps patches of similar redness about the body or face, or there may be roseolous spots or maculæ about the body and face, with a more diffuse rash on the soles of the feet. The eruption is at first a vivid bright red ; in a few days it fades, becoming more of the tint of lean ham ; then the affected part desquamates, leaving the skin smooth, shiny, and dry. The rash may be visible for weeks, assuming in its later stages a coppery colour. Instead of the roseola, the rash may consist of *papules* of a bright red colour, which are confluent about the genitals and buttocks, but scattered irregularly over the body. The rashes most likely to be confounded with a syphilitic roseola are those so commonly present about the genitals, especially those produced in infants with diarrhœa by the irritation of fæces and wet napkins. The difficulty of diagnosis is only likely to arise in the absence of a characteristic rash in other parts of the body, or of coryza. It is needless to say that a red rash with excoriations and signs of irritation about the anus and genitals may occur in both syphilitic and non-syphilitic children, and no rash in this situation should be regarded as specific without confirmatory evidence elsewhere. Sometimes the 'napkin-rash,' which is present about the genitals and folds of the knee, takes on a syphilitic aspect ; there are small, shallow, kidney-shaped ulcers with raised mucoid-looking edges. *Psoriasis*, or *scaly rashes*, *vesicles*, *pustules*, and *ecthyma*, may occur in syphilis, in infancy. Simple psoriasis

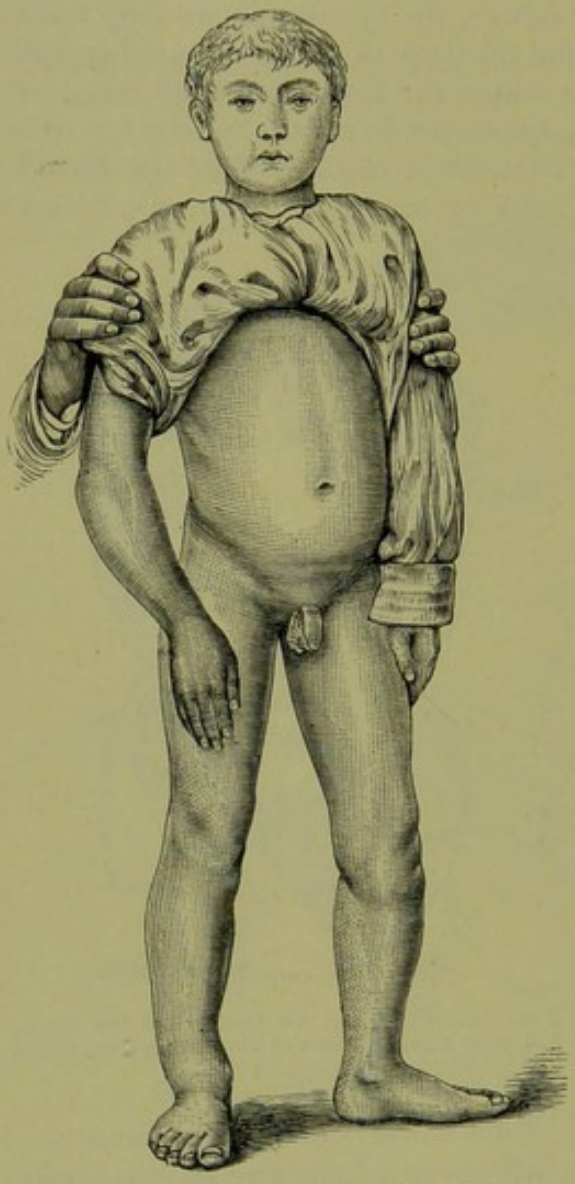


Fig. 101.—Congenital Syphilis. Disease of bones of upper and lower extremities.

rarely occurs before the third or fourth year, while syphilitic scaly rashes are not uncommon in early childhood, on the plantar and palmar surfaces, and on the face. Pustules followed by deep ulceration are not rare in cachectic children apart from the effects of syphilis ; thus occasionally in chicken-pox the vesicles are succeeded by pustules or bullæ and a deep ulceration is produced. In making a diagnosis several points must be borne in mind : syphilitic rashes mostly affect the genitals, palmar and plantar surfaces, and face ; they are usually bright red at first, then dull red and more or less of a coppery hue ; they are followed by free desquamation, and they cause no itching. Different varieties may be associated together.

Mucous patches and condylomata when present are of great diagnostic value ; they may occur at all ages, but are especially common in relapses in children two or three years old. Their common seat is around or by the side of the anus, vulva, fold of the groin, corners of the mouth, entrance to the nares—less commonly the folds of the neck. They form where there is some irritation, where a surface of skin is fretted by some discharge and kept constantly moist. Mucous patches may be present on the side of the tongue and soft palate. We must not forget, however, that acquired syphilis is not uncommon in children, and cases seen with condylomata may be suffering from the acquired form and not from hereditary syphilis. Loss of hair, especially on the top of the head, is often seen in congenitally syphilitic infants of a few months old, and onychia may also be met with.

Coryza is the earliest and most constant symptom present. The mucous membrane of the nose is swollen and congested, and respiration is carried on with difficulty on account of the obstruction. The infant is very restless at night, waking at short intervals to get its breath. Later on a purulent discharge tinged with blood makes its appearance, which frets and irritates the skin in the neighbourhood, and ulcers and crusts form along the upper lip and side of the nose. Caries of the nasal bones may take place ; there may be a discharge of pus, which makes its appearance down the nose and at the corners of the eyes.

Veins.—E. Fournier has called attention to the dilatation of veins, especially the frontal, parietal and occipital veins in hereditary syphilis. We have seen several cases of undoubted hereditary syphilis in which the veins draining the scalp were very dilated and prominent. It must be borne in mind that these veins are also dilated and prominent in chronic hydrocephalus.

Lesions of internal organs.—Parrot has pointed out that an ulceration due to syphilis occurs occasionally near the median line inside the lower lip ; serpiginous ulcers occur on the tongue, inside the lips, near the corners of the mouth, on the gums and soft palate ; they are mostly shallow, with a red and shiny base, surrounded by a raised, whitish, irregular border. Condylomata on the tongue are much commoner than any form of ulceration. Deeply cut ulcers make their appearance on the hard palate in tertiary syphilis, the bone is quickly affected, and a communication with the nasal cavity established. A deep ulcer may form on the soft palate, and shortly a sharply cut hole be seen right through the velum palati. Laryngitis, mucous tubercles, and ulcerations along the edge and at the base of the epiglottis, occur, but specific lesions of the larynx are less common in children than in adults. Specific lesions of the **lungs** are not common,

though syphilitic infants frequently die of broncho-pneumonia. In the **lungs** of infants born dead, or dying soon after birth, gummata and fibroid indurations may be found, and a form of chronic pneumonia which has been described as white hepatisation by Virchow. Patches of white hepatisation may sometimes be found scattered through the unexpanded lungs of infants born dead, and the mediastinal glands may also be enlarged and infiltrated in a similar way. The gummata are most often seen on the surface of the lung and are apt to soften in the centre (Parrot). The **liver** of newly-born infants may be enlarged from the effects of interstitial hepatitis. Gummata of the liver are occasionally found in infants and older children, but they are comparatively rare. Depressed scars, the remains of gummata, may also be seen. (See p. 202.)

The **spleen** is frequently enlarged and indurated, especially where cachexia is a marked symptom, as pointed out many years ago by Gee. It is generally simply indurated, but gummata have been found. Dr. G. F. Still records a case of a boy of 11 years, in whose spleen were found gummata from $\frac{1}{4}$ in. to $\frac{3}{4}$ in. in size ; and another case in a boy of 6 years, the spleen was found enlarged, with many yellow fibrous masses, varying in size from a pin's head to a horse-bean.[1] A. Fruhinsholz found a gumma in the spleen of an infant 2 weeks old.

Lesions of the **brain** may also occur, especially during the first or second year. The infant suffers from eclampsia, most marked on one side ; the convulsions perhaps begin in one hand and then become general ; they are frequent rather than severe. Later the arm gradually becomes paralysed and spastic ; later still the leg of the same side is affected in the same way. The limbs of the other side also suffer, and the infant gradually passes into a condition of dementia. At the *post-mortem* syphilitic endarteritis and softening are found. Chronic hydrocephalus may also occur in syphilitic children. Dementia and general paresis (see Juvenile General Paralysis) may come on in the course of syphilis about puberty ; gummata of the brain are rare : only a few cases are recorded (Henoch, Barlow). Gummata have in rare instances been found in the **kidney, testes,** and **glands** (Fournier).

Syphilitic disease of the **bones** may occur both early and late in the disease. Caries of the nasal bones may follow the coryza, leading to the falling in of the nose which is so common in syphilitic children ; or the bones may be completely destroyed. During the tertiary period caries of the hard palate and turbinated bones, as well as of the long bones, more especially the tibia, may occur. In the latter bone caries may follow periosteal nodes ; or thickening of the bones may be met with. Apart from caries a peculiar inflammation termed syphilitic epiphysitis is apt to occur near the epiphyses in the long bones in infants, especially at the lower ends of the humerus, femur, radius, and tibia. The mother notices that the infant does not move one arm or leg so freely as the other, and it screams as if in acute pain if the limb is handled or moved suddenly. An examination of the end of the humerus, if the arm is affected, may show it to be swollen and tender, and the limb hangs useless, so that the term 'pseudo-paralysis' has been applied. (See fig. 102.) The shafts of several of the long bones perhaps show an enlargement where they join the epiphyses, and sometimes a slight

[1] *Path. Soc. Trans.*, 1897.

effusion is present in the joint. More rarely the phalanges of the fingers are also swollen. The nature of this lesion has been studied with great care by Wegner, Parrot, Taylor, and Kassowitz. Separation of the epiphysis from the shaft and the formation of an abscess may take place, though in this country the latter accident is rare. Lesions in the cranial bones have been described by Wegner; he found gummatous periostitis of the dura mater beneath the parietal bone, a possibility to be borne in mind when epileptiform attacks occur in syphilitic children. The natiform skull belongs to rickets rather than syphilis; a hypertrophic condition of the bones of the forearm and leg, giving rise to a marked enlargement of the shaft of the bones, is not uncommon (see fig. 101).

Chronic synovitis of the knees, wrists, &c. is apt to occur in older children. (See DISEASES OF JOINTS.)

The **teeth** of the second or permanent set are often misshapen and peculiar. The most characteristic changes are seen in the central incisors

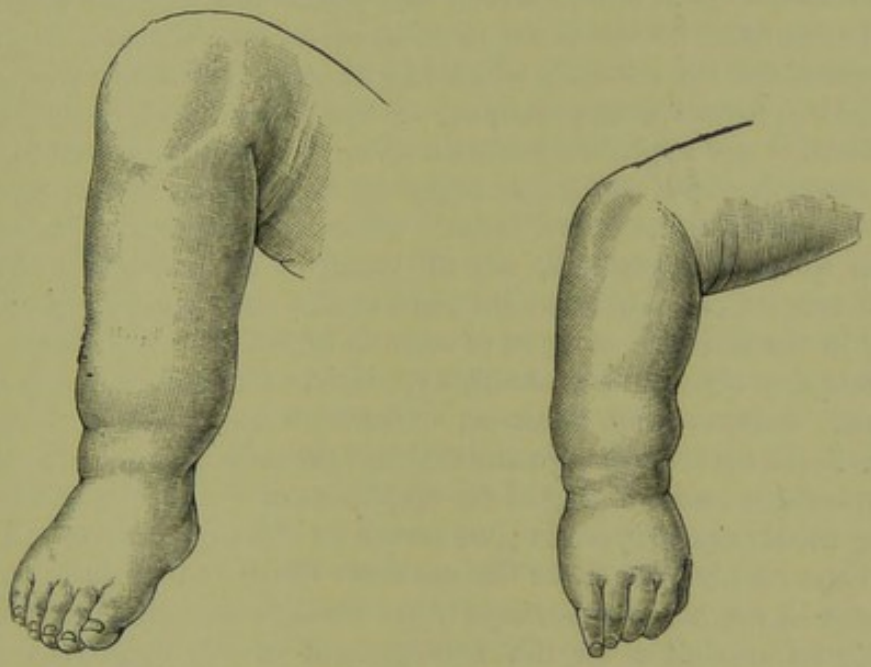


Fig. 102.—Swelling of lower ends of Tibia and Fibula, and also of Radius and Ulna, from a syphilitic infant 4 months old. The swelling lies at and above the line of junction between the epiphyses and shafts. (Compare with Rickety Enlargement, p. 214.)

of the upper jaw; they are more or less dwarfed, peg-shaped—i.e. they taper inferiorly—slant towards each other, and have a central notch in their cutting edge; the other incisors may be more or less dwarfed and notched (see fig. 131).

Affections of the eyes are most common about puberty, the commonest being interstitial keratitis, iritis, and choroiditis. The two former usually occur together, though they may appear singly. The first symptom noticed is watering and irritation of the corneal conjunctiva, then a steamy appearance or cloudiness of a portion of the cornea; this is followed by the formation of minute blood-vessels on the surface of the cornea, giving the steamy patches in some cases a reddish or salmon-coloured tinge. These patches reach the sclerotic, are generally symmetrical, and are apt to relapse. Disseminated choroiditis may occur: in such cases small patches of atrophy of

the choroid, of a white or grey colour, are generally seen scattered about the fundus of both eyes ; pigmentation is frequently present ; there is often the remains of a past retinitis and neuritis. Disseminated choroiditis and deafness in the same child is certain evidence of syphilis.

Ears.—Gradually increasing deafness, which is often very intractable to treatment and depends on labyrinthine mischief, is common in congenital syphilis. It usually appears at about the same age as interstitial keratitis, i.e. from the seventh to the fifteenth year, but occasionally begins much later. Complete deafness frequently results from this affection. The three lesions, of the teeth, the cornea, and the ear, are known sometimes as 'Hutchinson's triad' of symptoms, and may be looked upon as quite pathognomonic. Middle-ear disease is also sometimes caused by congenital syphilis.

Syphilitic orchitis affects usually both testes, which become enlarged and hard, but painless. The gland itself is usually involved and the condition appears at about three months (Still).

Diagnosis.—This is often difficult and sometimes remains uncertain. In the infant care must be taken not to mistake, as students are very apt to do, an erythema about the genitals, which has its origin in the irritation caused by fouled napkins, for a specific rash, or, on the other hand, hastily to assume that an infant is *not* syphilitic because there is a certain amount of excoriation and rawness about the anus caused by the fretting of the wet napkins. No rash can be taken as characteristic which is not present in other places as well as about the genitals, out of reach of the irritating effect of the urine or fæces. Coryza in an infant a few weeks old is exceedingly suspicious, especially in the absence of signs of catarrh of the bronchial tubes or larynx, and if it remains chronic is probably syphilitic, even though a rash may never be present. Infants may, however, suffer from acute coryza without being syphilitic. A purulent discharge and caries of the nasal bones are usually syphilitic. Tenderness and swelling of the epiphyses of the long bones in an infant are strong evidences of syphilis ; we attach no importance to cranio-tabes, or bosses on the cranial bones, or the natiform skull, as they may be undoubtedly present in rickets and perhaps other conditions. Syphilitic epiphysitis can hardly be mistaken for the enlargement of the epiphyses present in rickets. In syphilis the swelling is situated between the epiphysial line and the shaft (see fig. 102), while in rickets the swelling involves the epiphysis itself (see fig. 33). Syphilitic thickening occurs in infants of six weeks to three months old, while the rickety enlargement is rarely seen before six months, and more commonly at a year or eighteen months of age. Infantile scurvy is not seen till after the sixth month.

Marasmus, anæmia with enlarged spleen, and eclampsia may all occur in infantile syphilis, but in the absence of other symptoms we must be very cautious in accepting them as evidence of syphilis. The rashes which present the greatest difficulty for diagnosis as to whether they are syphilitic or not are the rashes seen at times in newly-born infants, especially those who are artificially fed. Various forms of erythema and dermatitis occur as the result of sepsis or of intestinal disturbance, and are very likely to be attributed to syphilis. An erythema with ulceration appears on the buttocks and around the mouth, which suggests syphilis, but is really due to the contact of the secretions with the skin surrounding the anus or mouth

in a weakly and wasting infant. Dermatitis with exfoliation of the skin in the newly born is non-syphilitic. (See Ritter's disease, p. 34.)

Treatment.—In all cases where the parents are known to have suffered from syphilis, or some older child has been affected, anti-syphilitic treatment must be commenced without waiting for the appearance of symptoms, in the hope of mitigating the disease or of preventing its development. The anti-syphilitic treatment of the parents who have had syphilitic children forms an important part of prophylactic management, and may prevent the taint being transmitted from the mother to the fœtus. In the treatment of infantile syphilis it should be borne in mind that the effects of the poison are apt to impair the functions of almost every organ in the body, and in the worse cases there is a marked tendency in the direction of anæmia and gastro-intestinal atrophy. The dietetics of the syphilitic infant require the most careful attention, especially if it has to be artificially fed, as such infants are exceedingly likely to suffer from aggravated dyspepsia and mal-nutrition. It should, if possible, be suckled by its mother ; if this is impossible, it must be artificially fed, as a wet-nurse is not permissible on account of the danger of her becoming inoculated by the nasal or other discharges from the infant. As soon as the diagnosis is made or the disease suspected, mercury must be given in some form or other. The usual plan is to give mercury and chalk-powder in half-grain doses twice a day, this form of mercury being used on account of its mildness and its being less likely to disturb the bowels than calomel. If any looseness of the bowels follows its administration, it may be combined with a grain of chalk and opium powder or the compound cinnamon-powder. In a few weeks the dose may be increased from half a grain to a grain : this treatment should be continued as long as any of the special symptoms are present, or for some six weeks or two months, when the mercury may be omitted for a fortnight or so, and the syrup of iodide of iron in five to ten drop doses may be substituted. If there is much cachexia or mal-nutrition, a few drops of cod-liver oil may be added. Instead of the mercury and chalk, some prefer to give calomel in one-sixth to one-half grain doses combined with half a grain of saccharated carbonate of iron. In Vienna a combination of mercury and tannic acid is used (hydrarg. tannicum oxydulatum) when other mercury salts disturb the bowels ; the dose is the same as calomel. In obstinate cases, especially where the skin eruptions are chronic, sublimate baths as recommended by Baginsky may be used with good effect. A bath may be given daily in which ten grains of corrosive sublimate are dissolved ; the child should remain in the bath some five minutes, care being taken that none of the water gets into its mouth. The baths are more cleanly than, and preferable to, the inunction of blue ointment, and act with greater certainty. During the time the infant is taking mercury the gums should be carefully watched, and any signs of stomatitis or sponginess should be the signal for at once discontinuing all forms of mercury. It is, however, very rare for salivation to occur in children. The coryza should be treated, when the obstruction or secretion is excessive, by injections of weak solutions of nitrate of silver (gr. i ad ℥i) or boric acid ; the dried secretion should be removed, and any soreness and excoriation about the nares or lips should be smeared with yellow oxide of mercury ointment, which may be applied on a small

camel's-hair brush. Boric acid may be applied locally as a dusting powder to the rash about the genitals or elsewhere. During the relapses mercury should be given in some form or other, and the mucous patches and condylomata which so frequently accompany relapsed syphilis should be frequently dusted with finely-powdered calomel. In the later stages, during the tertiary symptoms, the solution of bichloride of mercury in doses of half a drachm to a drachm, combined with iodide of potassium, should be given and continued for many months, when the syrup of iodide of iron may be substituted. Tertiary syphilis is apt to be very chronic, the ulcerations of skin and caries of bone and corneal affections remaining for months nearly stationary, and quickly relapsing when treatment is suspended. Iodoform and the yellow oxide of mercury ointments are the most useful local applications for the skin and conjunctiva, while a solution of nitrate of silver (gr. x ad ℥i) may be used as an application to the specific ulcerations of the mouth and palate. During the treatment of syphilis, both in infancy and later childhood, the most generous diet which can be digested must be prescribed. Abundance of fresh air and change must be insisted on, and the most scrupulous care taken to promote cleanliness and to prevent any non-syphilitic individual from becoming infected by any discharges from the patient.

In some cases of late congenital syphilis, healing of ulcers or bone lesions will only be procured by the use of very large doses of iodide of potassium, either alone or, better still, in combination with mercury. We have had to order twenty-grain doses of the iodide three times daily for a boy of about 12 before any material improvement was effected.

CHAPTER XXII

RHEUMATISM—DIABETES MELLITUS—DIABETES INSIPIDUS

Rheumatism

Acute Rheumatism.—Acute or subacute rheumatism is not common during the first four or five years of childhood; it is commoner after this age, but typical attacks of acute rheumatism occur less often in children than in young adults. Concerning the etiology and pathology of rheumatism but little need be said: hereditary influences, the effects of cold and damp, the retention of waste products in the blood, and the toxins of scarlet fever, and influenza seem to predispose to or excite an attack of rheumatism. Poynton and Paine have isolated a diplococcus from the tissues and blood of rheumatic patients, which they believe to be the exciting cause of the disease.

Scarlatinal synovitis has been fully described (p. 275); but it remains to be said that, during convalescence from scarlet fever, attacks of what appear to be true rheumatism occasionally occur. This is in our experience more common in young adults than in children.

Symptoms.—The symptoms in older children closely resemble those seen in adults, except that the attacks can rarely be called acute, but belong rather to the category of subacute. The illness sometimes begins with vomiting and chilliness, but more often the first thing complained of is pain and tenderness in the larger joints, which may become red and more or less swollen. The commonest joints to be affected are the larger ones, such as the knees, ankles, hips, wrists, and shoulders; these are rarely all affected at the same time or indeed in the same attack; much more commonly one or both knees are distended with fluid, while subsequently a wrist or an ankle becomes red, tender, and useless. The joints of the cervical vertebræ are often affected, and occasionally some of the smaller joints, such as the fingers. There is not often much fever, the temperature rarely exceeding 102°. Usually there is not much sweating, the joints quickly recover themselves, and the pain and immobility disappear in a few days. Sometimes the only evidence of a rheumatic attack is a slight redness and tenderness about a single joint. It is the exceeding mildness of these attacks as well as the want of intelligence to localise their pains that make attacks of rheumatism readily overlooked in young children. A crying out when disturbed, with a certain amount of paresis or immobility about a limb, may be all there is to indicate an attack of rheumatism, which, mild as it may be, is yet perhaps accompanied by endocarditis which may inflict a life-long injury.

Distinct attacks, however, may be noted in young children, of which the following, a patient seen with Dr. Earle, may be taken as an example :

Acute Rheumatism.—A little girl of 22 months was going about as usual on March 22 ; on being taken up the next morning she seemed in pain and was unable to stand, complaining (apparently) of her left ankle, which was supposed to be sprained. The next day, however, the right ankle appeared to be similarly affected, and during the succeeding two days her knees, elbows, and neck were attacked successively in the same way. On the 27th the knee joints, especially the left, were considerably swollen and hot with fluid in the joints ; the next day both joints were equally enlarged. The general system was only slightly disturbed ; there was no cardiac affection. The knees remained swollen for a few days, but gradually recovered, so that at the end of thirteen days she could again walk a little.

In most attacks the child becomes anæmic. Children, like adults, are liable to relapses ; usually fresh joints are affected, with the symptoms attendant on the primary attack. In some instances the attacks are of a chronic type. Thus stiff neck, or torticollis, as the result of the joints of the cervical vertebræ being attacked, may be very intractable, and the condition suggests caries of the upper cervical vertebræ. However, the symptoms usually disappear with a few weeks in bed, with the head fixed between sand bags.

The complications and manifestations of rheumatism are of great importance, but they are all overshadowed by **acute carditis**, and it is the danger of cardiac lesions supervening that makes us look with so much care and anxiety at all joint pains in children. As already remarked (see p. 432) it is the exception for children to escape suffering from endocarditis during an attack of acute rheumatism, and, moreover, peri-endocarditis may supervene with but very slight joint pain, or the latter may come on later. The younger the child the more is an attack of acute carditis to be dreaded, inasmuch as the mortality is high in the very young, and if the patient survives, it is with dilated heart and damaged valves. As already pointed out, the pericardium, muscular walls, and endocardium covering the valves are liable to take on an inflammation, as the result of infection with the diplococcus. The heart cavities dilate, the pericarditis notably increases the work of the heart, and an injured mitral also puts the heart at a disadvantage. The chief danger, however, lies in the damage to the muscular walls themselves ; the patient goes on fairly well for a while, then cardiac syncope gradually supervenes, and in a few hours perhaps the child is dead. A *post-mortem* examination shows pericarditis in most instances, and, as Drs. D. B. Lees and Poynton have demonstrated, morbid changes in the vessels, interstitial tissues, and muscle of the heart-wall. In some of our own cases which were rapidly fatal there was only slight pericarditis, and no great dilatation, but the muscular wall of the heart was friable, pale in colour and mottled.

Chorea is another frequent associate of rheumatism, and may either precede or follow, or sometimes actually complicate, the rheumatic attack. It has been referred to elsewhere. **Pleurisy** and **Pleuro-pneumonia** occur at times as complications of a rheumatic attack, especially when pericarditis is present. **Erythema multiforme** and **Urticaria** occasionally occur in connection with rheumatism and endocarditis. The erythema may take various forms, occurring sometimes as irregular patches of redness, at others

as red or white papules. In all cases where such forms of erythema occur the heart should be carefully examined. **Purpura** occurs also at times in rheumatic attacks. It is doubtful if **Erythema nodosum** has any association with rheumatism. Peculiar **nodules**, first described by Drs. Barlow and Warner, occur in some rheumatic cases, mostly in the neighbourhood of joints. They are subcutaneous, the skin being freely movable over them ; they are most common at the back of the elbows and wrists, at the ankles, and by the patellæ. In one case seen by us, that of a girl suffering from severe chorea and rheumatism, there were several hundreds of these nodules, many of them being situated over the bones ; friction during the severe movements seemed to act as the exciting cause. They were present at the back of the scalp, over the spinous processes, along the edges of the scapula, and along the ribs. They are not painful, and vary in size from a split pea to an almond. These nodules are, when present, associated with heart disease. Subacute **tonsillitis** is not uncommon.

Diagnosis.—There is often much difficulty in distinguishing the synovitis which accompanies rheumatism from the many other forms of synovitis. Thus there is the acute suppurative arthritis of infants, the synovitis of septicæmia and scarlet fever, and the synovitis which is apt to go on to effusion and has a chronic course which chiefly attacks the knees ; there are, moreover, the rarer arthritic attacks which accompany hæmophilia, syphilis, gonorrhœa, and purpura. It may be impossible definitely to say if some arthritic attacks are really rheumatic or not ; their subsequent course may possibly clear up the doubt. In infants and young children it may be difficult to localise the seat of pain in a limb, and consequently a doubt may be raised as to whether in a given case where there is pain and helplessness the joints are affected or not. Such difficulty may arise in the epiphysitis of congenital syphilis and in the tenderness of the periosteum and hæmorrhages which are associated with infantile scurvy.

Treatment.—On the least suspicion of any joint affection in a child it should be put to bed between the blankets and restricted to a milk diet. It is a comparatively small matter if we are over-cautious in our treatment, in keeping at rest in bed a child who has but slight joint trouble and who appears to the friends to ail little ; while it is a grave matter to allow a child who is suffering from incipient endocarditis to get up and run about, or to suffer one to contract endocarditis in consequence of getting up. Knowing the readiness with which peri-endocarditis supervenes in mild attacks of rheumatism in children, it is our duty to warn the friends of this, and to insist on placing the heart under the most favourable circumstances by giving it as little work to do as possible. This is best accomplished by keeping the child at rest in bed, perhaps for several weeks after all pain and tenderness have disappeared.

In the milder cases the only medicine required will be a simple saline such as citrate of potash ; the affected joints should be painted with extract of belladonna and glycerine, and surrounded with cotton wool. A small dose of Dover's powder may be given at night. In the more severe cases, where many joints are affected and there is much fever, salicylate of soda should be given ; five to ten grains may be given every four hours to children of from 6 to 8 years of age for two or three days, and then given only

every six hours or three times a day ; it may be prescribed with a saline or given with syrup of orange peel.

In all acute or subacute cases milk is the best form of food ; it may be given in combination with potash, soda, or seltzer water ; as long as there is any fever this should be adhered to. There is always a risk of a relapse if beef tea, soup, or meat is allowed too early during convalescence. Arrow-root, rice, and custards may be allowed when all pain has been absent for several days and the temperature has been normal for a week.

Chronic Synovitis.—In a few instances an attack of subacute rheumatism becomes chronic, and certain joints are swollen stiff and painful for many weeks or months. The ends of the metacarpal bones and first phalanges of the fingers, as also some of the larger joints, become enlarged, deformed, and stiff.

In syphilitic cases there is at times chronic multiple arthritis coming on about puberty, which is apt to be persistent in spite of treatment. In some cases there is chronic synovitis with effusion in both knees, with no history of syphilis or rheumatism, though the former should always be suspected. Chronic synovitis involving several of the large joints in some cases is tuberculous, and may be associated with tuberculous peritonitis or other lesions.

Arthritis deformans or **Osteo-arthritis** occasionally commences during early life, mostly about the age of puberty. (See DISEASES OF JOINTS.) It is commoner in girls than boys and in those who are weakly and anæmic. The attacks usually begin insidiously with stiffness and pain in the small joints of the hand ; in other cases there are pyrexia, pain and tenderness of the joints, which subside, and later on are followed by another attack. The larger joints sooner or later are apt to become involved. As time goes on the joints become more or less deformed, creaking is felt on movement, and permanent ankylosis takes place. The synovial membranes and cartilage of the joints disappear, the ends of the bones are smooth and hard with osteophytic growths at their margins. Atrophy of the muscles acting on the joints takes place.

In some similar cases Heberden's nodes are present. These are small nodes of bone on the distal ends of the second phalanges of the fingers, and the joints are apt to suffer from subacute inflammatory attacks. Arthritis deformans appears but little influenced by salicylates. Cod-liver oil internally and warm dry heat externally to the joints are the most likely helps.

Chronic Arthritis—Sarah E. L., 10¾ years. A year ago began to walk lame and her ankles swelled. She went to bed a month after this, and has been bedridden since. She has never had acute rheumatism or chorea. The ankles first became swelled, since then the knees and wrists ; the joints were at first stiff and extended, later they have become flexed. She is an anæmic girl and very thin ; both wrist joints are semi-flexed, the left especially is almost ankylosed ; the hands are thin, the fingers tapering ; there is much thickening over the carpal joints. The hands are in position of 'main en griffe.' The ankle joints are also very immobile and the bones thickened. The knees are flexed (? subluxation), swollen and fluctuating ; extension, which is very limited, causes pain. Heart and lungs normal ; no albumen ; there is much muscular wasting. Attempts were made by means of chloroform, extension, and splints to straighten the knees, but the latter lapsed again into the old position.

Chronic Arthritis with glandular and splenic Hyperplasia (*vide* also chapter on JOINT DISEASES).—This form of arthritis, which has been especially described by Dr. G. F. Still,[1] is not very common in our experience, though Dr. Still has collected 22 cases, 19 of which he had investigated personally. The disease may begin during the first three or four years of life, and is specially distinguished by a progressive effusion and enlargement of the joints with hyperplasia of the lymph glands and spleen. The enlargement of the joints differs from osteo-arthritis in that there is effusion into or around the joint, with a general thickening. There is creaking or grating as in osteo-arthritis. Where the joints are swollen there is no pain ; in some of Dr. Still's cases the children became bedridden through chronic flexion of the joints. The common joints to be affected are the wrists and knees, later elbows, ankles, and fingers. There is muscular wasting. The most remarkable feature is enlargement of the glands and spleen. This glandular hyperplasia suggests Hodgkin's disease ; the axillary glands and glands in the groin and posterior triangle of the neck are most often affected. The mesenteric, hepatic, and splenic glands may also be enlarged. The spleen seems constantly to be enlarged. Anæmia is present, and there is periodical pyrexia. The course of the disease is chronic. There seems to be a special liability to pericarditis and pleurisy. In our own case, we were suspicious of Hodgkin's disease on account of the enlarged glands and spleen, and erratic febrile attacks. At the *post-mortem* the enlarged glands were pale and by no means unlike the glands seen in that disease. It seems unlikely that the glandular enlargement is merely secondary to the arthritis, but what the connection is it is not possible to say.

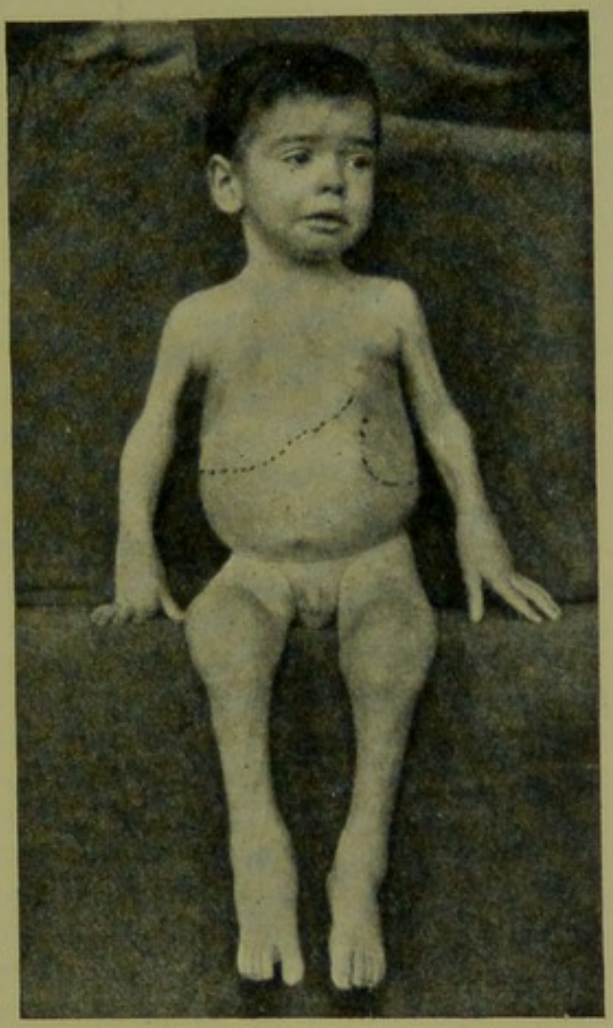


Fig. 103.—Chronic Arthritis with Glandular Enlargement. The dotted lines show the lower limit of the liver and spleen. Boy aged 3 years.

The following case evidently belonged to the same group of cases as those described above :

Joseph M., aged 3 years, was admitted to the Children's Hospital, November 2, 1896. The mother states that both the father and brother have had rheumatism. In February 1896

[1] 'On a form of chronic joint disease in children,' *Med. Chir. Trans.* vol. 80.

the child had scarlet fever badly; the attack was followed by dropsy. Three months after he suffered from rheumatism, a number of joints becoming affected at the same time; they were painful, but are not so now. There was no history of syphilis. On admission, it was noted that both wrist joints were puffy and swollen, having a pulpy feel, more like a tuberculous joint than rheumatism; both knees were also swollen and flexed, though they could be straightened without pain. There was no pain or tenderness in the joints. The glands in the axillæ, Scarpa's triangle, and posterior triangle of the neck were enlarged, but not tender (see fig. 103). There was well-marked enlargement of the spleen and also of the liver. The boy was pale; there were 2,700,000 red corpuscles per cub. mill., no relative excess of leucocytes or eosinophile cells. Heart and lungs normal, urine normal. Temperature erratic, 96°–104° F. Fluid withdrawn from knee-joint contains leucocytes, no tubercle bacilli. November 6.—Slight swelling of left elbow-joint. December 2.—Temperature continues erratic; some evenings it rises to 104°; joints contain less fluid. December 15.—Some swelling of dorsum of right foot. Temperature erratic. He developed broncho-pneumonia, and died January 9, 1897. The disease had existed about six months. *Post-mortem.*—Body fairly well nourished, very anæmic. Knee-joints, ankles, elbows contain fluid, thickened synovial membrane, overgrowth of bone and cartilage; ends of metacarpal bones enlarged, joints contain fluid. Axillary glands, glands in groin and neck, much enlarged, and of a pale colour. Heart normal. Lungs broncho-pneumonic. Mesenteric glands enlarged. Liver enlarged, glands large and white in fissure. Spleen enlarged, 5¾ oz., indurated glands in hilus also large and white. Kidneys normal.

Diabetes Mellitus

Though diabetes is much less common in children than in young adults, it cannot be said to be rare, as Gerhardt has recorded 111 cases at various ages, from 6 months to 15 years. Glycosuria has been observed in infants at the breast, though the diagnosis of diabetes in such may be open to doubt. Dr. Bruce Bell records a case of diabetes in an infant of 3 months; and Young in one of 6 months. Little can be said about the etiology of these cases; a history of diabetes in the family may, however, often be obtained. Thus, in a family we are acquainted with, two uncles died of diabetes, and two children, brother and sister, aged 14½ years and 3½ years. Another sister 6½ years has sugar occasionally in the urine.

Some remarkable instances of family diabetes have been recorded by Pavy, Mosler, Bouchut and others. In other families in which cases of diabetes have occurred, there has been a history of epilepsy, hysteria, and insanity. Diabetes also is apt to occur in families liable to gouty manifestations.

The *symptoms* noted are those which are present in adults. There is the harsh dry skin, red tongue, marked thirst, and voracious appetite. There is often incontinence of urine on account of the large quantities passed. The specific gravity of the urine is high, 1030 to 1040 or more, and perhaps 5 per cent. or even 10 per cent. of sugar may be found. The child usually wastes, and becomes 'cranky' and difficult to please; it is apt to contract a fatal pneumonia. Tuberculosis or chronic phthisis may supervene as in adults. Diabetic coma is not uncommon. The symptoms commence with headache, dry tongue, and dyspnœa, followed by coma. It is well to bear in mind the possibility of being called to see a child who has rapidly passed into a state of coma without diabetes having been suspected.

The *prognosis* is most unfavourable, though cases are recorded which made apparently a permanent recovery. We have never seen a recovery in a child when once a definite amount of sugar has been found in the urine. In the fatal cases the duration varies from a few weeks to two years.

Treatment.—All starch-containing foods and sugars should be forbidden, gluten bread and saccharin being substituted. Milk in moderate quantities or cream may usually be allowed, as children are much more dependent upon milk as a food than are adults. Beef tea, soups, fish, chicken, and butcher's meat, with gluten bread and green vegetables, will chiefly form the diet. Much difficulty is often experienced in keeping children to a rigid diet, as they long for bread-and-butter or puddings. With regard to drugs, codeia (gr. $\frac{1}{6}$ to gr. $\frac{1}{3}$) or opium should be given, while the bowels are carefully regulated with Carlsbad salts or Rubinat water. Great care should be exercised to prevent the child catching cold or any of the zymotic diseases, since bronchitis, whooping cough, or scarlet fever is almost certain to unfavourably affect the course of the disease.

Polyuria—Diabetes Insipidus

The etiology of this condition is for the most part quite unknown, and it probably owns a variety of causes. Cases of brain disease, of contracted kidney, cystic kidney, tuberculous kidney, and of functional diseases of the alimentary canal may be accompanied by polyuria. In the majority of cases no cause can be assigned, and we are obliged to speak of such as idiopathic, much in the same way as we speak of idiopathic anæmia. In a large class of cases polyuria is temporary only. Children, often girls between 3 and 6 years, are noticed to wet their beds, or make water in the daytime far more frequently than they have been accustomed to. In the same way boys will wet their trousers frequently during the day when it was thought that they had grown sufficiently old to have learnt proper habits. An examination in such cases will probably show no abnormal constituent of the urine, but that it is of low specific gravity, perhaps 1005 to 1010, and passed in larger amount than usual. Possibly there may be a trace of albumen. In the majority of cases this condition will be found to depend upon digestive derangements or improper feeding ; it appears to be a reflex irritation of the kidneys, the source of irritation being in the intestine, the presence of an intestinal catarrh being the cause. Perhaps also the deposition of uric acid salts in the kidney may be the cause of a large quantity of watery urine being secreted. The presence of thread worms or round worms in the intestine or rectum also appears at times to produce polyuria. In those rare instances of contracted kidney occurring in childhood large quantities of urine are sometimes passed ; in such cases the specific gravity is low, but there will usually be some albumen.

In those cases to which the name of 'Diabetes insipidus' is usually applied there is intense thirst, and large quantities of pale urine with a specific gravity of 1002 to 1005 are passed. A girl of $8\frac{1}{2}$ years under our care, who had suffered for some six months, drank as much as ten quarts in twenty-four hours, and passed a proportionately large quantity of water.

When restricted to ten pints of fluid daily, she would in the night crawl under the beds to the bath-room to obtain water or surreptitiously drink her own urine. Such patients have dry, rough skins, are anæmic, and of irritable temper. The course of such cases is exceedingly chronic, and *post-mortems* are seldom obtained.

Treatment.—The treatment must depend on the cause. If simply reflex, dependent upon intestinal irritation, a calomel purge may be given and a carefully restricted diet prescribed. In confirmed cases of Diabetes insipidus various drugs have been tried : opium, strychnine, valerian, and ergot usually fail ; in our own case no drug seemed to check the secretion of urine in the least—a temporary improvement took place during an intercurrent attack of tonsillitis. In all cases the patient should be warmly dressed and protected from cold, as a chill has the effect of checking the perspiration and so increasing the secretion of urine.

CHAPTER XXIII

DISEASES OF THE NERVOUS SYSTEM

Introduction.—The student who has gained his knowledge of the diseases of the nervous system entirely among adults will be certain to find, when he comes to see the same class of diseases among children, that the difficulties of diagnosis are much greater in the latter, and that some diseases which are rarely met with among adults are common among children. This is no doubt true of disease in children generally, but it is especially true of the nervous system. For instance, he will find very early in his career that it is often exceedingly difficult to estimate the amount of pain from which a child or infant suffers. An infant or peevish child will cry from fear, discomfort, or bad temper just as loudly as from the severest pain, and it may be quite impossible to localise the seat of pain or, indeed, to find out what it is crying for. There may be a general hyperæsthesia present, but it will be mostly very unsafe to draw any conclusions from this symptom alone as to the presence of organic disease, though it may be borne in mind that hyperæsthesia is frequently present in the early stages of meningitis. The infant's legs may hang down helplessly, and one may at first think that they are paralysed, but a closer examination discloses the fact that there is some epiphysitis or periosteal tenderness which prevents the child from using the limbs. On account of the readiness with which reflex disturbances are evoked in the young, we often find ourselves in difficulties and in error. Thus the infant has one-sided convulsions : are these due to a serious lesion on the opposite side of the brain, or are they reflex, the starting point being colic? How often the differential diagnosis between gastric and cerebral vomiting in infants is difficult and for a time impossible! The nervous system of the young is easily upset by a high fever or a poisoned condition of the blood, and there may be drowsiness, retraction of the head, and convulsions—symptoms which naturally suggest cerebral disease, such as meningitis.

Among the diseases which are much commoner in the young than in the old, meningitis stands pre-eminent, and assumes in consequence a position of great importance. It occurs alike in apparently healthy and robust infants and children, and in those whose history and symptoms suggest tuberculosis in some of its phases. Cerebral hæmorrhage from a ruptured artery is rare in the young, but an extensive bleeding may take place on the surface of the brain from over-distended veins or capillaries, and give rise perhaps to a lifelong hemiplegia. Convulsive disorders—the spasms being local or general—are vastly more frequent during the first two or three years of life than at any other period, and their results much more serious.

The infant may die in a convulsion from spasm of the glottis, or a meningeal hæmorrhage may take place, and a serious injury to the brain may be thus caused. Among other diseases which are of greater frequency in early than in later life, acute atrophic paralysis and chorea may be mentioned.

Clinical Examination.—The shape and size of the skull are of importance as giving some indication of the size and configuration of the brain. The condition of the skull may be investigated by inspection, palpation, and mensuration ; neither auscultation nor percussion yields any indications of much practical importance. By inspection a general idea may be obtained of the shape of the head, whether large (macrocephalic), small (microcephalic), asymmetrical, long (dolichocephalic) as in the negro, round (brachycephalic) as in the Mongols, hydrocephalic, or square as in rickets. By means of palpation the condition of the fontanelles can be ascertained, whether bulging, as in hydrocephalus ; or depressed as in anæmia ; or widely open for the child's age, as in rickets. The edges of the bones may be felt to ascertain if they are thickened ; the parietal or frontal eminences may be unduly prominent, or various bosses may be present, as pointed out by Parrot. Undue thinness of the skull (cranio-tabes), more especially of the occipital, may be detected by pressure with the finger, the bone being felt to bend or yield. By means of mensuration, using calipers and a thin flexible piece of lead wire, a tracing of the outline of the skull, both longitudinally and transversely, may be drawn, and a graphic record made for future reference. In this way the frontal or occipital regions may be shown to be smaller than normal, or one parietal region may be flatter than the other, as in some cases of deficient development or injury at birth.

It is convenient to remember that, roughly speaking, the average circumference of a child's head is 14 in. at birth, 16 in. at 6 months, 18 in. at a year old, 20 in. at 2 years, 21 in. at 4 years, and after this the increase is slight. At 12 or 13 years old, 21¼ in. would be an average. We must, however, remember that there are large heads and small heads without there being any abnormal condition of brain. In children over a year old a head measuring 17 in. or under would suggest imbecility.

The clinical examination will necessarily include observations on the condition of the muscles to see if any paresis or paralysis is present. A slight squint is easily overlooked, and the friends may have to be appealed to for their observations, as the squint may be present at one time and absent at another. The condition of the pupils must be observed, and it may be necessary to examine the optic discs and to test the refraction of the eyes. If there is any question of paralysis, the child should be examined when naked, and if it can walk the character of its gait observed. The condition of the reflexes, especially the knee-reflex, and the presence or absence of ankle-clonus observed. An exaggerated knee-reflex with ankle-clonus is present in cases of cerebral diplegia and hemiplegia, and in pressure myelitis when the disease is situated above the lumbar enlargement. But these phenomena are also present in some cases of hysterical paraplegia, especially when the paresis has lasted some time. We have twice seen exaggerated knee-reflex, both times in boys, following an ill-defined feverishness (possibly influenza), lasting several weeks, and finally completely disappearing.

The plantar reflex should be tested, bearing in mind that in healthy infants under 2 years of age the extensor type of response is present. The condition of the superficial reflexes should be noted, as their reactions may be of value in the diagnosis of lesions of the cord and brain. 'Kernig's sign' is practically of no value in diagnosis. Lumbar puncture is useful for obtaining cerebro-spinal fluid for bacteriological examination and for the relief of excessive tension in the subdural space and lateral ventricles. The spinal cord ends opposite the second lumbar vertebra, while the dural sac reaches to the second sacral vertebra, and contains the cords of the cauda equina and some cerebro-spinal fluid. Puncture is usually performed in the fourth space near the middle line by means of a sterilised platinum or steel needle; a small rubber tube is connected with the needle and about 10 c.c. allowed to flow into a clean test tube. The best position is for the patient to lie on his right side with his back convex. The usual guide to the fourth lumbar space is a line drawn connecting the highest points of the crests of the ilia; this line crosses the spine of the fourth lumbar vertebra. In careful hands no injury is likely to ensue, but the cords of the equina and also the blood vessels have been injured by lumbar puncture.

Meningitis

Tuberculous Meningitis.—In tuberculous meningitis there is an inflammation of the pia mater, set up by the presence of tubercles on the vessels, more especially at the base of the brain. While tubercles and meningitis are very commonly found associated together *post mortem*, it must be borne in mind that a simple or non-tuberculous meningitis is not uncommon, and also that tubercles may be present on the vessels without any meningitis, though the probabilities are great that if tubercles are present they will sooner or later light up inflammation of the meninges. Another point must also be remembered: that a meningitis so called is in reality a meningo-encephalitis: the vessels which penetrate the grey matter of the convolutions being certain to join in the inflammation.

Posterior basal meningitis is more common than the tuberculous variety in infants under 6 months or a year. Between the age of 1 year and the commencement of puberty tuberculous meningitis is a common disease.

It rarely happens that the pia mater is the first part of the body to become the seat of the tubercle; a tuberculous meningitis is in the large majority of cases preceded or at least accompanied by grey granulations or caseating tubercle in some other part of the body: it is often the closing act of a general tuberculous process, may occur early or late, and, when once established, quickly brings the end. The *post-mortem* evidence of this is clear and decisive, for in the bodies of those dying with tuberculous meningitis grey granulations or caseating tubercle will almost certainly be found either in the lungs, bronchial glands, brain, spleen, or other organs. Clinically the same thing is also evident: children suffering from hip-joint disease, spinal caries, caseating cervical glands, or chronic tuberculous peritonitis, are not infrequently cut off by an intercurrent attack of tuberculous meningitis, or the latter follows whooping cough, measles, or

pneumonia. In the large majority of cases there is a definite history of ill-health before the actual brain symptoms supervene. An exception to this is, however, seen in the case of infants and children under 2 years of age, in whom occasionally the attacks are sudden, supervening in the midst of apparent health.

What determines the growth of tubercle on the pia mater and the subsequent meningitis? No certain answer can be given to this question. It is easy, and perhaps natural enough, to attribute it to over-excitement of the brain, or excessive brain work; and possibly this may be so in some cases in tuberculous children, who have been badly fed and subjected to unfavourable life-conditions, while their brains are being driven at the highest pressure; but such cases must be exceptional. It must be borne in mind that tuberculous meningitis attacks children a few months old and children in hospital, and under conditions in which it is impossible that over-brainwork can have had anything to do with the supervention of the meningitis. In many cases there is the history of a fall or blow on the head. We cannot say why the tuberculous process should in one case attack the brain and in other cases the peritoneum, or lungs, or spine. The bacilli presumably reach the vessels of the brain viâ the blood current.

Symptoms and Course. Premonitory.—The onset is insidious and the early symptoms are ill-defined, being those of general malaise rather than of actual disease. In most cases there is a history of ill-health for several months, perhaps succeeding an attack of measles or whooping cough, during which time the child has wasted or lost flesh and become flabby. There may have been cough, dyspepsia, constipation, loss of appetite, otitis, enlargement of glands, or more or less feverishness, especially at night; such symptoms are not in any way distinctive, and are often the result of a chronic intestinal or gastric catarrh, yet, if there is a family history which suggests tubercle, they necessarily excite suspicion. In some cases definite brain symptoms precede by many weeks the actual attack of meningitis, and then perhaps pass away or remit for a while. Among these may be mentioned headache, squint, a staggering gait, an unusual tendency to fall, a temporary loss of control over the sphincters. The late Dr. Oxley recorded a case in which the boy's disposition entirely changed, and showed a constant tendency to bite on the least provocation; often there is extreme irritability, which is all the more suspicious if it occurs in a good-tempered child. Such symptoms are possibly due to the irritation caused by the presence of tubercles on the vessels or in the brain, which may perhaps precede for some time the attack of meningitis; or it is quite conceivable that a temporary congestion or even a patch of meningitis may be present.

It is impossible during the premonitory stage to do more than suspect the onset of tuberculous meningitis or tuberculosis in some form or other; in a large number of such suspected cases recovery gradually takes place without any definite diagnosis having been arrived at; in these cases, however, we are hardly ever warranted in assuming that our treatment has been the means of warding off an attack, and we may be left in ignorance as to its nature. In some cases, especially in infants, there are no preliminary symptoms: the infant, while in apparent health, begins to vomit and gradually becomes comatose, or almost the first symptom which attracts attention may be a

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hemiplegia. In such cases a simple meningitis is perhaps suspected, but the *post-mortem* usually shows it to be tuberculous.

The premonitory symptoms gradually pass into the first of the three stages into which the attacks are usually divided—namely, *the stage of excitement*. At the commencement of this stage the symptoms may be chiefly gastric, or they may be definitely cerebral from the first. In the former case the most prominent, and indeed sometimes for several days the only symptom, is vomiting. This may begin after a meal and be attributed to some improper food, but it continues in spite of the most careful dieting, is usually accompanied by a clean tongue, and, while aggravated by food, often recurs, with much retching and nausea, when the stomach is empty. Too much stress must not be laid on the character of the vomiting, and perhaps for a few days a doubt may be entertained as to its true nature, whether due to cerebral disease or gastric irritation. The vomiting of meningitis is usually erratic, coming and going without any apparent cause. At this stage the child may be perfectly intelligent, and no direct cerebral symptoms may be present. Constipation usually occurs : the abdomen, which is at first rounded, becomes flabby, and later retracted, from the contraction of the intestinal walls which takes place. Before long, other symptoms, more directly pointing to the head, become developed. There are headache, giddiness, great irritability, intolerance of light and noise. The child likes to be nursed by its mother, lies on her lap, and resists the interference of others. Its temper has completely changed ; it is feverish and extremely irritable.

The symptoms may be more definitely cerebral from the first, and the vomiting may not be a prominent symptom. The child complains of headache, which is often intense ; there is giddiness and staggering gait ; its sleep is disturbed by dreams, or it wakes up with a shrill cry of distress, often of a piercing character, and known as the 'hydrocephalic cry.' The child neglects its toys, preferring to lie quiet and undisturbed. The pulse is usually quickened, the temperature raised a degree or two at night, and the tongue becomes coated with fur, which has often a brown or yellowish tinge. Remissions are apt to occur, and for a while perhaps the little patient is again himself, bright and chatty, and ready for his toys ; but to the disappointment of the friends the old symptoms return with greater intensity. So far the symptoms have been those of cerebral excitement, caused in all probability by the inflammatory congestion of the pia mater which is present ; following this, comes the stage in which effusion is taking place and the brain functions become more and more effaced.

The *second stage*, often called the *stage of transition*, is marked by the commencement of drowsiness. The child becomes more and more dull and heavy ; it is no longer found on its mother's lap, but in bed, in a half-drowsy state. It likes to lie quiet, does not wish to be disturbed, and if roused it answers in a snappish manner and then curls up again and is off to sleep. The vomiting now is usually less urgent or perhaps ceases ; the abdomen is retracted, the bowels confined. The pulse is usually slower than in the earlier stages, and is frequently irregular and hesitating. Commencing optic neuritis may be observed, but the child in this stage will often keep its eyes spasmodically closed, so that observations on the discs are rendered difficult. The edges of both discs appear blurred and indistinct, from the

presence of swelling ; the veins become distended and tortuous, but the changes are never so marked as they are when a cerebral tumour is present. The intensely congested and swollen discs, with various minute hæmorrhages so often seen in other forms of cerebral disease, never occur, possibly because there is not sufficient time for these extreme changes to develop. Miliary tubercles may be present in the choroid, but these—as far, at least, as our experience goes—are chiefly present in cases of general miliary tuberculosis. Various other phenomena are apt to supervene, such as convulsions, muscular twitchings, paralyses, and spastic contraction of the muscles of the neck and back, less often of the limbs. The convulsions may be general and bring about a fatal result, especially in young children. The paralyses may involve the muscles of the eye, face, or limbs of one side. Some retraction of the head may take place, but it is only temporary, and not a marked feature in tuberculous meningitis, as it is in posterior basal meningitis. There is often a spasmodic contraction of the masseters, so that the child grinds its teeth, making a peculiar and unpleasant grating sound. There is apt to be incontinence of the urine and fæces. As the child becomes more and more drowsy the respirations become altered in character, approaching the 'Cheyne-

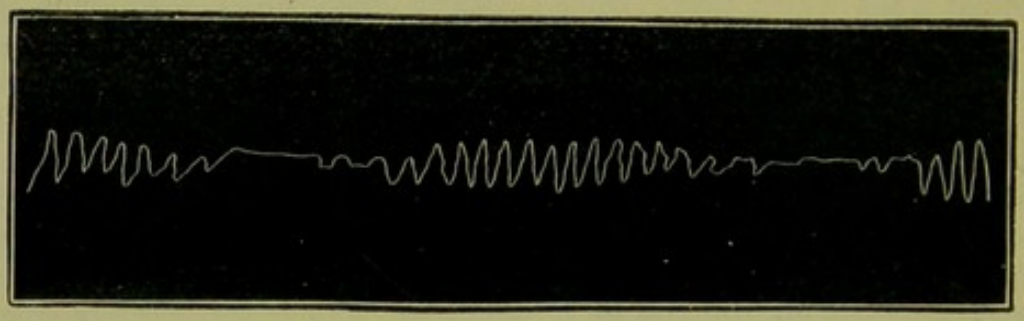

Fig. 104.—Tracing of Movements of Chest Walls from a case of Meningitis, showing 'Cheyne-Stokes' respiration. (After Landois and Stirling.)

Stokes' type—i.e. the respiratory movements become shallower and shorter, until they cease ; then a distinct pause in the respirations takes place, to be followed by a deep, sighing inspiration, which is again followed by a series of shallow respiratory movements, or the pause is followed first by shallow then by deeper respirations, as in fig. 104. The pause in deep coma may last for several seconds ; we have once or twice timed an interval of ten seconds.

From a condition of drowsiness the child passes into the *third stage*, or *stage of coma.* It can no longer be roused or recognise its friends ; the conjunctivæ become insensible, the pupils dilated and sluggish, and the optic discs can be examined without difficulty. The muscles of the limbs and abdomen are weak, flabby, and toneless. The tongue is coated with a thick brown fur, and sordes appear on the teeth and black crusts on the lips. The skin is harsh and dry, and the wasting extreme. Excessive secretion takes place from the conjunctivæ, so that the eyes are smeared with mucus or pus. The pulse becomes weak and rapid. The coma is usually profound, so that the child cannot be roused even for a moment, but usually the power of swallowing is retained to the last. In this miserable condition the patient lasts for many days, perhaps a week, and even after it appears moribund slight improvement may take place. The total duration of the disease is

usually about three weeks, but, especially in young children, death often takes place much sooner.

The temperature throughout the course is most uncertain, but always of an irregular, intermittent type, sometimes varying three or four degrees during the twenty-four hours ; at other times the flights are much less marked. The temperature is of course modified if there is an extensive tuberculous process in progress in the lungs and other parts. Hyperpyrexia is not uncommon ; in one case, that of a boy 3 years of age, who was convulsed, the temperature rose to 108° F. (rectal temperature) shortly before death. The *post-mortem* showed tuberculous meningitis, caseous mediastinal glands, and some miliary tubercles in the spleen and kidneys. The lungs were free. The paralyses which are apt to occur are seldom marked, often only temporary, being rather paresis than paralysis ; sometimes, however, when extensive softening takes place in one hemisphere from thrombosis of some large vessel, the paralysis of an arm, or arm and leg, may be complete. Anæsthesia is rarely, if ever, present ; hyperæsthesia is not uncommon in the early stages, but more as a part of a general irritability than anything else.

Whilst in typical attacks the various stages are fairly well marked, cases are frequently met with which are extremely irregular, the typical symptoms are absent, and no diagnosis is made until the child is comatose and moribund. In such cases the symptoms may be indefinite for a week or two, then a marked improvement takes place, which gives hopes that the diagnosis of meningitis is incorrect ; then suddenly convulsions and coma supervene and death speedily occurs. The fact that a remission of many of the symptoms may take place, the child being decidedly improved for a while, must be constantly borne in mind. In other cases the course is short and sharp, in this respect resembling some cases of simple meningitis. Thus, for instance, a boy of 8 years, who came of a tuberculous family, attended at school till April 23, though for the last few days he had not felt well. He then stayed at home on account of cough and weakness ; he began to vomit on May 3 ; the next day he became drowsy, gradually passing into coma, and died on May 8. At the *post-mortem* miliary tubercles, with some pneumonia, were present in the lungs and in the abdominal organs ; there was also tuberculous meningitis, with much fluid in the lateral ventricles and subarachnoid space.

In infants of six months, the symptoms are often the reverse of characteristic ; the infant perhaps vomits food, but in other ways appears quite well, and the vomiting is not unnaturally looked upon as due to some gastric irritation ; then possibly some rigidity of the muscles of the neck and slight retraction of the head are noticed, and it gradually passes into a condition of drowsiness and coma. Muscular twitchings of the facial muscles or frequent clonic spasms of the muscles of a limb or arm may be present. In other cases the infant appears to be 'teething,' there is some slight fever and restlessness, but nothing to indicate cerebral disturbance ; then suddenly convulsions come on, followed by hemiplegia, and perhaps coma. The state of the fontanelle is often a help in diagnosis in doubtful cases. The retraction of the head is not diagnostic, it occurs in cases of posterior basal meningitis, and sometimes is the result of reflex irritation from the pulmonary and

abdominal viscera. It occurs also in otitis. Posterior basal meningitis (see p. 504) is a commoner disease in infants under six months than tuberculous meningitis, and a differential diagnosis in the early stages may be difficult.

Prognosis.—As soon as a diagnosis of tuberculous meningitis is made there is little hope of recovery. In any case the hope must be rather that our diagnosis is wrong, otherwise we cannot expect a permanent recovery to take place. Yet undoubtedly the meningitis produced by the presence of tubercle does not always kill at once, and, moreover, in any case, there is the hope that the meningitis is a simple one without the presence of tubercle. We have seen at least three cases—in which there was good evidence to show that the patients were suffering from tuberculous meningitis—recover for a time and die subsequently of a second attack or of a general tuberculosis ; one of these cases may be shortly referred to.

Tuberculous Meningitis. Temporary Recovery.—Mary S., aged 6¾ years, was quite well till a month or two before admission to hospital, when several 'cold abscesses' formed on her legs and discharged. Lately she has had headache, been giddy, staggered in her gait, and rambled at night. For several nights after admission she was restless, and screamed with pain shooting through her head ; an internal squint was noted in the left eye ; she was fairly sensible in the daytime, but complained of headache, and frequently passed her motions under her ; there was occasional vomiting. She was treated with ice to her head and complete rest in bed, and bromides. There was slight optic neuritis, which gradually subsided during her stay. She gradually improved, and was discharged after a three months' stay, apparently quite well. She was readmitted six months after with undoubted signs of meningitis, and died after a fortnight's illness. The *post-mortem* showed miliary tubercles in the lungs, cheesy nodules in the liver, recent tubercles on the vessels at the base of the brain, and recent lymph ; there was also very distinct fibrous tissue at the base, as if resulting from a past inflammation ; the interpeduncular space was matted, so that the third and fourth nerves had to be dissected out and cleaned of fibrous tissue, and the lobes along the Sylvian fissures were firmly matted together. The history of the case and the *post-mortem* appearance made it clear that a recovery had taken place from a basal meningitis in a tuberculous subject.

A permanent recovery from an attack of tuberculous meningitis means in the vast majority of cases a recovery from a general tuberculosis—a result which is improbable. The prognosis becomes bad in the extreme when the patient has sunk into a drowsy condition and Cheyne-Stokes respiration is present, though several days may elapse before the end comes.

Diagnosis.—In a disease which begins so insidiously and assumes such varied forms the diagnosis is necessarily difficult. It must be in the experience of most to have made mistakes in diagnosis, in suspecting the onset of tuberculous meningitis when the patient was suffering from some dyspepsia or intestinal catarrh, and, on the other hand, making light of the anxieties of the friends when subsequent events have justified their fears. As regards diagnosis in the early stages too much stress must not be laid on irritability, grinding the teeth at night, loss of appetite, wasting, and sleeplessness, as these may be symptoms of a perfectly recoverable disease. On the other hand, sickness, giddiness, frequent stumbling, staggering gait, temporary squint, loss of power of the sphincters, even though these remitted after a while, would justify grave suspicions. They may indicate the presence of tubercle or some irritation of the brain, which may be quickly followed by definite symptoms of meningitis. We once made the mistake of diagnosing

a local encephalitis when the case was one of tuberculous meningitis with softening. It was in an infant of 6 months, suddenly seized with convulsions and hemiplegia..

The principal errors which are likely to be made may be summed up as follows :

1. Mistaking the vomiting of meningitis for simple gastro-intestinal disturbance. This is a very common mistake in the early stages of meningitis ; the vomiting of meningitis, like the vomiting of gastric catarrh, usually follows the ingestion of food, but it may also follow any movement of the patient ; it may occur when the stomach is empty and the tongue clean. The vomiting of a gastric disturbance mostly ceases after the stomach and bowels have been unloaded, while a cerebral vomiting is continuous in spite of treatment. In any case of causeless vomiting in a child a careful lookout must be kept for more definite brain symptoms, such as convulsions, dilated sluggish pupils, and retracted abdomen. A hesitating or intermittent pulse would strongly suggest the onset of meningitis. The past history of the patient is often important. The vomiting and the convulsions present at times during dentition may be a source of difficulty.

2. The mistake may be made of attributing to meningitis symptoms which are due to the presence of some febrile disorder or reflex irritation. A child cutting his teeth may be irritable, feverish, drowsy, and may start in his sleep, simply from the effects of dentition or from undigested or improper food in his alimentary canal. The sudden onset of fever is against meningitis, as also is evidence of dyspepsia, such as flatulence and colic ; the condition of the gums should be carefully examined. A few days would decide the diagnosis. The diagnosis between typhoid and meningitis is not usually difficult, that between typhoid and acute miliary tuberculosis being often much more so. The symptoms presented by a child sickening for typhoid may not be unlike those presented in the early stages of meningitis ; vomiting, however, is not a symptom of typhoid : the fever present and the condition of the abdomen would usually decide the diagnosis. The possibility of a simple meningitis occurring in the course of typhoid or pneumonia must be borne in mind, though it is not a common complication in either case.

3. At the end of certain exhausting diseases, such as acute diarrhœa, marasmus, &c., in infants, cerebral symptoms due to arterial anæmia of the vessels of the brain are apt to arise, such as convulsions, coma, contracted pupils, convergent squint, &c. This condition has been called 'false hydrocephalus.' The history of the case, the depressed fontanelle, the almost pulseless condition of the infant, and the rapid onset and course of the 'false hydrocephalus,' would usually distinguish it from meningitis.

The differential diagnosis between tuberculous and non-tuberculous meningitis is often impossible. A family history of tubercle or a history of the individual having suffered from caseous glands or other tuberculous manifestations, or having recently suffered from whooping cough or measles, would naturally favour a diagnosis of the tuberculous variety, as would also an insidious onset. On the other hand, the history of a blow, or an otitis, or exposure to a hot sun, and a stormy onset, would favour the diagnosis of the non-tuberculous form. Lumbar puncture and a bacterial examination

of the cerebro-spinal fluid may afford help in diagnosis, but as a bacteriological diagnosis takes time, especially if inoculation experiments are performed, it is evident it can only be of use in chronic cases.

Morbid Anatomy.—The bodies of those who have died of tuberculous meningitis are usually wasted in a high degree, but in some acute cases they may be fairly nourished. On removing the skull-cap and exposing the convex surface of the brain the veins on the surface will be found to be unusually full of blood ; the convolutions are flattened, having been compressed by the distended lateral ventricles, and their surfaces are dry and sticky. More or less purulent-looking lymph is present : it may be usually seen on the lateral, less often on the convex, surface. On examining the base, the effusion of lymph will be found to have taken place much more freely than on the convex or lateral surfaces. The Sylvian fissures will be seen to be matted with lymph ; the interpeduncular space, with the optic commissures and tracts, the third, fourth, and eighth nerves, and the inferior surface of the pons, and cerebellum, will be found in the same condition. Lymph may generally also be found around the medulla and spinal cord. An examination of the small arterial branches will show that they are studded with minute grey or yellowish tubercles ; the lumen of some may be occluded with thrombi.

In some cases hardly any lymph will be found, but the arachnoid is opaque and there is more or less effusion of cloudy fluid beneath it, while the brain substance is œdematous and watery.

Important changes are also present in the lateral ventricles. The vessels forming the choroid plexuses and velum interpositum are studded with tubercles and besmeared with lymph ; the lateral ventricles are distended with fluid, while in the majority of cases the parts around the corpus callosum, fornix, and optic thalamus have undergone white softening and may be washed away or ragged out by a stream of water. The presence of fluid in excess in the lateral ventricles is due to the inflammatory processes going on in the choroid plexuses ; this gives rise when in excess to dilatation of the ventricles, softening of the surrounding parts, and flattening of the convolutions. It was these mechanical effects which so struck the older observers like Whytt, who overlooked the presence of tubercles as the primary cause, and saw only in such cases an 'acute hydrocephalus' or 'water on the brain.' What further justifies these older observations is that in some cases the amount of lymph is very small and tubercles are found with difficulty, while there is much subarachnoid fluid as well as distension of the ventricles, and the brain substance is soft and œdematous. In a few cases large tracts of the superficial or central parts of the brain are softened and diffluent, the brain substance being yellow or plum-coloured from the presence of extravasated and altered blood, effects due to thrombosis or some disturbed condition of the circulation. A microscopical examination of hardened portions of the grey matter will show tubercles and effusion of leucocytes around the capillary arteries which enter the surface of the brain.

How do the symptoms during life correspond with the appearances found after death ? The older writers were probably correct in ascribing the excitement during the first stage to the inflammatory engorgement of

the arterial system of the brain ; the later stages of drowsiness and coma to the effusion of fluid into the lateral ventricles, which gradually compress the surrounding parts and interfere with their blood supply ; the hemiplegia, paralysis of facial, &c., to the softening which so frequently takes place.

Other tuberculous lesions are constantly found in association with tuberculous meningitis, the commonest of these being caseous mediastinal glands. The lungs also are rarely free from tubercle.

In non-tuberculous meningitis the distribution of the lymph, which is often purulent, is less exclusively basal, more often being found over the convex surface and between the hemispheres in the longitudinal fissure. In the more chronic cases the base of the brain and cerebellum may be adherent to the skull, and much fluid may be present in the lateral ventricles.

Treatment.—The prophylactic treatment of tuberculous meningitis is much the same as that of tuberculosis generally. All children who are so inclined require the most constant care in all the relations of life. Residence in cities must be prohibited, and country or seaside life insisted upon. A farmhouse where pure milk and cream, &c., may be had, in a bracing but not too bleak situation, may be selected as a residence. All book work should be stopped, and all forms of excitement be strictly prohibited. The diet should be carefully regulated ; fats, if they are found to agree, should be taken in fair quantities.

The child should be warmly clad and carefully protected from changes of weather. The bowels, if inclined to be constipated, should be carefully regulated with hyd. c. cret. or rhubarb and soda. The slightest suspicion of cerebral symptoms should be met by putting the child to bed in a darkened room, giving a calomel purge, and an exclusively milk diet, with free administration of bromides. One or two grains of calomel with some sugar may be given, and some saline, such as a quarter or half a seidlitz-powder, the following morning. Five to ten grains of bromide of potassium should be given every four hours. The vomiting is best treated by purging smartly, and giving peptonised milk prepared with Benger's peptonising powders, or whey and barley water. If the vomiting is persistent, all food must be stopped by the mouth, and Brand's extract, or peptonised milk and bromide, given by means of an enema. Nothing is gained by continuing to purge after the initial dose of calomel has emptied the bowels thoroughly. If there is much cerebral excitement, larger doses of bromide may be given with the tincture or succus hyoscyami. We doubt very much if blisters, setons, or leeches are of any service in tuberculous meningitis, though in simple meningitis, if the excitement or delirium is severe, a leech applied to the temples will certainly relieve. Cold to the head is of undoubted value and in all cases should be applied, an ice-bag of india-rubber being used in preference to any other form. Leiter's tubes form a convenient method of applying cold to the head, and they can be used where ice cannot be obtained. Mercury given freely in the form of perchloride is of all drugs the one most likely to be of service in simple meningitis. Iodide of potassium is frequently prescribed, though with doubtful advantage. Drainage of the subarachnoid space in cases of acute tuberculous meningitis has been carried out by an opening made either in the lumbar or cervical spine, or by trephining the occipital bone. Successful cases have been

recorded, but we have no personal experience of the method. Operation, if done at all, should be performed before coma sets in. We doubt the value of any such operation. Lumbar puncture and withdrawal of fluid would be preferable.

Non-tuberculous Meningitis.—While tuberculous meningitis is by far the commonest form met with during early life, and overshadows all other forms by its importance, yet other forms are also met with which require careful consideration. A meningitis occurs at times in association with pneumonia, summer diarrhœa, pyæmia, otitis, scarlet fever, and some other of the infectious fevers. Presumably in these cases it is infective: there is a transference of pneumococci or streptococci or other organisms from the lungs, intestinal tract, or some other locality, to the membranes of the brain, and inflammation set up. One form of meningitis, or, rather, cerebro-spinal meningitis, occurs in widespread epidemics, though it is comparatively rare in this country. Another form which is also due to the presence of a specific organism mostly affects the posterior region of the base of the brain. Meningitis in some instances appears to be due to exposure to the sun; in other cases it follows an injury, and in some others it is idiopathic, or, in other words, no cause can be assigned. In acute cases it is mostly purulent.

Acute Form.—In some cases, both in infants and older children, the attack may run a very acute course, death from convulsions taking place in two or three days. The acute meningitis in some of these cases is associated with a pleuro-pneumonia or peritonitis. As an instance of rapid death from what was probably an acute meningitis, though the *post-mortem* examination showed no effused lymph, the following case may be taken as an example:

Acute Meningitis.—Beatrice B., aged 5½ years, was a healthy child till six months ago, when she was taken with pain in the head, fever, and vomiting, but recovered in a day or two. Two days before admission, when playing in the street, she ran in, complaining of pain in the head, and vomited; she continued to vomit constantly for two days; she had a fit shortly before admission. There had been no injury to the head; the weather was hot at the time (August). On admission she looked ill, her face having an expression of anxiety; two hours after admission she was convulsed and died. Her temperature was not taken. At the *post-mortem* all the organs were healthy, the capillaries of the brain were intensely injected, and there was much clear fluid in the lateral ventricles; the arachnoid membrane was somewhat opaque.

In this case microscopical examination showed that the capillaries of the meninges and grey matter of the brain were distended and gorged with blood, and, though it cannot be certainly assumed that this congestion was primary and inflammatory, there is a strong probability that the case was one of acute inflammatory congestion of the brain and membranes. Similar cases of rapid death from acute hyperæmia of the brain after exposure to a hot sun are recorded by Lewis Smith and Soltman. Henoch mentions a similar case in a girl of 5 years, the attack beginning in the same way with headache and vomiting, death taking place within forty-eight hours, preceded by convulsions and coma. At the *post-mortem* a purulent exudation was present on the convexity and at the base of the brain.

In the following case meningitis supervened on acute diarrhœa :

Acute Enteritis, Meningitis.—Annie B., aged 3¾ years, was seized with vomiting and purging (in August) ; the next day, when admitted, she was in semi-collapsed condition. A few hours afterwards she lapsed into unconsciousness. She was delirious, and there were muscular twitchings. Death took place rather suddenly at the end of the second day of the illness. At the *post-mortem* the pia mater was found intensely congested, the arachnoid opaque, the Sylvian fissures were glued together with lymph ; there were no tubercles ; there were patches of congestion in the intestines and commencing pneumonia of the base of the right lung.

These extremely acute cases are exceptional, and a doubt may often surround the diagnosis, as acute meningitis in the early stages may with difficulty be distinguished from the onset of some zymotic disease, as scarlet fever or influenza, or perhaps more likely of pneumonia ; and if the course terminates early in a convulsion it may be impossible even at the *post-mortem* to say with certainty what has been the exact nature of the case. Death from a convulsion, accompanied by a spasm of the glottis, gives rise to a mechanical engorgement of both lungs and brain, and caution is required in positively asserting that an early meningitis or pneumonia is present.

In the majority of cases acute meningitis runs a course of a week or ten days, the symptoms resembling those described under tuberculous meningitis. There may be a history of an injury, or of a past otitis, or of exposure to the sun, or there is an empyema, pleurisy, or erysipelas. The early symptoms are those of intense headache, with injection of the conjunctivæ, vomiting, delirium, strabismus, and often high fever, perhaps as high as 103° to 105°. Later, the pulse becomes slow and hesitating, the abdomen is retracted, the cervical muscles are rigid, and Cheyne-Stokes respiration, coma, and various paralyses ensue. At the *post-mortem* a more or less intense, perhaps purulent, meningitis is found affecting the convexity and base of the brain. Pneumococci or other organisms are present in the lymph or inflammatory exudations.

Latent Form.—Meningitis, like peritonitis and pleurisy, may be present without giving rise to any very definite cerebral symptoms ; this is especially so when it occurs secondarily, and the symptoms to which it gives rise may be overshadowed by the primary disease. It may occur in association with acute pneumonia or peritonitis or acute intestinal catarrh, without its presence being suspected, partly because the headache, delirium, and fever are naturally attributed to the more obvious disease present, and there is necessarily a difficulty in unravelling the complex association of symptoms and referring each to its cause. In some few instances a meningitis may exist without there being any cerebral symptoms whatever, as in the following case :

Purulent Meningitis.—An emaciated child (boy) of 4 years of age, who had recently suffered from whooping cough, was admitted to hospital with some dulness at the base of one lung. There was a history of diarrhœa, and during the fortnight preceding his death he had five or six diarrhœal stools daily. There was a hectic temperature, no vomiting, headache, or optic neuritis ; he was perfectly intelligent, and died apparently of exhaustion. It was supposed that there was general tuberculosis. At the *post-mortem* the lungs were found adherent to the diaphragm ; some inspissated pus was found present at the left base, evidently the remains of a small empyema ; there were no tubercles anywhere.

There was some purulent lymph covering the inner surface of the dura mater, the convex surface of the brain, and the vessels in the transverse fissure, and bathing the surfaces of the lateral ventricles; the base of the brain was matted with lymph. There was clear fluid in both tympanic cavities, but no pus.

It is in wasted, anæmic children that such lesions as purulent meningitis, pleurisy, or peritonitis may exist without giving rise to marked symptoms.

The diagnosis between acute meningitis and otitis is often difficult, and yet it is of the greatest importance. The relation between the two conditions is somewhat complex: a meningitis may undoubtedly arise from contiguity of diseased bone in the ear or acute suppurative otitis; a purulent meningitis may exist with suppuration in both tympanic cavities, or the latter cavities may contain cloudy fluid only, under circumstances which make it probable that the meningitis and otitis are both dependent on the same cause, and are not related as cause and effect. There is much reason to believe that an acute suppuration in the middle ear may closely simulate acute meningitis, and there is little doubt that they have often been mistaken one for the other. Cases which have been diagnosed as acute meningitis have quickly recovered after a discharge of pus from the ear, either bursting through the tympanic membrane spontaneously or being relieved by incision. In cases of double suppurative otitis there may be intense pain in the head, fever, delirium, convulsions, optic neuritis, and deafness. The point of greatest diagnostic importance is the deafness without facial paralysis; for, as Gowers points out, meningitis 'never gravely injures the auditory nerve without the adjacent facial nerves'; nevertheless the diagnosis between otitis and otitis with superadded meningitis is exceedingly difficult and often impossible. In any doubtful case incision of the membrana tympani should be performed.

Posterior Basal Meningitis.—Basal meningitis is for the most part tuberculous, but there is a well-marked non-tuberculous form which is limited pretty much to the neighbourhood of the pons, medulla and cerebellum, and interpeduncular space. The inflammation is subacute or chronic, adhesions form between the parts gluing them together, the fourth ventricle becomes obliterated, and internal hydrocephalus takes place from blocking of the aqueduct of Sylvius, if the patient lives long enough. Infants are usually the chief sufferers, but older children are sometimes affected. The most prominent symptom is cervical opisthotonos; this varies from time to time, the muscles of the neck being sometimes relaxed; usually they are so rigidly and completely contracted that the neck is bent and fixed at right angles to the trunk. The rigidity is not confined to the cervical muscles, but the muscles of the back and lower limbs are in a state of spasm, so that the opisthotonos is general. Vomiting and convulsions are often present in the early stages. Drowsiness and fever are present, and later coma. Squint or nystagmus may occur, often there is impaired or complete loss of vision; optic neuritis is absent. The bowels are often loose or normal. The abdomen is not retracted as in tuberculous meningitis. The course of the disease is acute or chronic, lasting two or three weeks or possibly three or four months. In the later stages—that is, if the patient survives—enlargement of the head takes place, as the result of an internal hydrocephalus

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caused by the adhesions formed at the base of the brain. There may be hyperpyrexia, as in the case related below, before death. While these cases are usually fatal, they are by no means always so. As we have said, infants are most often attacked, but we have seen similar cases in children of 3 or 4 years of age which have ended in complete recovery. There has been hyperpyrexia, drowsiness, extreme opisthotonos, the symptoms lasting for a week or ten days and then gradually disappearing. Perhaps ten per cent. of these cases recover. Amaurosis is frequently left with dilated and sluggish or it may be normal pupils, recovery taking place in the course of some months.

As already stated, the *post-mortem* findings in these cases include lymph or fibroid adhesions, according to the stage in which death has taken place, matting together the interpeduncular space, pons, medulla, base of the cerebellum, fourth ventricle, and internal hydrocephalus. Dr. G. F. Still has shown that a specific organism is present in these cases; a diplococcus, which grows readily on agar, is stained by methylene blue, but not by Gram's method. It differs in many respects from the pneumococcus and the diplococcus of cerebro-spinal meningitis. It is possible the diplococci gain entrance from the mucous membrane of the naso-pharynx to the base of the brain. The diagnosis in the early stages may be difficult. In pneumonia there is sometimes retraction of the head, and also in tetany. Continued and well-marked retraction of the head with vomiting occurring in an infant is diagnostic of posterior basal meningitis.

The following case may be taken as an instance:

Basal Meningitis, Hydrocephalus.—E. P., aged 7 months; no history of syphilis. At six weeks of age had an attack during which he was always crying and throwing his head back. A month ago he became drowsy and dull, and had twitchings of right arm and leg. He is unable to see. Admitted June 13. Constant vomiting; abdomen retracted; limbs rigid; toes point; fingers are flexed. From June 13 to June 25, when he died, he was comatose; there was remarkable hyperpyrexia; the temperature rising on succeeding days to 106° F., 108·6°, 107°, 107·4° and 107·8° before death. *Post-mortem* showed lymph mostly confined to the interpeduncular space, pons, and base of cerebellum. Both ventricles contained fluid and lymph; cortex thinned to about ½ inch in thickness from internal pressure.

A subacute basal meningitis may occur in older children, and recovery from such attacks apparently takes place. Thus in a case of our own—that of a boy who died suddenly, in apparent health, and on whom a coroner's inquest was held—an acute hydrocephalus was present, with some adhesions between the base of the brain and the skull, apparently the remains of a meningitis from which there was a history of the boy having suffered some months before.

As an example of a simple subacute meningitis following an injury, the following case of Dr. Hutton's may be given:

Basal Meningitis, Hydrocephalus.—William C., aged 8 years, fell into a cellar, striking the back of his head, some three months before admission. He vomited off and on for a day or two, but did not lie up; he suffered from pain in the back of his head almost constantly after the fall. He was admitted with squint and pupils of unequal size; he had convulsions, optic neuritis, and lapsed into a semi-comatose state with Cheyne-Stokes respiration. He died twenty-four days after admission. At the *post-mortem* the dura mater was found thickened and congested, there was much lymph at the base and between the

hemispheres, and also between the latter and the cerebellum ; the lateral ventricles were much dilated and distended with serum. There were no tubercles anywhere.

The following case illustrates the association of subacute meningitis and hydrocephalus with pneumonia :

Basal Meningitis, Hydrocephalus, Chronic Pneumonia.—B. V. R., aged 5 years, was always a healthy girl till seven weeks before admission, when she had an attack of feverishness and vomiting ; she has vomited more or less ever since ; she has also been losing flesh. On admission she was drowsy and irritable ; screaming with a shrill cry when disturbed ; the head was thrown back, the neck retracted ; there was no optic neuritis. A few days after she had two fits. She continued to vomit at frequent intervals. There was much rigidity of the muscles of the neck, with the head thrown back ; the hands and arms remained normal, while the hips and knees were flexed and the abdomen retracted. Later she suffered from double pneumonia at the bases, she wasted more and more, gradually became unconscious, and died ten or eleven weeks from the commencement of her illness. An examination of the brain showed that the Sylvian fissures were matted together with fibroid adhesions ; similar adhesions were present in the interpeduncular space and surrounding the third and fourth nerves ; fibroid adhesions were also present on the upper surface of the cerebellum. The lateral ventricles were much dilated and distended with fluid ; there had also been an inflammatory condition of their lining membrane, with exudation of fibrin. There was no tubercle anywhere ; there was a double pneumonia becoming caseous.

It is uncertain if the last three cases related were not examples of the posterior basal meningitis of infants just described—at any rate, were not caused by the same micro-organism. Our knowledge is still imperfect respecting the bacteriology of meningitis.

Epidemic Cerebro-spinal Meningitis.—Meningitis occurs in some countries in epidemics, and is usually accompanied by inflammation of the membranes of the cord ; sporadic cases, however, occur. Limited outbreaks have occurred in Dublin and Glasgow, but such are rare in this country. Both adults and children are attacked. The symptoms of cerebro-spinal meningitis in infants closely resemble those of simple meningitis, but usually there is more marked rigidity of the cervical muscles and muscles of the spine, the legs may be rigid and drawn up, and there may be more or less rigidity about the muscles of the arm and forearm. Sometimes there is opisthotonos resembling tetanus. In older children pain in the back and limbs may be complained of, being more especially referred to the back of the neck or sacrum ; sharp shooting pains may be complained of in the limbs. There may also be general hyperæsthesia. In the epidemic form purpura and herpetic eruptions are common. Pneumonia is a common complication. Weichselbaum has described a diplococcus, the D. intercellularis, which he believes to be the specific cause of epidemic cerebro-spinal meningitis. The diagnosis between cerebral meningitis and a cerebro-spinal meningitis in infants is very difficult, often impossible, as it is difficult to localise pain and to arrive at a conclusion as regards a general hyperæsthesia. Retraction of the head and more or less rigidity in the limbs may be present in both, but they are most marked when the spinal meninges are affected. Both tetanus and tetany may be mistaken for the disease ; in the former there is marked trismus before the onset of the opisthotonos, and the temperature is normal or only slightly raised ; and in the latter the peculiar

spasm of the muscles of the hands and feet, and normal temperature, suffice to distinguish the two diseases. Blindness may result from optic neuritis, and deafness from inflammation of the auditory nerve. The child may recover its health completely, but is blind and deaf. Hydrocephalus may also take place. The child may suffer from imbecility.

Treatment.—The treatment of cases of non-tuberculous meningitis is very much the same as that already given. Unfortunately medicines can do but little. In the more chronic cases, blisters and iodide of potassium in large doses are worth trying. Ergot has also been given. Morphia, chloral, bromide may be necessary to relieve pain and sleeplessness.

Chronic Meningo-encephalitis. Pachymeningitis

Chronic Meningitis.—A chronic inflammatory process, affecting more especially the convex surface of the brain, occurs occasionally during infancy, apparently also during intra-uterine life. In such cases the surface of the brain becomes adherent to the dura mater, a thickening of the membranes taking place resembling the pachymeningitis of adults. A membranous exudation may be thrown out, and blood may be effused. Carr has recorded[1] a case of this sort in an undoubted syphilitic child of 19 months. It had suffered from repeated convulsions and was idiotic. At the *post-mortem* there was no hydrocephalus, the dura mater was lined by a membrane of a gelatinous appearance, the same gelatinous material covered the cortex and base. The brain weighed 18 oz., there were some areas of sclerosis bordering on the fissure of Sylvius. Such a condition may be associated with a chronic hydrocephalus. The symptoms present are frequently not distinctive, or they may be simply those of chronic hydrocephalus ; there may be defective intelligence or idiocy, probably also convulsions ; retraction of the head and rigidity and flexion of the limbs are likely to be present if the child lives any length of time. The etiology of such cases is doubtful ; they are always suggestive of hereditary syphilis. As chronic hydrocephalus is often associated with the meningitis, a diagnosis of hydrocephalus is probably all that can be made during life.

Fig. 105.—Microcephalic infant. Syphilitic infant 4 weeks old. (See case.) From a photograph by Mr. J. Hepworth.

A meningitis during intra-uterine life, by interfering with the growth and development of the brain, may produce various results, such as hydrocephalus, sclerosis, or an abnormally small brain. Thus in a case[2] of Sir T. Barlow's, in an infant dying at 7 weeks of age, the head measured only 10½ inches round, and the brain weighed only 9 drachms ; the convolutions were hardly recognisable over the greater part of the convexity, and the pia

[1] *Lancet*, January 1895, p. 154.

[2] *Path. Trans.* vol. xxxviii. p. 8.

mater and cortex beneath it were invaded with calcareous plates; the choroid plexuses of the lateral ventricles were also partially calcified. In this case there seems to have been an intra-uterine meningitis, followed by calcification of the effused lymph and some atrophy of the subjacent brain tissue. In the following case there had been apparently a meningo-encephalitis occurring during fœtal life giving rise to sclerosis; the infant was syphilitic.

The father of the infant suffered from sore throat, rash, and serpiginous ulceration of his legs. The mother, when pregnant, suffered from sore throat, and has had a squamous syphilide on her face; an infant born subsequently to the patient suffered from coryza and eclampsia. The infant was first seen when 2 weeks old: it was microcephalic, its head

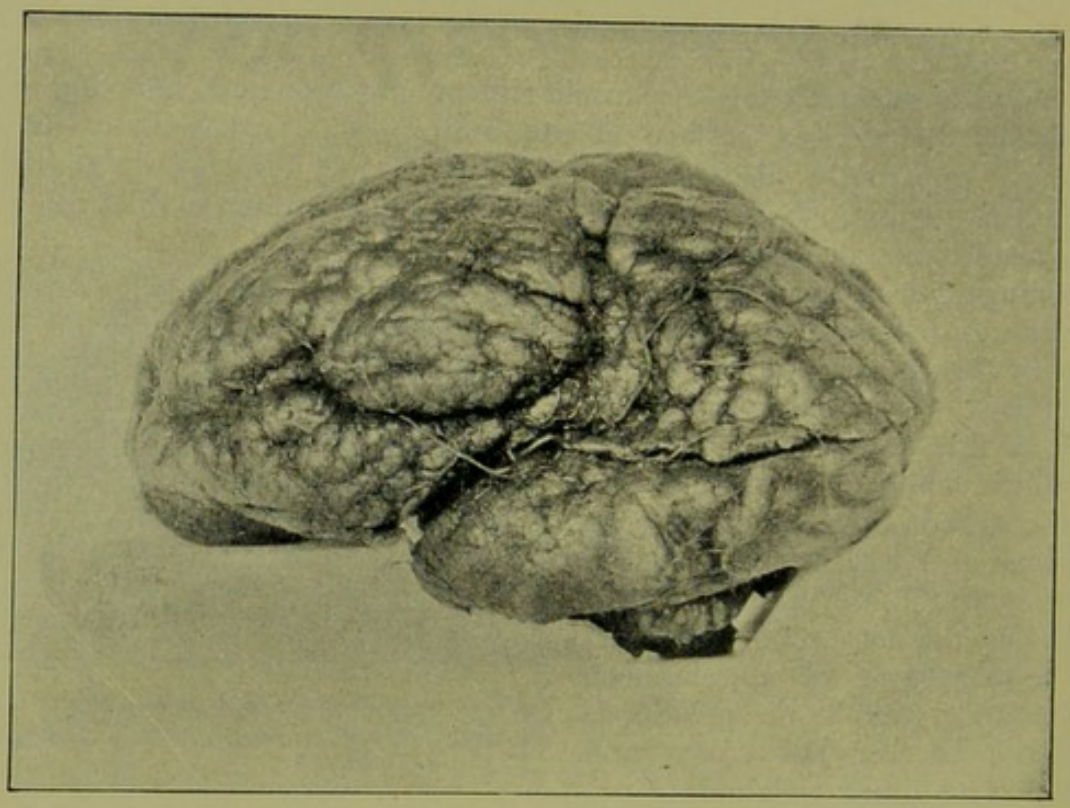

Fig. 106.—Brain of a Syphilitic Infant (fig. 105), showing irregular nodulation of surface from meningo-encephalitis. From a photograph by Mr. J. Hepworth.

measuring 10½ inches in circumference (see fig. 105), it suffered from coryza and eclampsia. It was idiotic, being unable to recognise anything. The fits continued, both arms and legs became paretic and later spastic. It died at 5 months of age. The brain weighed 3¼ oz. (after having been in weak spirit). There was excess of subarachnoid fluid, the arachnoid was milky, there was no recent lymph, but at the base of the brain there was some yellow detritus. The convolutions in the Sylvian fissure and neighbourhood had mostly disappeared, the surface of the brain being irregular and nodular. There was a depressed scarring over both frontal lobes (see fig. 106). There had been a meningitis of the choroid plexus and hydrocephalus. No endarteritis was found.

In the following case, which lived to be 20 months old, the sclerosis on the surface of the brain was well marked:

Fœtal Meningo-encephalitis.—A child who died at the age of 20 months had been a complete idiot from his birth, and had suffered from convulsions; he was blind and deaf; the legs and arms were drawn up and stiff. At the *post-mortem* the brain was found hard and shrunken over the convex surface; the convolutions had completely disappeared, the

surface being simply grooved by the vessels and granular like a 'cirrhosed' liver; at the base and median surfaces the convolutions were fairly well marked (see fig. 107). The pia mater consisted of many tortuous vessels, which could be dissected off. On vertical section it was seen that the grey matter and white matter also were hard and shrunken, and hardly distinguishable from one another. Microscopical examination showed an increase of connective tissue and an absence of nerve elements. There was descending degeneration, or rather perhaps failure of development in the pyramidal tracts of the pons and cord.

Endarteritis. Softening.—An acute arteritis in rare instances occurs in infants a few months old who are the subjects of congenital syphilis. Such cases have been recorded by Sir T. Barlow, Chiari, and Heubner.

In infants, the principal symptoms are convulsions, in the form of muscular twitchings of an arm or leg, followed by paresis and contractures. The infant gradually becomes idiotic. The chief changes are in the arteries as described by Heubner: there is a thickening of the internal coat, the nuclei between the endothelium and the fenestrated membrane becoming

Fig. 107.—Sclerosis of Brain. From a boy of 20 months. The convolutions have disappeared, the surface of the brain resembling a hob-nail liver (probably syphilitic). The openings which transmitted the meningo-cephalic vessels appear as black points.

increased in number, to be followed by fatty changes; thrombosis takes place at the seat of the inflammatory changes. Softening of the brain follows over the area supplied by the blocked arteries. The following case illustrates this:

Syphilitic Arteritis. Softening.—Infant first seen at 3 months of age, when suffering from coryza and a well-marked rash. A month later the epiphyses of the lower end of the tibia and fibula, also the lower ends of the radius and ulna, were swollen and tender (fig. 102 was drawn from this case). When 7 months old he began to suffer from convulsions, mostly left-sided at first; later the convulsive movements became general. In the course of a few months the left arm and leg, which were more or less paralysed, began to draw up and become more or less rigid; the elbow was bent at right angles, the arm pronated, and the fingers flexed; still later the right arm became similarly affected; the child gradually became idiotic, and died when 14 months old. It was under mercurial treatment from 3 months of age. At the *post-mortem* the arachnoid was of a milky colour, and there was an excess of subarachnoid fluid; there was no effused lymph or meningitis. The superficial layer of the grey matter on the convex surface of both hemispheres, especially the right, was softened and could be readily scraped away; the superficial

layer of the caudate nucleus and the optic thalamus were in the same condition of softening. Microscopically, the grey matter showed extensive fatty degeneration ; the minute arteries were extensively blocked with old thrombi, their inner coats being thickened and their nuclei increased in number. The large arteries were normal, as far as could be made out. There seems to have been an extensive syphilitic arteritis of the small meningo-encephalic arteries, thrombosis, and secondary softening of the superficial grey matter.

Pachymeningitis, with thickening of the dura mater and adhesions to the brain and skull, and wasted convolutions of the brain and endarteritis, is found in cases of syphilitic dementia. The paresis and dementia commence shortly before puberty ; there is usually more or less blindness from disseminated choroiditis and deafness. The course is very chronic. (See Juvenile General Paralysis.)

Hydrocephalus

Acute Hydrocephalus occurs only in association with an acute meningitis. In the majority of cases of acute meningitis, whether tuberculous or simple, there is an excess of fluid in the lateral ventricles, the result of an intra-ventricular meningitis, and a consequent excessive exudation from the vessels of the choroid plexus. In exceptional cases the meningitis is confined to the ventricles.

Chronic Hydrocephalus.—The accumulation of an excess of fluid in the ventricles of the brain is by no means an uncommon condition in infants and children. (1) It may be congenital, the accumulation taking place before birth, and it may give rise to difficulty in the extraction of the head. (2) It may follow meningitis, especially post basal meningitis. (3) It may arise without any apparent cause. (4) It may be the result of a tumour, as for instance a tumour of the cerebellum, compressing the veins of Galen, and in other ways interfering with the circulation.

Ante-natal hydrocephalus is generally due to an embryological arrest of development. In some instances it occurs in several successive pregnancies, and is associated with other deformities, such as spina bifida, cephalocele, club-feet, hare-lip, and cleft palate (Ballantyne).

In the majority of cases the child is born healthy, and the enlargement of the head is first noticed when the infant is a few weeks to a few months old ; usually no cause can be assigned, but some of the cases are syphilitic, and it is not improbable that syphilis plays an important part in the production of hydrocephalus. Enlargement of the head is preceded in a few cases by distinct cerebral symptoms, as convulsions, fever, drowsiness, and retraction of the head, so as to suggest the probability of the meningitis being local rather than general. As the fluid accumulates in the ventricles the head enlarges, the bones forming the vault of the cranium become thinned and open out, so that the fontanelles are enlarged and the edges of the bones at the sutures are separated from one another (see fig. 108). The fontanelles are bulged and have a fluctuating feel ; the occipital and parietal bones may be so thin that moderate pressure with the finger is sufficient to bulge them in. The cranium assumes a spherical form, and its increased size contrasts with the child's face, which may be thin and sunken, giving the child a characteristic appearance. The forehead is rounded, and projects so as to overhang the face ; the parietal and occipital bones

assume a similar shape, so that the head has a globular or rounded form. There may be nystagmus. The general rounded contour is broken by the prominence of the frontal and parietal eminences ; at these spots the bone is thick and solid, and consequently cannot be bulged out like the thinner bone elsewhere. The skin of the forehead and scalp is thin and shiny from being stretched, and the cutaneous veins are distended, especially when the infant cries ; the eyes project : their axes may be divergent, and there may be difficulty in closing the eyelids. The infant cannot raise its head, and if propped up the head rolls over in a helpless sort of way. The condition of the intellect varies considerably ; in the majority of cases, where the hydrocephalus is moderate in degree, the intellectual powers are surprisingly good

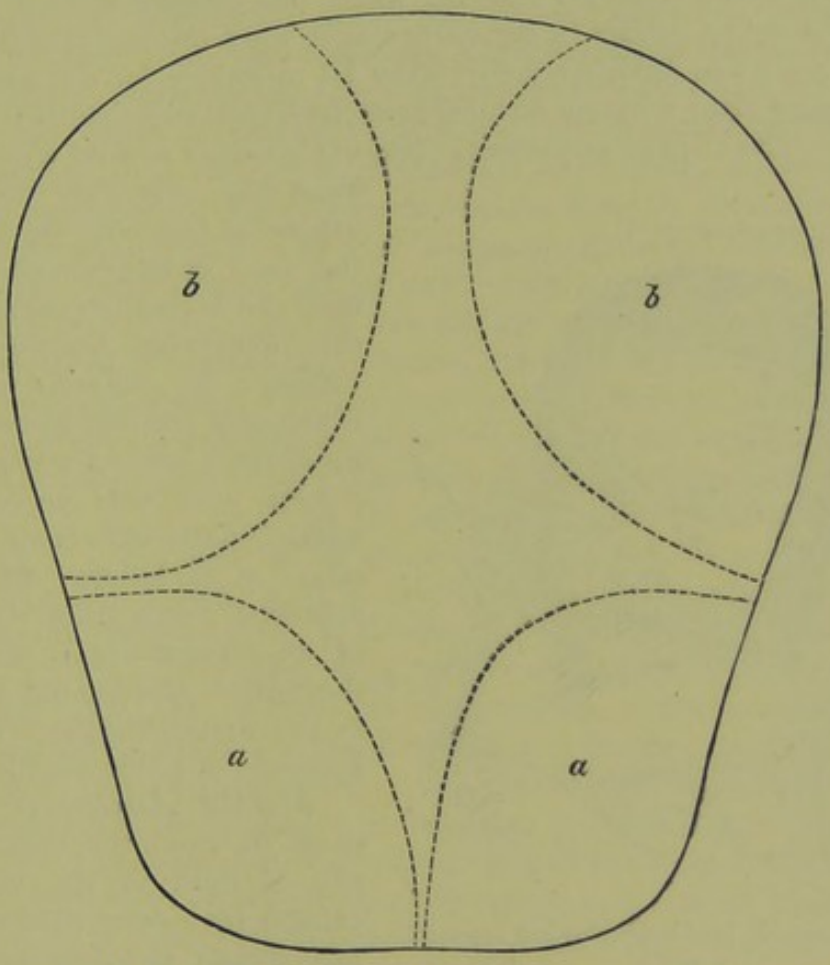

Fig. 108.—Outline of Head in Chronic Hydrocephalus. *a*, *a*, frontal bones *b*, *b*, parietal bones.

when it is considered what amount of compression and flattening out the grey matter on the surface of the brain is exposed to by the accumulation of fluid in the lateral ventricles. In extreme cases there is certain to be marked intellectual defect, perhaps amounting to idiocy. The limbs are mostly paretic, and the lower extremities especially are rigid, and flexed upon the abdomen ; permanent contractures are apt to follow, a result probably due to compression of the pons. Atrophy of the optic nerves may take place from compression or stretching of the optic tracts or commissure. The course of the disease is usually chronic, and infants will live for months or even years, but ordinarily they gradually waste and die. The child shown

in fig. 109, who was 6¾ years of age, had suffered from chronic hydrocephalus since three months old; he was well nourished; his head measured 31½ inches in circumference; he was a complete idiot. The legs were bent at the knee and flexed on the abdomen, but the spasm of the muscle varied from time to time; the hands were kept closed, and the elbows were flexed and more or less rigid. We have known recovery to take place even after rigidity of the legs has come on.

In older children, when the disease comes on after the closure of the fontanelles, the head enlarges more gradually, thinning the bones and even opening up the fontanelles and sutures; in these cases the hydrocephalus is mostly due to a cerebellar tumour; blindness and imbecility gradually supervene.

Diagnosis.—This is not difficult when the disease is well advanced; difficulty, however, occurs in the early stages when the accumulation of fluid is small, and when hydrocephalus may be mistaken for a rickety skull, or simply a large head without distension of the lateral ventricles such as occurs in rickets. The friends of patients often ask whether a child who has a large head has 'water on the brain.' A diagnosis can only be made when the head enlarges under observation, the bones becoming thinned, the fontanelles bulged and fluctuating; the globular shape which it assumes distinguishes it from the misshapen head of a typical case of rickets with the prominent eminences, flattened vertex, and thick edges of the bones. In the simply enlarged head, from the presence of an abnormally enlarged brain, there is no opening out and bulging at the fontanelles, nor usually any evidence of a thin skull.

Fig. 109.—Chronic Hydrocephalus in a boy aged 6¾ years.

Morbid Anatomy.—In those cases in which the excessive quantity of fluid in the ventricles is caused by a cerebellar tumour the mechanism is tolerably clear, for any stretching of the tentorium cerebelli must compress the straight sinus which runs along at the base of the falx cerebri, and consequently check the onward flow of blood in the veins of Galen and inferior longitudinal sinus. As the veins of Galen return the blood of the choroid plexus, it is easy to understand how a chronic hydrocephalus may be thus produced. In these cases the lateral ventricles are distended with a clear fluid of low specific gravity, the third and fourth ventricles join in the dilatation, and the iter is also enlarged. In another class of case which occurs after a basal meningitis (see p. 504), it is clear that the adhesions which form in the neighbourhood of the fourth ventricle have the effect of sealing up the communication between the lateral ventricles and the subdural space by closing the aqueduct of Sylvius

and transverse fissure. There is no escape for the fluid secreted in the lateral ventricles, and it is consequently ponded up and gradually distends the ventricles as it increases. In the cases which form the majority, i.e. where no tumour is present, and no evidence of a past or present meningitis, the mechanism of the hydrocephalus is by no means clear. In these the lateral ventricles and their horns may be enormously dilated, the grey matter on the surface flattened out and reduced in some instances to the thickness of cardboard, the convolutions being lost or only traced with difficulty. The contained fluid is clear, of specific gravity about 1005, with a small quantity of albumen and salts ; the third and fourth ventricles are dilated ; the pons is often flattened by the pressure of fluid in the fourth ventricle. In all these cases, where there is no apparent obstacle to the escape of the fluid from the ventricles, no satisfactory explanation of the hydrocephalus is forthcoming. In some cases at least there may be an inflammatory condition of the choroid plexuses, but as a rule the lining membrane of the ventricles and choroid plexuses are healthy to the naked eye. It would appear that for some unknown reason there is an excessive secretion of cerebro-spinal fluid. In rare instances there is excessive fluid in the lateral ventricles without enlargement of the head (Ballantyne).

Treatment.—The treatment of chronic hydrocephalus when once established is unfortunately unsatisfactory, and but little can be done to influence the progress of the disease. In any case in which there is reason to suspect syphilis some mercury should be given internally, and some ung. hydrarg. applied to the head ; or strips of mercury plaister may be used to effect a moderate compression and aid the absorption of the drug. Sometimes infants appear to be benefited by this treatment ; but, presuming there is a chronic syphilitic meningitis, it is by no means certain to be influenced by anti-syphilitic treatment. Both mercury and iodides should be tried, especially as there is no other drug which affords any chance of success. Some success has been claimed for compression of the head by means of strips of plaister or an elastic bandage ; if it is decided to try this method its risks must be borne in mind. The circulation through the scalp is interfered with by its compression between the skull and bandage, the brain is also compressed between the skull and the fluid in the ventricles. We have seen extensive sloughing of the scalp in a case of hydrocephalus, the result of a too tightly applied elastic bandage. No real compression can be of any service, and it is decidedly risky ; but a lightly applied bandage may be of use as a support. Puncture with one of Southey's cannulæ through the anterior fontanelle, avoiding the superior longitudinal sinus, offers more chance of at least temporary relief. It is usually harmless, though if too much fluid be withdrawn there is a risk of collapse of the brain substance, with perhaps convulsions and sudden death. We have frequently drawn off as much as 12 oz. through one of Southey's cannulæ, but the fluid reaccumulates in a few days. In a few recorded cases a rapid rise of temperature and sudden death took place when the lateral ventricles were quickly emptied (Sutherland). Instead of puncturing the lateral ventricles, the fluid may be in part removed or intracranial pressure lessened by repeated lumbar puncture, withdrawing 10–20 c.c. at intervals. It is only in the early and slighter cases that this can be of much use. It is worthy of a trial, but by no means free from risk.

Of other methods of treatment we have had no experience. Pott has treated chronic hydrocephalus by incision and drainage, and Ranke by puncture and injection of tincture of iodine (10 grms. diluted with 20 grms. of water). It cannot be said that these plans have met with much success. More recently Sutherland and Watson Cheyne have devised a method of draining the over-distended lateral ventricles into the subdural space by means of a bundle of fine catgut. The catgut drain is so arranged that one end projects into the ventricle, the other end into the subdural space. The wound in the dura mater and skin necessary to insert the drain is then sutured up. In the cases operated on the fluid gradually diminished as the ventricle drained, but in one case a second operation was necessary to drain the other ventricle. It is possible that this operation may be of use in cases of chronic hydrocephalus following basal meningitis.

Hypertrophy of the Brain.—Rickety children often have abnormally large heads, a condition which is frequently attributed to 'water on the brain.' In reality such abnormally large heads are not hydrocephalic, their increased size being due in some cases to the prominent frontal and parietal eminences, but more often to an enlarged brain. The cause of this hypertrophy is not known, and the nature of the enlargement in the brain, liver, or spleen, which is apt to take place in rickets, is not clearly understood. In several cases coming under notice of children in their second and third years, with large heads, who have had rickets in a severe form and who have died in convulsions, the brains have been large, the convolutions well marked, the brain substance fairly firm, and the microscopical examinations revealed no change that we could detect. Such brains are usually very vascular, but, as death often takes place through convulsions, it is hardly safe to assert that the vascularity is anything more than a secondary effect, resulting from the manner of death. In some cases the increase in size has been attributed to an increase of the connecting elements, the neuroglia, but it is needless to say it is a very difficult matter to decide if this is so in a brain in which the enlargement is general; in our own cases, certainly, there was no striking change. It is certain that enlargement of the brain in these cases is not accompanied by any precocity of intellect; indeed, it is rather the reverse, as such children are mostly backward, not only in physical, but also in mental development. If the quantity of brain matter is large, the quality is certainly poor. Apparently a compensatory hypertrophy may take place.

Cerebral Tumours

Cerebral tumours are not uncommon during early life, though comparatively rare before 3 or 4 years of age. Small tuberculous masses are found at times in the brains of infants under a year old, and Demme found a cheesy mass in the cerebellum of a newly-born infant. In by far the majority of cases in children, the tumour consists of a caseous mass formed by a local tuberculous process. These tumours may be multiple; indeed, half a dozen or more may be found. If of any size they are surrounded by softening or œdema, and pressure effects are produced out of all proportion to the size of the caseous mass. These tumours have a marked predilection for one of the lateral lobes of the cerebellum, but they may be found not uncommonly

in the pons, and both on the surface of the grey matter and in the connecting white substance. In not uncommon instances the tuberculous tumour ceases to grow actively, becomes quiescent, and later cretaceous, and the patient recovers with perhaps more or less blindness from optic atrophy.

Gliomas infiltrating the white matter of the brain, especially of the pons Varolii, are common. These growths are prone to softening and hæmorrhage. Villous tumours growing from the choroid plexuses are not rare and belong to the adenoma class. Sarcomata and endotheliomata growing from the dura mater occur. Simple cysts, hydatid cysts, and gummata occur, but the last two are rare.

Little is known as to the cause which determines tumour growth in the brain or its coverings; it appears certain, however, that an injury acts as an exciting cause. A fall or blow on the head is followed in the course of a few weeks or months by cerebral symptoms. On the fatal termination a cheesy tumour is found in the cerebellum. How the injury can have given rise to this can only be surmised; possibly there is a local bruising and punctiform hæmorrhage.

Symptoms.—In considering the symptoms to which cerebral tumours give rise, we must remember that a new growth within the cranial cavity is certain sooner or later to disturb the cerebral circulation and increase the tension; and the symptoms produced may be due to these causes rather than to destruction or injury of some local part of the brain. Then again compensation readily takes place, i.e. some other part of the brain may take on the function of the part destroyed, or if one nerve path is blocked, another path may conduct in its stead. And further we must bear in mind, in spite of the gains in recent years, that our knowledge of the functions of the nerve centres in the brain and their connections is very imperfect. There is much yet to be unravelled and made clear.

The general symptoms include (1) headache; (2) paroxysmal vomiting; (3) optic neuritis. These are by far the most important. But besides these there may be convulsions, giddiness and nystagmus. The localising or focal symptoms are caused by destruction or pressure on some nerve centre or nerve path, and thus help to give a clue to the position of the tumour.

General symptoms.—Headache is almost constantly present, though in young children, who are unable to complain or describe their feelings, its presence or absence cannot be determined. Its locality may help to indicate the seat of the lesion, but for this purpose it is an uncertain guide; it may be either frontal or occipital in tumours of the cerebellum, and it may shift about from time to time, but if fixed and constant at one spot it is of some value for localisation. It is often tolerably constant, or not absent for long together, but is apt to be much worse at some times than others. It is mostly made worse by movement and when the child is up and about, and is better when it is at rest and lying down. Percussion over the seat of the headache usually makes it worse or gives acute pain, but it is seldom of any diagnostic value in children. The headaches most likely to be mistaken for those due to a tumour are the hysteroid headaches, which are often very persistent and severe. Headaches may precede any other symptoms or signs of cerebral tumour for some months. It is important to remember this and not too hastily to assume that a headache is functional.

Vomiting is a frequent and very characteristic symptom, and may be present in tumours of all parts of the brain, especially of the cerebellum, pons, and medulla, and when the root of the pneumo-gastric is involved. The vomiting usually comes on suddenly without warning, and without much nausea, and may be repeated daily or several times a week without any cause being detected : such vomiting is very suggestive of cerebral disease, though it must not be forgotten that hysterical vomiting also occurs, especially in girls about puberty. There may be nausea and constant sickness, with much retching, in the later stages of a cerebral tumour. It is often paroxysmal, coming on and lasting for several days continuously, in spite of treatment, and then suddenly improving. In the early stages it is quite possible to fall into the error of mistaking cerebral vomiting for gastric disturbance.

Optic neuritis occurs in the majority of cases sooner or later, and is especially common in tumours of the cerebellum. The discs become swollen, so that on examination the edges appear at first blurred, and then all distinction between the edges of the disc and retina is lost, even to the direct method of examination. The veins become distended and tortuous, and hæmorrhages occur ; finally, after some months, the discs gradually pass into a condition of atrophy. The exact cause of optic neuritis is uncertain ; it occurs in association with tumours in all parts of the brain, but may be absent from first to last ; it has been known to occur in otitis and in disease of the cord without any discoverable cerebral lesion. In a case of our own of acute otitis there was optic neuritis, and no lesion of the brain was discovered *post mortem*. Optic neuritis, it is important to remember, may occur without any loss of sight, though as atrophy sets in the sight is certain to be damaged. It is often of great diagnostic importance, its presence being of much value as an indication of a cerebral lesion, though its absence in any given case where other symptoms point to some cerebral lesion does not necessarily negative the diagnosis. Optic neuritis may come on either early or late in the disease. In every case of persistent and unexplained headache in a child a most careful examination should be made from time to time of the optic discs ; any tortuosity of the veins, fulness of the arteries, or blurring of the edges of the discs would suggest a cerebral tumour.

Giddiness is often complained of, most commonly in disease of the cerebellum and pons.

Convulsions.—The first symptom may be a convulsion, which may never be repeated, or convulsions may be frequent during the course of the disease. In the early stage of a cerebral tumour the case may be looked upon as one of idiopathic epilepsy.

Nystagmus is common as a general symptom in cerebral, and more especially in cerebellar, tumour.

Localising signs.—It is obvious that 'localising signs' making their appearance late in the course of the disease are of less value in diagnosis of locality than the early ones. Thus pressure of a large tumour in the cerebellum may give rise to facial paralysis, but paralysis of the seventh is not a localising sign of any value of a cerebellar tumour. We will give a short summary of the localising signs of cerebral lesions.

Hemiplegia, when uncomplicated, points to a lesion of the pyramidal system above the crura. If it commences as a monoplegia, as, for instance,

in one arm, and Jacksonian convulsions occur, the lesion is situated in the cortex or immediately beneath it ; if, however, the paralysis extends rapidly and is accompanied with anæsthesia or hemianopia, the internal capsule is probably affected. Hemiplegia, with third nerve paralysis on the opposite side, points to the crura. Hemiplegia, with paralysis of the sixth, seventh, eighth nerves of the opposite side, points to the pons. The knee-jerks are mostly increased on the affected side, and as time goes on there is a tendency for the paralysed limbs to become spastic. The plantar reflex is usually extensor and ankle clonus present. Cerebral diplegia may be caused by a tumour of the pons situated centrally.

Hemiataxy is often present in lesions below the tentorium—i.e. affecting the cerebellum and its peduncles and also the pons. The child's fine movements, both of the upper and lower extremities, should be tested by telling him to pick up a number of pins and stick them into a pin-cushion, or to touch his toes one after another, and use his toe to point to some object. The ataxia may be bilateral.

Ocular paralysis.—Partial or complete loss of the lateral movements of the eyes occurs when the sixth nerve is paralysed, as in a tumour of the pons. The paralysis will be on the same side as the lesion. Impaired vertical movements indicate paralysis of the fourth nerve, and suggest a lesion in the mesencephalon or near the aqueduct of Sylvius. Double ptosis may result from a tumour in the interpedal space, that is near the origin of both third nerves, or, if single, it may be caused by a tumour involving the cavernous sinus, crus cerebri, or tip of the temporo-sphenoidal lobe. Anæsthesia of the face and paralysis of the masseter, temporal, and mylo-hyoid muscles point to a tumour of the pons involving the fifth nerve. Facial paralysis is in the majority of cases peripheral—that is, the nerve is interfered with below the facial nucleus in the pons ; while in central paralysis the lesion is situated between the cortex and the pons nucleus.

If the lesion is above the facial nucleus, the orbicularis palpebrarum and oris escape : if peripheral and above the geniculate ganglion, the whole face is affected, but there is no loss of taste, but deafness may be associated if the auditory is involved. If that part of the nerve which lies between the geniculate ganglion and the origin of the chorda tympani is injured, there will be loss of taste on the same side, as well as paralysis of the face. If below the origin of the chorda there is no loss of taste, but probably one division of the facial will be injured more than another. Paralysis of the tongue, velum palati, pharynx and larynx, may result from pressure by a tumour on the medulla, such as an epithelioma growing from the meninges.

Vision.—Loss of sight is caused by optic neuritis ; hemianopia by a lesion involving the optic tract or radiation or cuneus. The investigation of the field of vision in young subjects is often impossible and always difficult.

Convulsions. — Jacksonian convulsions, when associated with optic neuritis and other signs of tumour, are of great localising value, indicating a lesion of the Rolandic area. Occurring by themselves they are of no value, or rather suggest epilepsy.

Mental.—Delirium is mostly the result of softening around the tumour or meningitis. Dulness and slow comprehension suggest slowly increasing

hydrocephalus. In some cases of tumour of the frontal lobe there has been a failure of memory and mental powers.

Hydrocephalus occurring early may be due to a tumour blocking up the aqueduct of Sylvius or it may be situated in the cerebellum.

Tumours of the Cerebellum.—It is well to bear in mind in connection with the functions of the cerebellum, that the lateral lobes are connected by means of the decussation of the superior peduncles with the cerebral hemisphere of the *opposite* side, and that they receive afferent impressions from the posterior column of the cord of the *same* side by means of the inferior peduncles. Efferent impulses pass from the cerebellum, through Deiter's nucleus, to the anterior lateral columns of the cord of the same side. Thus the cerebellum is connected with the cortex of the opposite cerebral hemisphere, with the sensory mechanism on the same side of the body, and indirectly with the motor mechanism of the same side. It is also closely connected with the semicircular canals and the eye muscles. It would seem that the cerebellum receives tactile, muscular, visual, and labyrinthine impressions, and sends out motor impulses, which enable it to take part in co-ordinating and controlling bodily movements.

With regard to the diagnosis of the cerebellar tumour, it must not be forgotten that compensation readily takes place in the cerebellum, and consequently localising signs may be present for a while and then disappear. Then a large tumour in a lateral lobe is certain by stretching the tentorium and compressing the veins of Galen to give rise to chronic hydrocephalus. This increased cerebral pressure is likely to mask the localising signs.

The history given by friends often includes an account of a blow on the head or a fall, followed some time afterwards by headache or vomiting. Cross-questioning the patient, if old enough to answer, elicits the fact that the headache is a dull ache and usually frontal or occipital. In one of our cases the pain was always referred to the right occipital region, and the boy would go to sleep with his hand on this spot. At the *post-mortem* a large sarcomatous tumour was found in the right lobe of the cerebellum. The vomiting is fitful and uncertain ; it is less troublesome when the child is kept in bed than when he is allowed to go about. Optic neuritis mostly makes its appearance early, perhaps as early as the vomiting. Nystagmus and internal squint may be early symptoms.

The localising signs of a cerebellar tumour may be absent at times and easily overlooked. The most reliable signs of a tumour in a lateral lobe are the following : (1) Some bulging in the occipital region on the same side as the tumour ; this occurs in the majority of cases sooner or later (J. Taylor). (2) Cerebellar position of head. Batten has pointed out that when the child sits up the head is inclined to the shoulder of the same side. (3) Standing attitude. The body bends or inclines to the side of the lesion, or the child may fall towards the same side. (4) Gait. The body is bent laterally to the side of the lesion, and the child tends to walk in a curve towards the side of the lesion. (5) The fine movements are tested by asking him to pick up pins or some small object ; there is unsteadiness in the performance of these movements. He is requested to touch some object with his great toe.

It is very certain that blindness, weakness, and continued headache, producing dulness of intellect, will interfere with the gait and tests for hemiataxy.

Late in the disease certain false localising signs may be present, such as pressure on the facial and on the abduceus nerve of the eyes. In many cases there is gradual enlargement of the head.

In tumours of the middle lobe we have seen marked retraction of the head and neck, coming on in paroxysms and accompanied by severe pain. In one case a cystic tumour was found which had compressed the fourth ventricle. It is said that lesions of the posterior part of the middle lobe are associated with a tendency to fall backwards, and lesions of the anterior part with a tendency to fall forwards and bilateral ataxy.

Fig. 110.—Paralysis of the sixth nerve; glioma of pons.

The knee-reflex is very uncertain in cerebellar tumours; it is said to be increased on the side of the lesion. Ankle clonus is absent, and the plantar reflex is flexor. But in a late stage, especially if there is hydrocephalus, both knee-reflexes are increased.

Tumours of the Pons and Medulla.—Tuberculous masses not infrequently invade the pons, being situated in the central part, or small masses may be found in the floor of the fourth ventricle. They are apt to cause symptoms, less, perhaps, by their direct pressure effects, as they grow but slowly, than from the softening which often surrounds them; at the *post-mortem*, when the size of the cheesy mass is discovered, we have often been

surprised how little paralysis was present during life. Gliomas of the pons are not rare. The combination of symptoms in disease of the pons varies much in different cases ; this is due to the close proximity of the motor tracts and the centres of various cranial nerves. The paralyses produced by tumour of the pons are apt to be bilateral as the tumour grows, on account of the right and left motor paths and nerve centres being near together. The symptoms vary according to the position of the lesion in the pons ; thus in a glioma of the right lower border there is 'crossed paralysis,' viz. a left hemiparesis with paralysis of the right external rectus, and right facial paralysis, optic neuritis, and vomiting. Cheesy masses are often more centrally situated, and may after a while involve the medulla ; there may then be double facial paralysis, perhaps more marked on one side than the other ; the saliva dribbles from the mouth, the speech is thick, and there may be difficulty in swallowing. There may be paresis and rigidity of the limbs, squint, and sloughing of the cornea from interference with the fifth nerve. Ataxy may be present in consequence of interference with the middle peduncle of the cerebellum. Optic neuritis may be late in appearing, and headache and vomiting be slight. In one of our cases there was no paralysis, but general weakness, and optic neuritis coming on late. The cerebellum was explored but nothing found ; at the *post-mortem* there was a general enlargement of the pons from an infiltrating glioma.

Basal Ganglia and Internal Capsule.—Cheesy masses may be present in the caudate or lenticular nucleus or thalamus, but they only produce a definite hemiplegia when they involve the internal capsule. In one of our own cases a villous growth from the choroid plexus compressed the left thalamus and internal capsule, and produced a paresis of the right arm and leg, with marked rhythmical shaking movements when voluntary action was attempted, so much so that his mother said his arm used to 'work like a clock' ; contractures, facial paralysis, and optic neuritis supervened before death. The rhythmical tremors were no doubt produced by gradual pressure on the motor path which passes along the internal capsule. In children there is rarely loss of sensation : this occurred, however, in one of our cases, in which two large cheesy masses involved the whole of the posterior limb of the internal capsule ; the arm and leg of the opposite side were contracted and anæsthetic.

Rolandic Area.—Irritation of any part of the motor area of the cortex, which includes the ascending frontal and parietal convolutions and the anterior portion of the superior parietal lobule, gives rise to convulsions, which begin in the arm, leg, or face, according to the part affected. Destruction of this region, as by softening following embolism, or the presence of a tumour, gives rise to a hemiplegia affecting the face, arm, and leg, a partial destruction giving rise to a partial paralysis. The presence of a syphiloma, a tuberculous mass, or pressure by a tumour growing from the membranes, is likely to give rise to epileptiform seizures, the convulsions starting in the arm, leg, or face, though they are not necessarily confined to the limb in which they start, but may become general. In the later stages a hemiplegia results. The superficial and knee reflex are increased ; there may be ankle-clonus. The plantar reflex is of the extensor type.

Tumours of the Frontal Lobe produce no paralysis unless they encroach upon the ascending frontal convolution: in that case they may produce a paresis of the leg, arm, and face, according to the part involved. A tumour involving the posterior third of the left frontal convolution causes aphasia. Pressure may be exercised as the tumour grows on the third, fourth or sixth nerves, producing squint, or on the inner surface of the opposite frontal lobe. Headache over the frontal region and convulsions are usually present. Some mental disturbance may take place.

Occipital Lobe.—Homonymous hemianopia occurs, when the tumour involves the cuneus (mesial aspect), and convulsions preceded by visual aura. The angular gyrus of the left side is the visual word-centre, and when it is damaged word-blindness results.

Prognosis.—The prognosis in cerebral tumours is exceedingly unfavourable, whatever their nature may be, unless perhaps syphilis be excepted. Undoubtedly tuberculous masses may cease to spread and become cretaceous, though against this must be set off the chance that other masses may form, or the child die of tuberculous meningitis or tubercle elsewhere. Every other form of tumour is certain to progress from bad to worse. In the majority of cases the progress is slow, often lasting over a year or more. Death may supervene from intercurrent disease, as tuberculous meningitis, or other form of tubercle; it may be sudden in tumours of the pons and medulla, or it may be exceedingly slow, as in cases of cerebellar tumour and chronic hydrocephalus. Occasionally cases in which the diagnosis of tumour is made partially recover, or remain stationary for many years. Gowers records a case of a girl of 15 years who suffered from hemiplegia, headache, hemianopia, and optic neuritis of gradual onset; she gradually recovered, except the hemianopia and paresis of arm, and was well, with these exceptions, six years after. In the case of a girl aged 10 years, who was seen by the late Dr. Ross and one of ourselves, there could be little doubt that there was a brain tumour, as there was optic neuritis and spastic condition of both legs; she eventually recovered while under the care of a quack, but became quite blind.

It is not uncommon to find cretaceous masses in the brain, evidently the result of the shrivelling up of a tuberculous mass. This was so in the following case:

Cheesy Tumour of Cerebellum. Temporary Recovery.—A boy aged 11 years was admitted into hospital, November 1881, with internal squint, optic neuritis, and almost complete blindness. He was intelligent and walked about; there were no signs of any paralysis, he had no headache or vomiting; during his stay he got better, and was discharged (January 1882) apparently in good health, though quite blind from optic atrophy. He was re-admitted February 1883, having suffered for six months with pain in his head, and recently he had lost power in the right side; the right elbow was semi-flexed, the wrist pronated and flexed, the fingers over-extended, except at the metacarpal joints; the knee was bent, and the ankle in the position of equino-varus; there was also loss of sensation on the right side, and the boy had some difficulty in finding the right arm with his left. In March there was some difficulty in swallowing, with paresis of left side of face and arm, followed by death. At the *post-mortem* there was a small cyst, with thickened cretaceous wall, found on the inferior surface of the right frontal lobe, evidently the remains of a tuberculous mass; there was a cheesy mass involving the left caudate nucleus and optic thalamus and internal capsule; there was a second cheesy mass involving the lenticular

nucleus and internal capsule of the right side. In this case there is no doubt there was a cheesy mass in the right pre-frontal lobe on the inferior surface, which gave rise to optic neuritis and internal squint, and which passed into a quiescent state; subsequently other tuberculous masses formed, which, with a general tuberculosis, caused his death.

Diagnosis.—The most important point to be decided is whether there is a cerebral lesion, or whether the symptoms are due to functional disease; the question as to the nature and seat of the lesion is of less practical importance. The cases which at first sight present a superficial resemblance to cases of cerebral tumour are those of chronic headaches in children at puberty, which are often severe, and are sometimes accompanied by vomiting or nausea. The latter, however, are never accompanied by optic neuritis or by sudden vomiting, are rarely acutely painful, and are improved, or got rid of for a time, by active exercise in the open air. We have already referred to cases, which are not uncommon, of headache, vomiting, and optic neuritis which get well, at least for a time, though probably with impaired sight. There can be little doubt these are really cases of cerebral tumours which have become cretaceous.

The vomiting in a case of cerebral tumour is erratic; it may come on the first thing in the morning, is perhaps constant for a day or two or more, then passes away for awhile without any apparent reason. The paralyses of hysteria are not often hemiplegic, being more often paraplegic, and are never accompanied by optic neuritis.

When fits are present there may be a difficulty in distinguishing between epilepsy and a tumour, especially as a hemiparesis is apt to remain after a fit. In these cases, if the convulsions have constantly a local commencement, they are probably due to a tumour, and later on optic neuritis or some paralysis would decide the diagnosis. The presence of more tumours than one may make the differential diagnosis difficult.

Treatment.—Except in the case of syphilomas of the brain, the treatment of cerebral tumours by medicines resolves itself into a treatment of symptoms. Wherever there is the least chance of the tumour being syphilitic, iodide of potassium should be given in full doses, though in children gummatous disease of the brain is rare. If it is supposed that the tumour is tuberculous, cod-liver oil and iodide of iron may be prescribed, while the child is kept at rest, and placed under the most careful hygiene.

For the headaches, bromides, phenacetin, and opium may have to be prescribed. The vomiting, which is so often troublesome, must be treated by perfect rest in bed, peptonised milk or iced drinks being given in small quantities. Hydrocyanic acid may be given. In some tumours at least the question of operation may be entertained, or at least trephining for relief of the tension (see *infra*).

Cerebral Abscess.—In children, as in adults, the common cause of abscess of the brain is chronic ear disease or brain injury; less often it is the result of suppuration in a distant part, as an empyema or abscess of lung. Before puberty abscess resulting from ear disease is ten times more often in the temporal lobe than in the cerebellum (J. Taylor).

Symptoms.—The early symptoms are those more or less of meningitis, namely headache, fever, vomiting, and perhaps convulsions; they may, how-

ever, be very slight and readily overlooked. The later symptoms, those of the chronic stage, vary according to the seat of the abscess, and are more or less those of a cerebral tumour, including optic neuritis, headache, vomiting, convulsions, and varying paralyses, also perhaps hectic, slow pulse, and emaciation. The diagnosis of abscess from meningitis or tumour is sometimes very difficult, as the following cases show. A girl of 2 years of age, who was admitted into hospital under Dr. Hutton, had had a discharge from her right ear for three months, but was otherwise well and strong till fourteen days before admission, when she had a right-sided convulsion lasting four hours, followed by unconsciousness; four days afterwards she had a similar attack: she squinted, and was more or less blind. On admission there was almost complete motor and sensory paralysis of the right arm and leg, with loss of sensation on the left side of the face and ptosis of the left eyelid; she became convulsed, the convulsions beginning in the right side, and was unconscious before death. At the *post-mortem* an abscess cavity was found in the left temporo-sphenoidal lobe, extending into the occipital lobe and reaching the internal capsule: it contained three ounces of pus. The left tympanum was full of pus. In the following case the abscess followed a perforating wound of the orbit. A boy aged 6 years was playing in a hayfield when by accident he was wounded above the left eye with the prong of a hayfork; the eye swelled, but no external wound was found. During the next few weeks he was irritable and frequently vomited. Six months after he was brought for advice, as his sight was failing. On admission he was quite blind (atrophy of discs) and somewhat dull of comprehension; he could walk well; the right hand was weak but not paralysed; he remained much the same for a month, when he died suddenly. At the *post-mortem* the left frontal lobe was found to be larger than the right, its convolutions, including the superior, middle, and inferior, with more or less of the ascending frontal and parietal, flattened; its inferior surface was adherent to the orbital plate and of a yellow tinge; and there was an abscess containing four or five ounces of greenish pus. It was clear there had been a penetrating wound through the orbital plate into the brain.

Diagnosis.—The diagnosis, as already remarked, between abscess, thrombosis of lateral sinus and meningitis is very difficult, as all three may follow ear disease, and may only be possible by an exploratory operation. Abscess in the temporo-sphenoidal lobe rarely gives rise to localising signs unless it extends beyond the limits of the lobe and compresses the internal capsule. When situated in the cerebellum there may be hemiataxy.

Treatment.—When pus has formed there is little hope in any method of treatment, except operation.

Surgical Treatment of Cerebral Lesions.—Our knowledge of the operative treatment of tumours of the brain is still very limited, but enough has been learnt to justify a short account of the subject being given here. At present chiefly those growths which lie on or near the surface of the cerebrum have been successfully dealt with; tumours at the base of the brain, or involving the basal ganglia, may be looked upon as inaccessible to surgery at present, though cerebellar growths are not beyond our reach. Surgery chiefly deals with growths situated in the motor area of the cortex, since the localisation of the tumour is most satisfactorily to be made out in this region. Again,

only those growths which are of limited size are suitable for removal, since the destruction or disturbance of large areas of the brain would lead to as great evils as the tumour itself. Assuming that the presence and exact position of a tumour have been ascertained by the symptoms presented, an attempt at its removal is well worth consideration, and a few particulars of the present position of the question are therefore given here.

Warrington has analysed the work of Oppenheim, Starr, and others ('Med. Chron.' 1903–4–5), and finds that about one in six, or rather less, of the brain tumours are cerebellar, that in nearly a third of the cases operated on the tumour was not found, while in many in which it was found a palliative operation alone was attempted. Operation was probably responsible for death in more than a third of those quoted, while recovery or marked improvement has been obtained in a quarter of the patients. The motor area, largely no doubt from the possibility of accurate localisation, is the most favourable position and the cerebellar the least so.

Operation is probably justifiable when the diagnosis is fairly certain and the patient is getting worse. Palliative operations such as opening the dura to allow of escape of cerebro-spinal fluid and relief of tension is undoubtedly of much value in some cases where nothing more is practicable. Its value in preventing loss of sight appears to be undoubted, and it is preferable to and apparently not more dangerous than lumbar puncture.

The question of operation in cerebellar tumour is more difficult, not only on account of difficulties of diagnosis and localisation, but by reason of the risks of operation, chiefly in injury to the medulla and pons. Further than this, since half the number of cerebellar tumours in children are tuberculous, and many of such cases have multiple foci, the advisability of palliative operation rather than an attempt at removal seems at present greater, and even this, of course, only in cases where absence of tuberculous lesions elsewhere and conditions indicating marked intra-cranial pressure coexist.

The technique of operations cannot be discussed here, but it may be said that in no part of the body is absence of sepsis more important, while great care is necessary, especially in cerebellar operations, to avoid injury to the medulla and pons, since the tumour is apparently frequently found at the cerebello-pontine angle (*vide* Warrington and Murray for abstracts of various papers, 'Med. Chron.,' June 1905).

We may say that our own experience showed us long ago in the case mentioned under meningocele, p. 604, that removal of considerable portions of the cerebellum is not necessarily at once fatal, and the value of a palliative operation may be illustrated by the following case :

A boy of 10 years with marked evidence of cerebral tumour was seen in December 1901. He had then no perception of sight in the right eye and could only read with the left with difficulty. An opening, the size of a florin, was made in the right parietal region and the dura mater punctured ; a drachm or so of fluid escaped. He recovered and for a time had fair perception of sight in the right eye, and in 1905 he was reported as being able to do anything in an ordinary way. The left eye is quite good, the right not of any service. He has completely recovered the use of the limbs.

If exposure of the brain has been decided on, as soon as the bone has been removed the surface of the dura mater should be carefully examined as to its colour, as to the presence of pulsation, and as to any tendencies to

protrusion through the aperture in the skull. We have noticed in a case of cerebral tumour thinning of the bone over the seat of the growth, with engorgement of the diploic vessels, but this can only be expected to be seen when the growth is large and superficial. Should the tumour be extra-dural, its removal may be now accomplished; but if it is truly cerebral, a crucial incision should be made in the membrane, and the surface of the brain inspected and felt with the finger for evidence, either visible or palpable, of the mass; if the growth is seen, its size and connections should be studied, and the question of the possibility of its removal decided upon. If it is determined to proceed with the operation, the substance of the cortex must be separated from the growth, and the mass removed with as little injury as possible, both to brain substance and to the vessels of the part. If there is softening (encephalitis) of the brain round the growth, the prognosis is bad, but any actually disintegrated brain should be removed. All bleeding is then to be arrested, the dura mater sutured over the brain, and the portion of skull removed, which should have been kept lying in warm carbolic lotion (1 in 80), may be cut up into pieces about the size of canary seed, and replaced on the surface of the membrane; or the whole disc of bone may be replaced entire; even, however, if the bone is not replaced, the gap is largely filled up by bone. In some cases, of course, it is desirable to have the aperture yielding, so that it may give way before increased intra-cranial pressure. Provision may be made for drainage, or the wound may be closed and dressed antiseptically in the ordinary fashion. After the operation the child is kept absolutely quiet in bed, and fed on weak animal broths and diluted milk in small quantities. If the case is doing well, there will be no need to disturb the dressings for a week or ten days, when the wound will be found healed, with the exception of the drain opening. Should no growth be found, or should there be very extensive encephalitis or meningitis, or if the tumour be too extensive for removal, further operation must be abandoned. Such are briefly the general rules to be adopted in dealing with brain tumours, and a large part of the description will also apply to operations for cerebral abscess, or for those cortical lesions which give rise to epilepsy or other troubles and necessitate surgical measures. A few additional remarks may be made on the two last-mentioned subjects. As to cerebral abscess, it is the result most commonly of injury or disease of the ear; in the case of traumatic abscess the seat of the abscess will usually, though not always, correspond with the seat of the external injury, though this guide should be, of course, supplemented by the indications given by any paralyses that may be present. The steps of the operation are those already described; should, however, no evidence of the abscess be seen on exposing the brain, careful systematic exploration to a depth of from 1 to 2 inches should be made in every direction from the centre of the part exposed. This is best done with a grooved needle, fine trochar and cannula, or director. Should pus be found, the opening must be enlarged and the abscess cavity drained, and the operation completed as above described. (For further details of cerebral abscess, the result of otitis, *vide* chapter on DISEASES OF THE EAR.)

Where trephining is done for Jacksonian epilepsy, it must be remembered that pressure or irritation may be due to a depressed or thickened portion of bone, to a local pachymeningitis, or to a cicatrix, or to local inflammation of

the cortex of the brain itself. If the irritant is cranial, the offending bone must be removed. So also, if a local thickening of the dura mater is found, it should be excised. If, however, the lesion is in the brain itself, the question arises whether it is so extensive that removal of the injured part can be effected without an extent of paralysis following which would render the patient's condition worse than it already is. The details of the operation are the same as in the case of tumour or abscess. For further information we must refer to the papers of Sir W. Macewen, Sir V. Horsley, and others. There is no doubt that, on the one hand, the brains of children are more tolerant of operation than those of adults, and, on the other hand, that brain lesions which would prove fatal to adults are not only recovered from in children, but may leave little or no permanent effects, even if left to nature. Each case must be judged on its merits.

The dangers of hernia cerebri and diffuse encephalitis or meningitis are no doubt considerable, but with thorough antisepticism these risks may be generally avoided. It has been shown by Macewen that hernia cerebri, though it may result from imperfect wound management, may also be due to a pre-existing encephalitis, even in the absence of any septic condition of the wound. Should hernia cerebri appear, it is best dealt with by pressure applied over the wound by means of a plate of sheet-lead laid outside the inner layer of dressings.

The subject of operative measures in disease and injury to the *spinal cord* is still more in its infancy than is that of cerebral surgery, and no definite rules can be laid down ; some account of the matter will be found under the heads of Spinal Caries and Spina bifida.

It must be looked upon at present as a much more serious matter to open the spinal theca than to incise the dura mater ; hence greater hesitation should be felt in dealing with cases requiring so severe a measure.

Cerebral Diplegia—Spastic Diplegia

Under these terms are included a group of diseases which for the most part are ante-natal in their origin. The individual cases differ much in character but they agree in that the affected limbs are spastic, and that both sides of the body are involved. Often 'perverse movements' occur. Mental defect is common, and a diffuse lesion of the cortical layers of the brain affecting both hemispheres is found *post mortem*. Until recently these cases were attributed to meningeal hæmorrhage occurring during the act of birth ; hence the term 'birth palsy' ; but the investigations of Dr. James Collier and others have shown that the essential lesion is a primary degenerative process of the cortex taking place during intra-uterine life. Heredity appears to play no part in their causation ; syphilis or some other toxin which has a specific action on the cortical layers is probably the agent at work.

In some instances there is a history of the health of the mother having suffered during pregnancy before the birth of the child ; it also happens that several infants in the same family have been born dead or affected with spastic paralysis (see below).

The common type of brain found *post mortem* is the 'walnut type' ; the convolutions are narrower than normal, and are surrounded by deeper and

wider sulci. The membranes are normal ; the cortex is firm and hard. The pyramidal system corresponding with the affected part of the cortex is either undeveloped or degenerated. The atrophic sclerosis may affect only a local part of the hemispheres, but appears to be always symmetrical ; it may be the Rolandic area, or the paracental lobes, in those cases in which the lower extremities are affected.

In other cases scarring and cicatrisation are found in the motor areas. The skull is thick, the dura mater and pia thickened and adherent over this area, and instead of fully developed convolutions in the ascending frontal and parietal regions, sclerosis and cicatrisation are present. It is difficult to say what is the original lesion in such cases ; it may be due to injury and hæmorrhage during birth, or thrombosis of the veins entering the superior longitudinal sinus (see fig. 111).

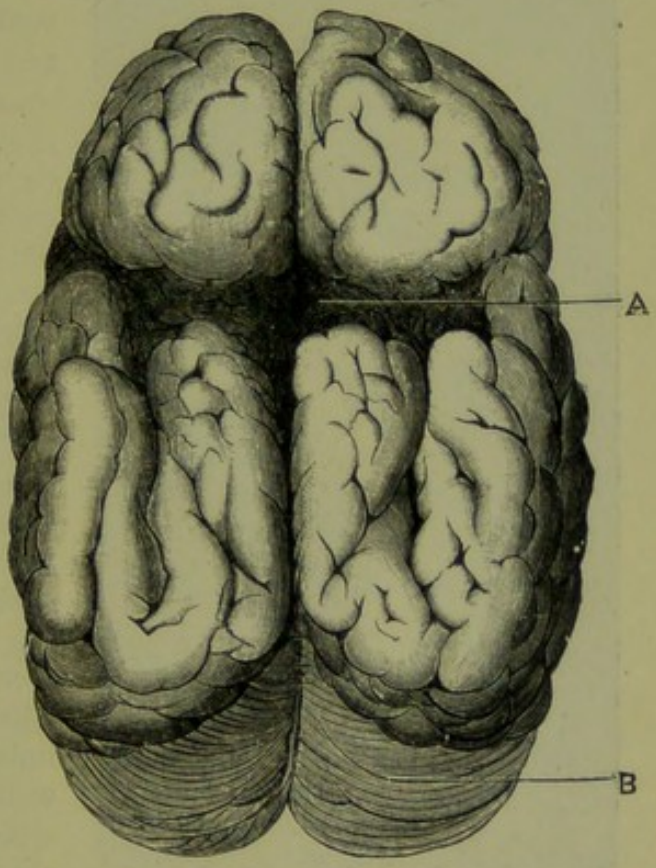

Fig. 111.—Brain of a Boy aged 18 months, showing, A, depression over both motor areas ; B, cerebellum only partially covered by the occipital lobes. The patient had a typical diplegia. (Dr. H. R. Hutton's case.)

Symptoms.—In some cases stiffness and rigidity of the legs and arms are noticed at birth, in others not till some months after birth when the infant should be sitting up or crawling about. In the less marked cases the child may learn to walk, but easily falls and is clumsy on his legs. In rare cases the child is apparently quite normal, and the rigidity comes on after some convulsions or acute disease. The chief characteristic is rigidity of the muscles, more especially of the limbs, with more or less loss of power ; the lower limbs are almost always most affected. In a severe case the child cannot walk or stand unaided, and lies helplessly in bed ; the knees are semiflexed, from contracture of the hamstring muscles, the thighs rotated inwards and adducted from over-action of the adductor muscles ; the foot is usually in the position of talipes equinovarus, there is exaggerated knee-reflex and ankle-clonus. If supported by the arms, the child stands on his toes ; and if walking is attempted, the adductor spasm gives rise to cross-legged progression (see fig. 112). In less marked cases the child though unable to walk can crawl about, and may learn to do so fairly well. This was the case with Willie G., aged 8 years (see fig. 113) ; later, as the result of tenotomy, he learned to walk with some difficulty, and in after years earned his living as a caretaker of a chapel.

Many, however, learn to walk, but with difficulty, on account of the spasm of the gastrocnemii and the consequent tendency there is to fall forwards, and the awkwardness and want of control over their movements. The arms are more rarely affected than the legs ; sometimes there is slight rigidity in one only or in both, which interferes with their use, or the elbow is flexed, the wrist flexed and pronated, and the fingers flexed at the metacarpo-phalangeal joints. There may be present the irregular movements known as athetosis Sometimes there is facial paralysis, only noticeable when the child laughs or cries. Stridor is sometimes present, and also a difficulty in swallowing.

Fig. 112.—Cerebral Diplegia. Mental feebleness.

In slight cases the child learns to walk at the usual time, but is clumsy and tends to fall forward, tripping over obstacles or inequalities in the ground. On examination a slight rigidity of the tendo Achillis is noticed, the foot cannot be dorso-flexed beyond a right angle ; there is more or less pes cavus and over-extension of the great toe. Several in the same family may often be noted with this condition.

The mental condition varies from complete idiocy to a normal intelligence. In the former case the sclerosis has affected the frontal and perhaps occipital regions ; in the latter case the lesion is confined to the motor area. All combinations may be seen. There may be one a 'borderland' imbecile, yet able to get about fairly well, though the legs are more or less spastic and the movements of the hands clumsy. Or the child may be bed-ridden with extremely rigid extremities, but with fair intelligence. They are often late in learning to talk. The boy (fig. 112), if asked his name, would take down his bed card from over his bed and point to his name. He could hardly say a single word.

All degrees of 'perverse movements' may be present. There may be but little rigidity, but the limbs may be thrown about in the most erratic way whenever the child is excited or attempts voluntary movement. The face is perhaps affected and all sorts of grinning and grimaces are seen. If asked to protrude the tongue, it jerks about in an irregular way. For the most part the movements cease during sleep.

Cerebral diplegia in various degrees may affect several children of the same family, and there is often a history of stillbirths. In the case of Willie G. (fig. 113), he was the eldest of a family of seven ; the second died at

13 months, of convulsions ; the third was normal ; the fourth died a few days after birth ; the fifth was born dead ; the sixth was normal ; the seventh, when seen, was a girl of 4 months, with rigid limbs and exaggerated reflexes. In other instances we have known the first infant to be born dead, the second with cerebral diplegia, and the third and fourth normal children.

A history of premature delivery and also of a difficult and prolonged labour is often given. Perhaps, as pointed out by Jas. Collier, in the latter

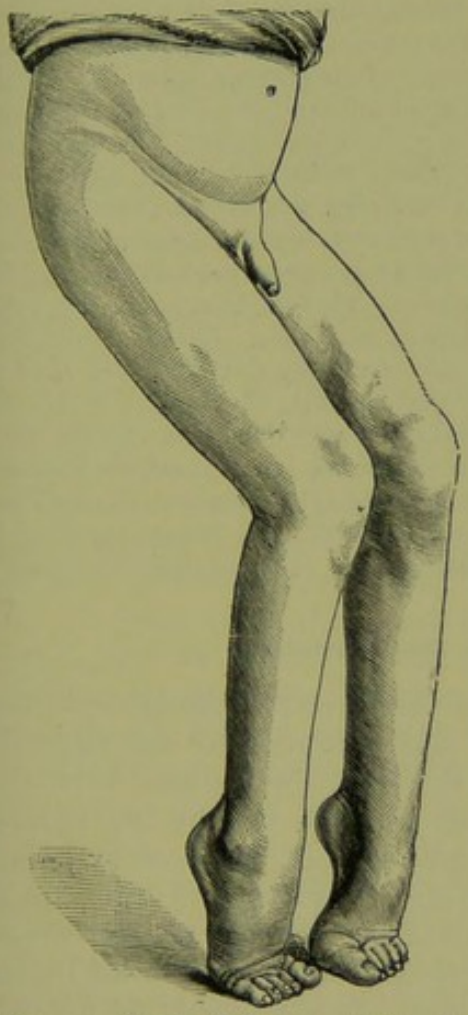

Fig. 113.—Cerebral Diplegia. Willie G., aged 8 years. The weight of the body is partly supported by being held up by the arms, partly by resting on the toes.

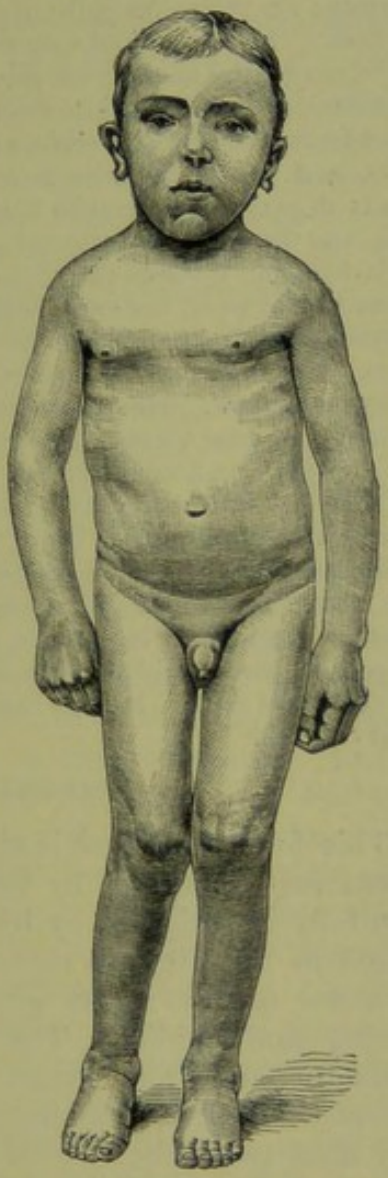

Fig. 114.—Willie G., after division of the tendo Achillis and forced dorso-flexion.

case, there is uterine inertia rather than a contracted pelvis or rigid soft parts.

The following clinical types are distinguished (Jas. Collier) : (1) general rigidity, where the spasm and paresis are more or less uniformly distributed throughout the whole body ; (2) paraplegic rigidity, where the lower extremities alone are markedly affected ; (3) bilateral athetosis, where slow perverse movement, occurring chiefly in the peripheral part of the limbs, is well marked ; (4) choreiform diplegia (congenital chorea), where the

movements are quick and occur chiefly at the proximal joints; (5) congenital spastic idiocy, where the mental deficiency is marked and the other symptoms slight.

Cerebral diplegia is in some instances post-natal, supervening during infancy or childhood as the result of some acute lesion involving both sides of the cerebral hemispheres. The following case illustrates this:

Cerebral Diplegia—Pseudo-bulbar Paralysis.—William H., aged 11 years, admitted November 13, 1899, with pains in the knees and ankles, and with a typical erythema nodosum rash. He was treated with salicylates. Seven days after admission his temperature rose to 102·4°, the tonsils were swollen, there was a purulent discharge from the nose and an anomalous rash. The exact nature of the attack was uncertain; neither diphtheria nor scarlet fever could be with certainty excluded. Shortly after the onset he became unconscious, and passed his urine and fæces under him; this lasted three or four days, but he was drowsy for some time longer. Fluids returned through his nose; he could not speak, and there was some flaccid paresis of both arms and legs. Power gradually returned in his legs, but fourteen days later his arms were more or less spastic. By December 29 he was able to walk, but swallowing remained difficult; fluids choked him unless he held his head back, and he used his finger to push his food after mastication to the back of the fauces. Chewing was done entirely on the right side, and the food accumulated between the jaw and cheek. His expression was blank, but there was no marked facial paralysis. He could not utter a word, but made guggling sounds. He would write on a slate, though with difficulty, an account of the spastic condition of his hands. Given letters he would join them up into words and sentences. He was constantly slavering, and kept a rag to mop his mouth. The arms were more or less spastic, elbows and wrists flexed, thumb bent into the palms, fingers adducted and extended. He could use the right to feed himself; he would pick up a piece of bread and butter between the first and second fingers, and pass it to his mouth, chewing with the right side of his jaw, using his fingers to assist in the mastication; swallowing was very difficult. In March 1903 condition practically the same. He can understand everything said; is still completely aphasic and seems childish.

Infantile Cerebral Degeneration

This form of disease is also known as 'amaurotic family idiocy' (Sachs). It was first described by Warren Tay, and more recently the disease has been fully investigated by Kingdon and Russell. The patients have all belonged to the Hebrew race. The infants are born healthy and remain so for a few months; then general weakness sets in, followed by muscular wasting and rigidity. The infant becomes dull and lethargic, his sight gradually fails. The retinal changes are in the macular region; the fovea centralis is described as being of a cherry-red colour, surrounded by a pale grey area twice the size of the optic disc. Death mostly occurs within two years. Marked degenerative changes are found in the cells of the cerebral cortex, especially in the pyramidal area. The disease is apt to affect several members of a family.

Infantile Hemiplegia

Infantile hemiplegia, unlike cerebral diplegia, owes its origin, with very small exception, to some acute lesion after birth. The onset occurs during the first six years of life in typical cases, and, indeed, the term infantile hemiplegia is usually restricted to cases of hemiplegia arising during this period. Strümpel long ago maintained that infantile hemiplegia and infantile spinal

paralysis were due to the same cause, namely, a focal inflammation of the grey matter, the one damaging the motor cells of the brain, the other the motor cells of the cord. Infantile hemiplegia has been recognised clinically for many years. The difficulty with regard to its morbid anatomy has been that *post-mortem* examinations have been made on cases dying many years after the lesion has occurred, and but very few in recent cases. In examining the brains of adults who have suffered from a hemiplegia since infancy, the evidence as to the nature of the original lesion is by no means conclusive.

It is now usually held that these cases of acute and sudden hemiplegia are not due to any one and invariable cause ; there may be a local encephalitis affecting chiefly the grey matter, or it may be more extended, affecting the whole of a cerebral hemisphere. In other cases there is evidence of a thrombosis of the minute or large arteries, or of the veins which empty into the superior longitudinal sinus. Again there is evidence that hæmorrhage from the vessels of the pia mater or from the vessels supplying the white matter, may injure the nerve cells or nerve paths. Presumably, in these cases, the hæmorrhage is secondary to convulsions or the overfilling of the veins during a paroxysm of whooping cough.

The attack is usually sudden, accompanied by a series of convulsions, followed by a period of coma ; perhaps lasting some days or a week. The temperature is often high, running to 105° or 106° F. The convulsions may be one-sided at first, but usually sooner or later are general and may continue in series for many hours or even days. The coma is often profound, and has been called the 'status eclampticus.' Recovery from the coma gradually takes place, and as the child becomes conscious a hemiplegia, including one side of the face, is noted. The child may be blind for many days or even months after these attacks, but gradually recovers its sight. In other cases the coma may not be a marked feature, and the paralysis may be noticed shortly after the convulsions. In a few cases hemiplegia occurs suddenly without convulsions, or there may be convulsions and coma without any paralysis, or a slight hemiplegia which passes off in a few days or weeks. While in the majority of cases these attacks supervene in a child in absolute health, in other cases they are associated with measles, measles-pneumonia, acute diarrhœa, whooping cough, or scarlet fever. In some there is a history of a fall or blow on the head.

The arm is usually more affected than the leg, and more power returns in the latter than the former. All degrees of paralysis may be noted ; in the milder cases recovery takes place in a few weeks or months, in the more severe it is life-long. The paralysis at first is a flaccid one, but in a few weeks or less contractures of the paralysed limbs begin to take place. The elbow is flexed, the wrist is flexed and pronated, the fingers and thumb are closed. The hip and knee-joints tend to become flexed, and the foot takes the position of equino-varus. The plantar-reflex is extensor, and the knee-reflex is exaggerated. Stunting of the limbs occurs, and there is vaso-motor paralysis. Speech is usually affected, but later is regained. The mental condition varies : some children are normally intelligent, others are mentally defective in varying degree. Many of these cases of infantile hemiplegia suffer later from epilepsy. The fits are usually unilateral at the start, but later become general.

Various perverse movements are apt to occur in the paralysed limbs, resembling those present in cerebral diplegia. (1) Choreiform or twitching movements accompanying attempts at movement. (2) Slow rhythmical

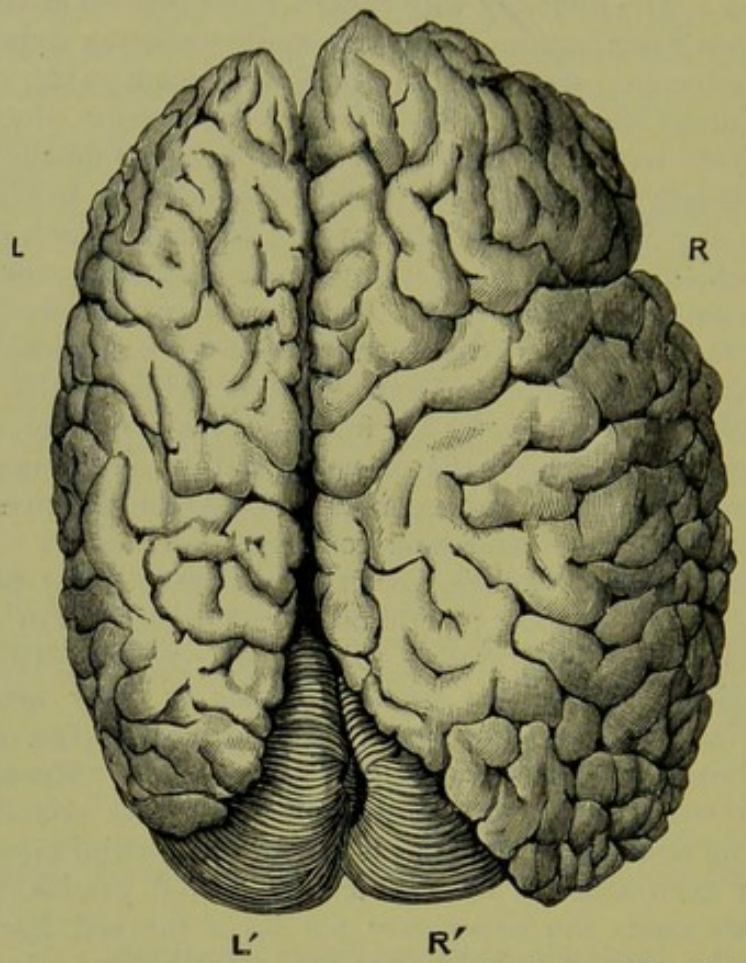

Fig. 115.—Showing Sclerosis of left side of the Cerebrum. The right lobe of the cerebellum is slightly smaller than the left.

movements which are like the movements of the tentacles of an octopus—athetosis. (3) Almost every variety of fine or coarse tremor.

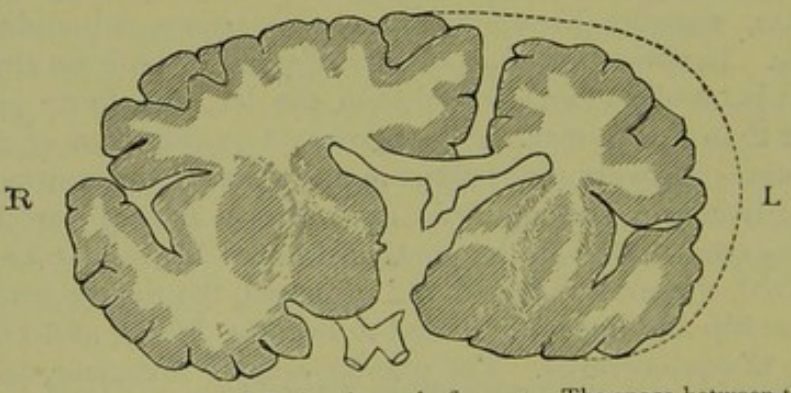

Fig. 116.—Transverse Section of Brain shown in fig. 115. The space between the left side of the cerebrum and the dura mater, shown by dotted line, contained fluid.

The following cases will illustrate the pathology of infant hemiplegia :

Atrophic Sclerosis of a Cerebral Hemisphere.—Bernard H., 16 months, admitted to the Children's Hospital, April 1893. The mother states the boy was perfectly healthy,

and had the use of his limbs up to fourteen weeks ago, when he accidentally fell off a table, striking the left side of his forehead on the floor. He was picked up unconscious, and remained so for three hours; on consciousness returning he was convulsed. The next day he was convulsed and again unconscious, in which condition he remained for three weeks. At the end of this time he regained consciousness, and it was found that his right side was paralysed. On admission he was a well-nourished child, his skull was well shaped and symmetrical, his right arm and leg were in a condition of spastic paralysis, resisting any attempt to extend them; there was no squint, but slight nystagmus. He was very fretful and not intelligent. As it was supposed there was a clot of blood compressing the left hemisphere it was decided to explore. On trephining the dura was found to be purplish in colour and partially calcified; on dividing it much clear fluid escaped; there was evidently an enlarged subdural space. The child sank twenty-four hours after the operation. At the *post-mortem* it was noted that both sides of the skull were symmetrical, the left hemisphere was much smaller than the right (see figs. 115 and 116), the right side of the cerebellum slightly smaller than the left. There was no trace of a past meningitis or hæmorrhage, and no thrombosis or embolism. The convolutions on the left hemisphere were wasted, but not markedly so, the pia mater peeled off readily; vertical sections, after hardening in Müller's fluid, showed there had been a general shrinkage of the left hemisphere; there was some hypertrophy of the right cerebral hemisphere. Microscopical examination showed there had been a chronic inflammatory induration of the left hemisphere. It is uncertain about the effects of the fall, but the history points to an encephalitis affecting the left hemisphere, followed by atrophy.

Richardière describes a similar case, under the title of sclérose cérébrale hémisphérique.

Convulsions; Cerebral Hæmorrhage.—George L., aged 12 years, was brought to the Children's Hospital, Manchester, suffering from tuberculosis and also hemiplegia; his mother gave the following history. He was strong and healthy when born, though the labour was somewhat tedious. There was no history of hereditary syphilis. He walked at twelve months of age, and was well and strong till two years of age. At this time he had a fit, which was attributed to his eating some crust of apple pie some half an hour before the attack. He was playing on the doorstep at the time; he suddenly became 'black about the mouth,' and would have fallen but for another boy who caught him in his arms. The fit, including the unconscious state which followed, lasted about ten minutes. Two weeks after he had another fit, which lasted half an hour, and was more severe than the first; his right arm and leg were especially convulsed. After this fit it was found that his right arm hung useless, and in trying to walk he dragged the right leg. The face was unaffected. The arm was always worse than the leg; at first he could not hold anything in it. Both arm and leg slowly improved, but have remained more or less stiff and rigid. Ever since the first convulsion he has been subject to fits, but he has not had any for the last two years. He has had on an average two fits a week, from two years of age till he was ten years. They only lasted some minutes, accompanied by loss of consciousness; he always knew when a fit was coming on by his right thumb beginning to 'work.' He used to say, 'Mother, my thumb's working'; then he would fall over almost immediately if not caught. The fits were mostly right-sided, but the left arm and leg would also 'work.' Lately he has used his right arm more than formerly, being able to hold things in it. When examined (September 8, 1890) it was evident he was affected with an old hemiplegia: he could walk, but dragged his right leg after him. He could use his right arm for holding things, but could not feed himself with it; the shoulder joint was fairly movable, the elbow bent and semi-rigid, and the hand pronated; the stiffness could be overcome by slight force. The right leg was somewhat stiff at the knee and slightly flexed as he lay in bed, with the foot pointed. There was exaggerated knee-reflex on the right side. There was no evidence of any mental weakness. He died of tuberculosis in February 1891. An examination of the outer surface of the brain showed it to be perfectly normal; the membranes were healthy; there was no flattening of the convolutions or any evidence of an old surface hæmorrhage. The internal parts were

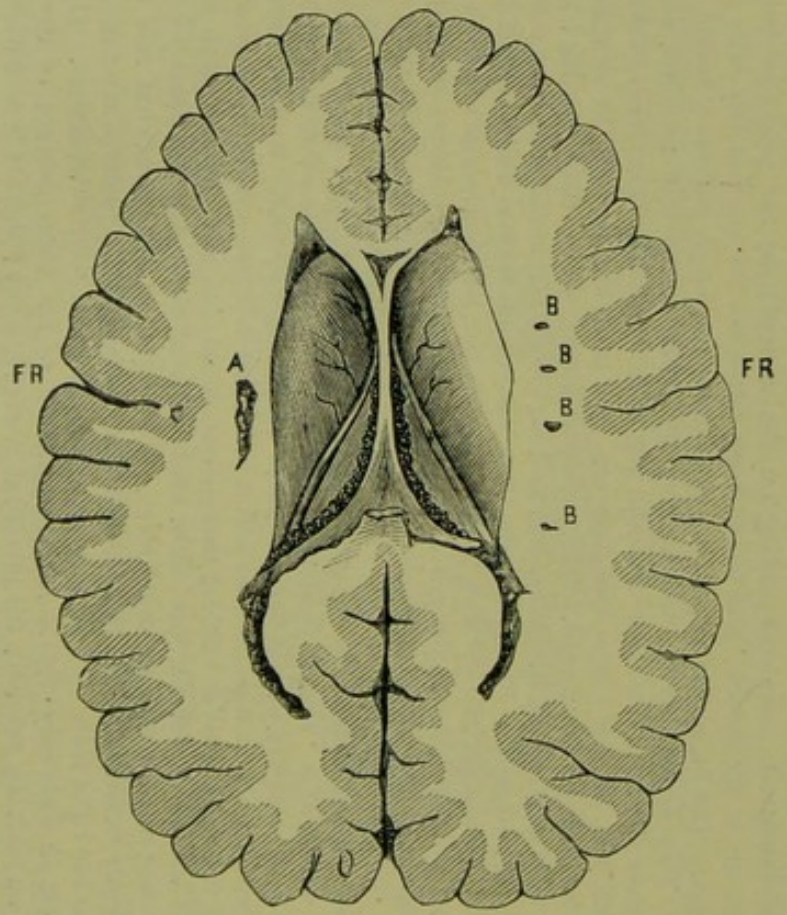

Fig. 117.—Horizontal Section of Brain, exposing lateral ventricles (×½). F R, fissure of Rolando; A, old blood cyst; B. B, B, B, small blood cysts. Hæmorrhage at 2 years of age; death at 12 years of age.

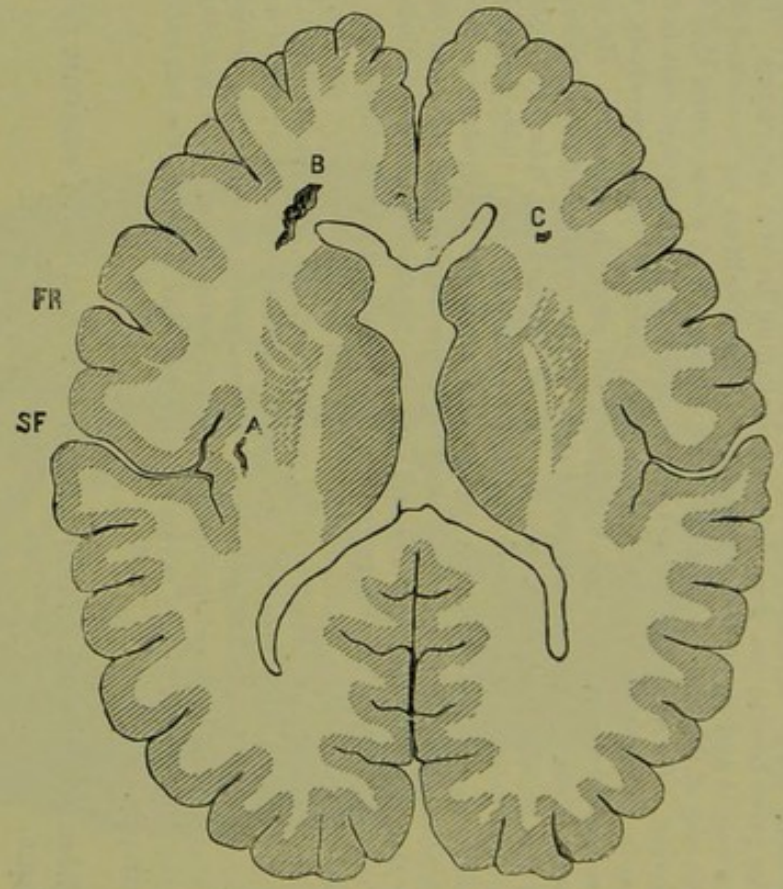

Fig. 118.—Horizontal Section through Brain at a lower level than fig. 117, showing optic thalamus and caudate nucleus (×½). B, C, old blood cysts.

examined by making transverse sections. The first section taken through the centrum ovale showed nothing abnormal. A section made exposing the lateral ventricles, without slicing the corpus striatum, showed an old cyst (fig. 117, A) with brownish contents, $\frac{1}{8}$ inch in length, situated on the left side in the white substance between the fissure of Rolando and the corpus striatum; and four small cysts B B situated on the right side in the white substance. There was no sclerosis or induration in the neighbourhood of the cysts. A third section made lower than the above, and on a level with the upper surface of the cerebellum, and slicing the optic thalamus, caudate nucleus, and internal capsule (fig. 118), showed the lower limit of the cyst seen in fig. 117 A, a second old blood-cyst B, and another small one at C. Another similar cyst was found in the white substance of the frontal region at a lower level than fig. 118.

It is difficult to account for the blood cysts found in this case except on the supposition that the fits were reflex and the hæmorrhages secondary and due to venous engorgement caused by the fits. He suffered later from post-hemiplegic epilepsy.

Thrombosis of Middle Cerebral Artery; Hemiplegia.—A boy of 1 year old, who had suffered since birth from marked cyanosis due to obstructive pulmonary disease (fig. 119 represents the brain of this case) and constant dyspepsia, was seized one night with vomiting

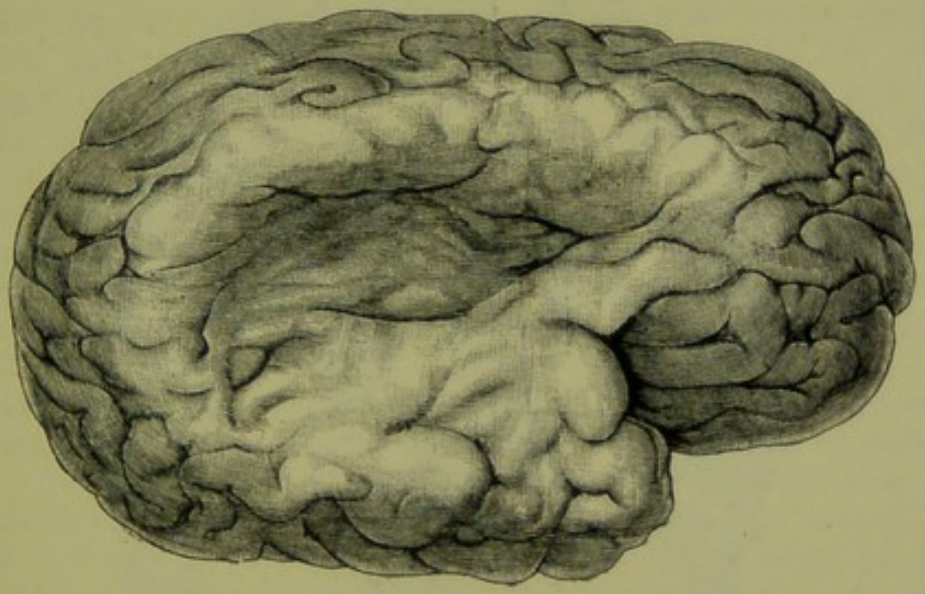

Fig. 119.—Cyst formed by softening of brain substance, secondary to obstruction of the middle cerebral artery beyond the first branch (to inferior frontal convolution). The cyst wall has fallen in from escape of its contents. Child 19 months old; death 7 months after onset of paralysis.

and convulsions, followed by paralysis of the left arm and leg. When seen on the following morning, the head and neck were turned to the right side, the eyes were suffused and blinking, as if some foreign body was present, the right pupil was smaller than the left, but both acted to light; the child was apparently quite blind; there were no retinal hæmorrhages, and the optic discs were normal. The face was drawn to the right side; there was complete loss of power, and apparently loss of sensation, in both arm and leg of the left side; no cry could be elicited on pinching or pricking the skin of either limb. The child was drowsy, but not unconscious, as he appeared at times to know his mother when in her lap. He was apparently deaf for the first twenty-four hours, though there was necessarily some difficulty in ascertaining this; by the next day, though remaining blind, he knew the voices of his friends, and turned in their direction when he heard their voices; it was clear, also, that he heard with both ears. Within a fortnight sight had returned, so that he could recognise his mother and his toys. His friends thought he regained his sight first in his right eye. By the end of six weeks sensation had returned, as far as could be judged, in the arm and leg, and some power was returning, as he moved both limbs on the left side. A week or two later he could hold a rattle in the left hand, but not raise it to his mouth; the leg showed a tendency to draw up, and the knee-reflex was

much exaggerated. The child was quite intelligent and bright. Before death (seven months after seizure) much improvement had taken place; the child could put out his hand, but there was some rigidity both in the arm and leg. Death occurred from bronchitis. *Post-mortem.*—On removing the brain, it was evident that the right hemisphere had shrunk, being slightly smaller than the left, and that there was a large cyst (porencephalus), containing clear fluid, occupying the central part of the convexity of the right hemisphere (see fig. 119); the cyst corresponded with the distribution of the middle cerebral artery, excepting the branch to the inferior frontal convolution. The middle cerebral artery beyond its first branch was impervious, and contained old clot. It was quite clear in this case that there had been thrombosis or embolism of the middle cerebral, with a subsequent softening of the area supplied by it; a horizontal section showed that the internal capsule had been compressed.

No emboli were found elsewhere; there was no endocarditis of the mitral or aortic valves, but a much-contracted pulmonary artery and open foramen ovale.

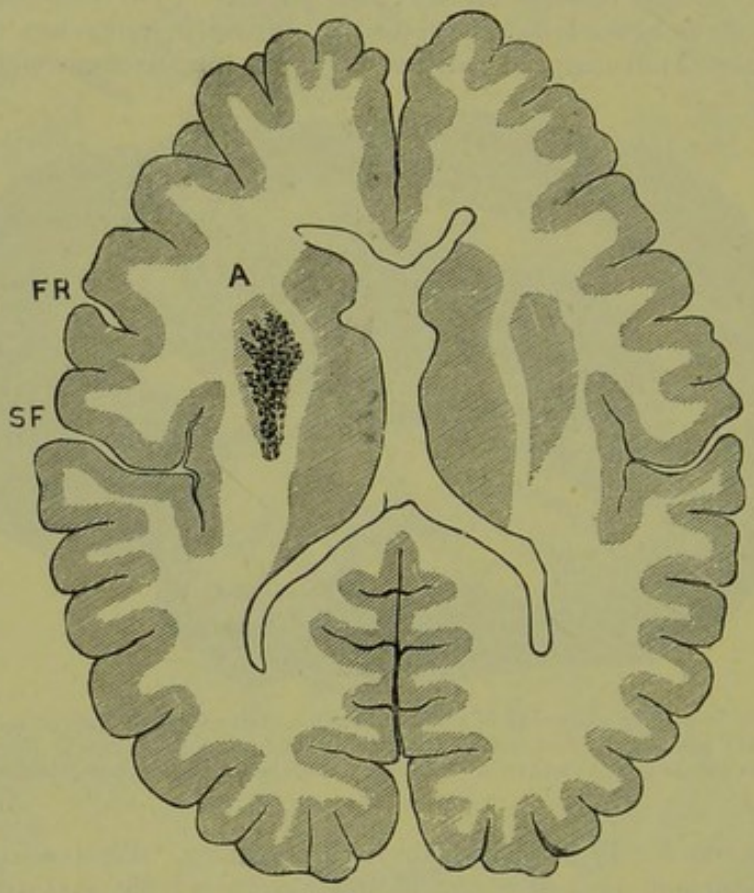

Fig. 120.—Horizontal Section of a Brain, showing patch of softening involving the left lenticular nucleus and anterior limb of the internal capsule. The lenticular-striate artery was plugged with an embolus and impervious. There was complete hemiplegia of the right side. (See p. 434).

Among the various causes producing a paralysis of hemiplegic distribution we must mention embolism. Embolism chiefly occurs in patients suffering from endocarditis, but also apparently at times when there is no form of heart disease present, the thrombus probably forming in the left auricle, or pulmonary veins. Embolism is perhaps most common in acute or malignant endocarditis; this was so in the case recorded on p. 434 (see fig. 120).

Dr. F. Taylor records a typical case of embolism following endocarditis:

A boy of 5 years, two weeks after an attack of scarlet fever, was seized with hemiplegia of the right side; the urine was albuminous. Death occurred from diphtheria nine weeks

afterwards; embolism of the left middle cerebral artery, with extensive softening of the left hemisphere, was found. There was endocarditis of the mitral valve.

Dr. J. Abercrombie reports a case of a boy aged 6 years who was under treatment for diphtheria, and who on the fifteenth day was seized with general convulsions and left hemiplegia; he died eleven days later. The middle cerebral artery was found plugged with an embolus; infarcts were also found in the spleen and kidneys. There was no heart disease, and it was difficult to understand the source of the emboli, unless formed in the cavity of the heart or in the pulmonary veins; this might be possible in paresis of the respiratory muscles and disturbed innervation of the heart, following diphtheria. Dr. Trevelyan reports a similar case to Dr. F. Taylor's, in a girl aged 8 years convalescent from diphtheria.

A sudden hemiplegia may develop in meningitis, the immediate cause being softening following thrombosis or embolism of the vessels; the meningitis is usually tuberculous. Thus a boy of 6 months, who had been apparently healthy, suffered for a week or two from febrile disturbance, dyspepsia, and irritability, attributed not unnaturally by his friends to 'teething.' One evening at 8 P.M. he was convulsed, the right arm and leg twitching most: this was followed by right hemiplegia, including the face. At 3 A.M., when seen, the infant was unconscious, with contracted pupils, Cheyne-Stokes respiration, the face drawn to the left, the right arm and leg completely powerless. Death took place three days later, the temperature rising in the meantime to 105°. The *post-mortem* showed a basal meningitis (tuberculous), much fluid in the lateral ventricles, and softening of the left hemisphere and corpus striatum.

Another lesion (this a rare one) giving rise to hemiplegia is an aneurism of the middle cerebral artery, the result of embolism in cases of acute endocarditis; this was the case in a girl of 9 years under our care who suffered from intermittent pyrexia and albuminuria, and in whom a loud systolic murmur was present. To these symptoms was added acute pain in the frontal region, coming on suddenly. An ophthalmoscopic examination showed large retinal hæmorrhages surrounding the disc. A week later there was paresis of the right arm, no paralysis, but exaggerated tendon reflex of the right leg. Six weeks later she fell back unconscious while sitting up in bed: there was now right facial paralysis, and paralysis of the right leg. Death followed ten days later. An aneurism the size of a small walnut, on the second branch (to the ascending frontal convolution), near its origin from the trunk of the left middle cerebral artery, which had ruptured and given rise to meningeal hæmorrhage, was found *post mortem*.

Treatment of Spastic Paralysis.—The treatment of cases of chronic spastic paralysis is almost entirely mechanical. Efforts should be made to prevent deformity, to bring forth what voluntary control is possible, and by the division of tendons and muscles wherever this can be of service. Massage is beneficial, especially when combined with active and passive movements. The classes of cases which are least hopeful for such treatment are those of congenital spastic idiocy, the choreiform diplegias, and those in which the spastic condition is very severe.

The most hopeful cases for treatment are those who have the most voluntary power over their muscles, both in contraction and relaxation. In any

case it is quite certain the treatment, to be of service, must extend over several years.

From the onset of the attack, or at least when all acute symptoms have subsided, efforts should be made to prevent the contractures which are certain to arise. To this end massage and movements should be employed, but one has to bear in mind the tender age of most of these patients, and it is quite possible to do harm by over-zeal. In some chronic cases of diplegia and hemiplegia treated by massage and regular exercises under the care of Dr. Mumford, there has been considerable improvement in voluntary power.

In the surgical treatment of the various forms of paralysis associated with spasm and dependent upon cerebral lesions, great progress has been made in the last few years, and in this country Messrs. Tubby and R. Jones have done much to develop interest and stimulate work in this direction.

In any particular case careful consideration must be given first to the mental condition. Unless there is a fair amount of intelligence, surgical interference is useless, for efforts on the part of the child and active movement are an essential part of the treatment. Next a certain amount of control and power of movement in the affected limbs is essential. Surgical treatment is chiefly applicable to cases in which the disability is due to contractures and to weakness of overstretched and feeble muscles. As general principles it may be taken that a contractured muscle is in itself a source of irritation, and that its division will both rectify deformity and improve the nerve centre, while shortening an overstretched weak muscle will improve its power and nutrition; exercises and training, where such have been made possible, will make the best of the material at our disposal.

In these cases, then, an examination must be made of the capacity of the child and the exact locality of the rigid structures; e.g. the tendo Achillis, the hamstrings, the adductors of the thigh, the flexors of the wrists, may require division or lengthening by a plastic operation, or actual excision of a portion of the tendon is necessary in some cases. The limb, after division of the resisting structures, is fixed in extension or abduction, or whatever corrected position may be required, till the wounds are healed, and then active movements and massage continued for a year or more make the best of the case. Conversely, weak muscles, as in infantile paralysis, may be strengthened by shortening and by tenoplasty—reinforcing the weak by transference of the strong to another attachment. The exact operation and particular apparatus required must be selected for each case. It will be found that open operations are usually the best.

Medullary Hæmorrhage.—In speaking of hæmophilia and of the hæmorrhagic diathesis we have mentioned the fact that a cerebral hæmorrhage may occur in these conditions after a slight head injury. We have related such a case (p. 465), and referred to some others recorded by Steffen. The following case is a rare one belonging to the same category:

Hæmophilia; Medullary Hæmorrhage.—Norah M., aged 3 years 10 months. Family history good. Father two years before suddenly lost the hearing in one ear, which was supposed to be due to hæmorrhage. Patient had a sharp attack of scarlet fever, followed by glandular abscesses eighteen months ago. For the last year it had been noticed that she had exhibited a tendency to 'bruise,' purple spots appearing on the skin after the

slightest injuries. She was a well-nourished child, but had always been difficult to feed. She was quite well till the morning of December 22, when she vomited and retched several times; there was no history of a blow, but she had been to a children's party the evening before and had romped a good deal. The following day it was noted she could not stand or sit, and when held up her head fell to the right side. There was slight paralysis of the left side of the face, including the orbicularis, but the eye could be closed; the voice was weak and had a nasal twang; on attempting to swallow, she coughed and spluttered as if some of the fluid had entered the larynx. There was no cardiac murmur. Temperature 98°. December 24.—She had recovered some power in her legs, and she could sit up, but her head still fell over to the right side. It was noticed that her breathing was peculiar, the right side of the chest was moving excessively, while the left side was hardly moving at all; râles were heard on both sides. December 25.—The swallowing was better, but it was clear the lungs were getting choked, as the râles were heard freely all over, the right side still moving more freely than the left. Temperature 102°. The child became more and more dusky, the respirations increasing in number; there was intense restlessness, and finally death from asphyxia on the evening of December 26. *Post-mortem* (head only).—No cerebral hæmorrhage except in the medulla, where it was noted that the right side of the medulla was swollen and discoloured (see fig. 121). On transverse section (after hardening) through the middle of the olivary bodies, a round laminated clot ½ inch in diameter was found, which had compressed the root of the right vagus, olivary nucleus, and also the nuclei in the lower part of the floor of the fourth ventricle (see fig. 122). We are indebted to Dr. R. T. Williamson for the microscopical examination of the clot. He found no evidence of any aneurismal sac.

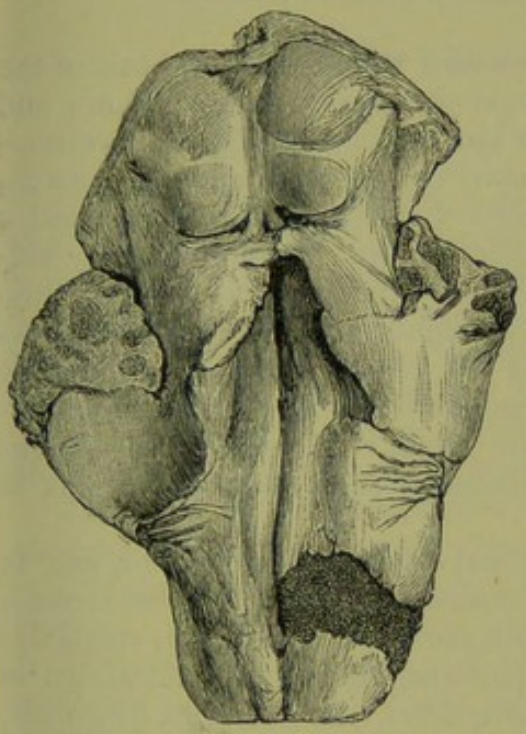

Fig. 121.—Posterior aspect of medulla showing discoloration over clot (nat. size).

Fig. 122.—Transverse section of medulla through middle of olivary body showing laminated clot compressing the right olivary nucleus, root of vagus, and nerve centres in floor of fourth ventricle. V, vagus; H, hypoglossal (nat. size).

Thrombosis of Medullary Artery.—In the following case acute symptoms were produced by the thrombosis of one of the arteries of the medulla in association with tuberculosis:

Alice N., aged 8 years, has had tuberculous disease of the metatarsal bones of one foot. She complained one morning of headache, and vomited. The same evening it was noticed she had paresis of the right side of the face and double nystagmus; the vomiting continued, and there was some difficulty in swallowing. The breathing gradually became difficult. She lay on her right side, making tremendous efforts to inspire. She was quite conscious, and could speak with difficulty. The violent efforts to inspire continued till death, three days after first seizure. At the *post-mortem* there was chronic glandular tuberculosis and some scattered tubercles on the arteries of the brain, but no definite meningitis. There was no cardiac lesion. Dr. F. E. Batten was good enough to examine the medulla; the following is a summary of his report: The medulla shows an

extensive area of softening in the lateral region of the right side, extending from just below the junction of the pons and medulla to the lower end of the olive; on the lateral surface of the medulla there is a thrombosed artery of considerable size. The lesion involved the lower portion of the facial nucleus, the glosso-pharyngeal, the vagus, the spinal accessory and hypoglossal nuclei. Also the inferior peduncle of the cerebellum, and the ascending root of the fifth nerve. Microscopic examination shows all the vessels in the neighbourhood engorged and thrombosed. There is a considerable small cell infiltration in the perivascular spaces and also in the surrounding tissue. It seems on the whole probable that the thrombosis was determined in some way by a tuberculous process, though none could be found in the immediate neighbourhood of the artery.

Thrombosis of the Cerebral Sinuses and Veins.—Thrombosis of the cerebral sinuses or veins is not a common occurrence during infancy and childhood. It may occur in the superior longitudinal, lateral, or cavernous sinus. It is most likely to occur in extreme anæmia, after exhausting diseases as acute diarrhœa, where the force of the heart is weakened and a stasis or slowing of the venous current takes place. Thrombosis may also occur in the surface veins under similar circumstances, or the clotting in the veins may be the result of meningitis. The immediate result of the obstruction to the veins or sinuses is to distend the venous branches behind the obstruction to their utmost capacity, and possibly also to give rise to punctiform hæmorrhage and softening of the brain. Thrombosis of venous channels may take place in the neighbourhood of some inflammation, as in otitis, and pyæmia may result.

Symptoms.—There is a condition of great exhaustion and pallor, and to these are added cerebral symptoms and venous obstruction. The fontanelle is tense, the veins of the forehead, nose, and face are distended; there is epistaxis; convulsions are probably present, and, perhaps, rigidity and retraction of the neck, and paralysis of one or more extremities. In making a diagnosis, it must be remembered that the so-called 'false-hydrocephaloid' or cerebral anæmia gives rise to convulsions, stupor, and coma, and is infinitely more common than thrombosis. We are only justified in diagnosing the latter when there is distension of the veins of the face and forehead, or some definite paralysis. Thrombosis of the cavernous sinus is most likely to occur in some local lesion, as a tumour, as a periosteal sarcoma of the sphenoid bone, or caries; the eyeball is prominent, there is œdema of the eyelids and distension of the veins of the forehead.

Treatment.—The action of the heart must be strengthened by stimulants and digitalis, and the tendency to exhaustion and syncope must be combated by beef tea and highly concentrated forms of nourishment. The patient should be kept in the prone position as much as possible, with the shoulders and head raised. The prognosis is necessarily extremely grave.

CHAPTER XXIV

DISEASES OF THE NERVOUS SYSTEM—*continued*

Chorea

CHOREA is a disease which occurs chiefly in children between the ages of 6 and 15 years, and is characterised by irregular movements of the voluntary muscles, and in some cases by paresis and mental weakness.

Ætiology.—Chorea can hardly be said to be hereditary, but undoubtedly a tendency to neuroses or 'weak nerves' runs in families, and instances might be adduced of emotional parents having children who suffer from chorea; moreover, it is a common experience to find several sisters or brothers with chorea, or perhaps one or more are neurotic or hysterical.

Chorea is not common before the age of 6 years, and after the age of 15 years the liability to attacks becomes very much less. It is more common in girls than boys, in this respect resembling hysteria and other emotional diseases. Analysing 633 cases which have attended at the Children's Hospital, we find that 454 were girls and 179 were boys, giving a proportion of five girls to two boys; these figures closely correspond to the statistics collected by other writers.[1] In 252 cases the ages of the patients were analysed, giving the following result:

Under 6 years	15 = 3 boys and 12 girls
Between 6 and 10 years . .	102 = 35 boys and 67 girls
Between 10 and 15 years . .	135 = 44 boys and 91 girls

The youngest child was a girl of 4 years of age.

The children most apt to suffer are the nervous and excitable, those who are easily frightened, especially if they are suffering from ill-health the result of unfavourable life conditions or rapid growth.

By far the commonest exciting cause is a fright; in 38 cases out of 252 there was a definite history of the patient being frightened, the symptoms following in some cases next day, in others within a few days or a week. The causes of the fright were various: in one case, that of a boy, the symptoms followed three days after seeing a 'man with his throat cut'; sometimes the attack was ascribed to a 'dog having flown at the child,' or the patient was 'frightened by a policeman,' or the child had been caned by the schoolmistress or had had a fall downstairs. In such histories there is often something it is necessary to discount: probably the scoldings at school were the consequence and not the cause of the chorea; but, on the other hand, it is

[1] See Fagge's *Principles and Practice of Medicine*, edited by Pye-Smith. 2nd edit.

certain that chorea may follow within a few hours of a serious shock to the nervous system.

Mental strain, as working hard for an examination, in some cases appears to excite an attack ; this has occurred too often in our experience to be attributed to any mere coincidence. A fast-growing and delicate girl of excitable disposition and not too well fed, who is at school for many hours during the day, and has to divide her attention between home lessons and various domestic duties, so that she becomes little else than a drudge, is likely enough to suffer from a nervous breakdown. 'School-made chorea,' as Dr. Sturges used to call it, is not by any means confined to the poorer classes, and, although among the better-to-do classes there is no question of poor food and household drudgery, yet there is often much forcing exercised to induce a girl, of perhaps delicate health, to keep pace with, or run ahead of, her stronger and more robust class-mates.

In some instances children who are convalescent from various depressing diseases, such as acute rheumatism, enteric fever, or scarlet fever, are attacked with chorea. Rheumatism excepted, enteric fever in our experience more often than any other disease predisposes to chorea ; other nervous disorders, such as dementia, mania, and aphasia, are not uncommon after enteric, and are no doubt due, as is also the chorea, to the anæmia and exhaustion caused by the long drain on the system during the disease. For the connection of rheumatism with chorea, see p. 545.

Heart disease in some instances precedes the attack of chorea, or, in other words, chorea makes its appearance in children suffering from cardiac disease.

It sometimes happens that a source of irritation in some part of the body is the exciting cause in an attack of chorea ; thus we have seen a temporary chorea occasioned by suppuration in the middle ear, the choreic movements ceasing when the discharge made its appearance. In other cases it happens that chorea is an early symptom in pericarditis—this we have also seen ; in one case, in a little girl of 4 years, choreic movements preceded by a few days the physical signs of a pericarditis which proved fatal. We cannot help thinking that in such a case the chorea was symptomatic of the pericarditis, the latter being the primary lesion, rather than that the heart lesion was secondary to the chorea.

Imitation in some cases seems to be a factor in the production of chorea. On one occasion five cases occurred in a girls' school immediately after the admission of a child suffering from chorea ; in such cases, perhaps, it may not be imitation so much as fright at seeing others affected, as Gowers suggests. We have never known children in the same ward to become choreic in consequence of a bad case being admitted, but we have seen cases of chorea apparently made worse by association with a bad case.

Symptoms.—Most of those who suffer from chorea are in some way or other weakly, or at least not in robust health ; they are often anæmic, rapidly growing girls. Not infrequently, it occurs in girls who have gone out to service, and who are undertaking work which is beyond their strength. Often the first symptoms are a loss of control over the muscles, especially the flexors and extensors of the fingers and wrists, and a want of precision in the movements of the hands. The patient drops cups and saucers on the

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floor, is unable to do needlework, fumbles sadly when she attempts to tie a piece of string, or spills her food when she passes it to her mouth. Sometimes, especially in younger children, the first thing noticed is that she 'makes faces,' her mouth screwing up so as to make grotesque grimaces, while she fidgets with her fingers, and when she attempts to dress herself makes useless, clumsy, ineffectual movements. All this may go on for many days, perhaps weeks, without the friends thinking the child is really ill, and perhaps she gets scolded, both at home and at school, for her clumsy ways and inattention to her work. It is needless to say the scoldings do no good. Sooner or later the movements become too obvious to escape attention; indeed, it is apparent to everyone that something is wrong. These movements are much more vigorous in the upper part of the body than the lower, the hands suffering most of all. The fingers are opened and shut, the extensor and flexor muscles being constantly worked; the arm is passed behind the back, then brought to the front; if asked to shake hands, it is thrust rapidly forward, being directed with difficulty to the hand to be grasped. The tongue is protruded with a jerk, and perhaps drawn back again in a moment with a quick movement. The muscles of the face are frequently spasmodically contracted, so that queer grinning grimaces are constantly being made. The muscles of the neck are frequently contracted and relaxed, so that the head is moved from side to side or rotated. When the child walks, the feet join in the spasmodic movements, so that the gait is altered, the legs being thrown forward quickly, or if the patient stands the feet are restless, being shifted about from place to place. When the patient is at rest in bed she will lie still if not disturbed, but directly she is interfered with—as, for instance, to examine the chest—the movements begin, the hands, face, and trunk muscles being thrown into a state of clonic spasm. The muscles of respiration do not escape; the child takes a deep sighing inspiration, then perhaps there is a series of shallow irregular respirations. The irregular respirations may affect the pulse, so that it is irregular and intermittent. The movements cease during sleep, though sleep is not readily obtained; indeed, in the worst cases the patient only sleeps when under the influence of chloral or opium, which has to be freely given in order to secure rest. In the milder cases the movements may be confined to one side: this, however, is never the case when they are severe, though it is very common to have the clonic spasms more vigorous on one side than the other. A **hemichorea,** in which the movements are vigorous and entirely confined to one arm or leg, is probably due to some organic cerebral disease.

The temperature is usually normal throughout, sometimes subnormal; if there is any fever, peri-endocarditis or rheumatism should be suspected. In the most severe cases the temperature may be raised a degree or two.

There is often marked paresis of an arm or leg, far more commonly the former; not only is the grasp feeble, but the arm is weak and powerless, though complete, or indeed well-marked, paralysis does not occur. This paresis of an arm is sometimes the most prominent feature in the case, but in all cases more or less of clonic spasm may be detected in the fingers or in the facial muscles. These cases have been spoken of as 'paralytic chorea.'

The *electric irritability* of the muscles in cases of hemichorea has been studied by several observers, most recently by Gowers, cases of hemichorea being selected on account of the possibility of comparing the muscles of one side with the other. In some cases no difference can be detected, but in others there has been noted an increase of irritability on the affected side, the muscles contracting with a weaker faradic and also voltaic current than those on the unaffected side.

The speech is affected, in some cases from the muscles of the tongue, jaw, and larynx not being under sufficient control. In other cases the mental weakness frequently present may be the cause. Headaches are often complained of; sometimes, especially in cases of 'hysterical chorea,' there is hyperæsthesia or anæsthesia.

Optic neuritis has been observed by Gowers, slight in degree in some cases; in one case there was sufficient to make it comparable to the neuritis seen in a case of cerebral tumour. In the vast majority of cases there are no ophthalmoscopic changes.

The mental state is often peculiar. There is a vacant, listless expression on the face, in many cases a dulness of comprehension. The child may cry on the slightest provocation. There may be actual dementia, or, on the other hand, maniacal excitement.

In the worst cases the movements are severe: the child constantly wriggles about, and the arms and legs move sufficiently violently to throw the patient out of bed. The constant movements of the limbs chafe the skin on the extensor surfaces, so that unhealthy-looking sores may result. We have seen such in a fatal case become actually gangrenous before death. The patient is sleepless, and becomes anæmic and completely exhausted. Death, however, may not result from actual exhaustion, it may occur in consequence of pyæmia or pericarditis. In over 634 cases there were five deaths, but one of these died, not from chorea, but from an intercurrent tuberculous meningitis. All five cases were in girls; indeed, fatal cases in boys are very rare. Dr. Fagge relates the case of a boy who died in nine days, and another boy of 12 years who died from obstructed breathing due to glossitis, the tongue having been severely bitten.

The following is the history of a fatal case of chorea:

Chorea, Endocarditis, Death.—Maggie May B., aged 10 years. Four members of the same family have recently suffered from sore throats and fever due to drain smells at the back of the house. No history of rheumatism or previous attack of chorea. Patient has been attended at home by Dr. V. Brown. She has had severe chorea at home for two weeks. Admitted February 27, 1891. The choreic movements are moderately severe; she cannot feed herself; the heart's action is irregular, but there is no bruit; there is incontinence of urine; sordes on her lips and teeth; temperature, 98°–100°; sleeps badly. March 2.—Has been taking bromide and chloral, is quieter, and the movements are less; temperature, 96°–98°. March 9.—Still improving, no bruit heard, sleeps better. March 11.—The temperature has gone up to 104° F. this afternoon; the movements are now very violent; chloroform has been given to quieten the excessive movements. Bruit heard for the first time at the apex. Nepenthe in 10-minim doses seems to excite; chloral appears to answer better. March 16.—Has been taking bromide, chloral, and hyoscyamus; is quieter, but takes food with difficulty; temperature, 97°–101°. Extensor surfaces of the arm are very rough and sore from friction; there is swelling of the right parotid. March 19.—Much worse to-day. Respiration, Cheyne-Stokes. Died in the evening.

Post-mortem.—Skin covering elbows and wrists roughened and abraded, ulcer on ball of thumb, ulcer over styloid process of radius and lower end of ulna; both ears are abraded; hair at back of head worn off; knuckles abraded. Much swelling of right parotid. *Lungs.*—Old adhesions round left; right upper lobe dark red, solid behind, and sinks in water; anterior edge emphysematous; lower lobe semi-solid. There are patches of consolidation in the left lung; the back of the upper lobe is engorged. *Heart* (6¼ oz.) is firmly contracted, especially left ventricle. Mitral valves show recent endocarditis, the edges being beaded (see fig. 88, which was drawn from this case); other valves healthy. No dilatation or hypertrophy. *Intestines* congested, Peyer's patches swollen, slightly abraded in places. *Liver* (44 oz.) enlarged and congested. *Spleen* (4½ oz.) large and soft. *Kidneys* congested. *Brain.*—Veins on surface full. Arachnoid membrane opaque and cloudy, excess of subarachnoid fluid. There is a patch of what appears to be lymph on the convex surface. In the Sylvian fissure the arachnoid is especially opaque. The brain substance is firm, the capillaries are congested.

Chorea is a chronic disease lasting for many weeks, often many months, but it is usually not equally severe throughout this period. Ten weeks is often stated to be the average; it certainly is often much longer. Relapses are exceedingly common; it is not uncommon for children to have three to five attacks, but the tendency passes off after puberty.

Complications.—In the majority of cases of chorea the **heart** is in some way or other affected. In some cases chorea apparently supervenes in children who are suffering from chronic heart disease; in a few cases it appears to be brought on by an attack of pericarditis, but in the majority of cases the heart complication comes on during the course of an attack of chorea. Out of 252 cases of chorea, nothing abnormal was noted in the heart's action in 79; in 54 there was irregularity or reduplication of the sounds; in 119, bruits, mostly heard at the apex more loudly than at the base, were detected. Some of these bruits were, no doubt, anæmic, inasmuch as they were present only at the base; it is seldom, however, possible to say dogmatically that a bruit heard during the course of chorea is simply hæmic, and it is necessary to have the patient under observation for a long period during convalescence before we are in a position to say if a so-called hæmic bruit is due to organic disease or not. It is well also to remember that endocarditis may occur and yet no bruit be produced; thus we have sometimes failed to detect bruits in cases of chorea, but some months afterwards have noticed undoubted organic murmurs. Both mitral and aortic valves may be affected, though the former are far more commonly affected than the latter; while many of those in whom bruits are heard during chorea have suffered from rheumatism, this is by no means the case with all.

Acute or **sub-acute rheumatism** was associated with chorea in 46 out of 252 cases, while 20 more, according to their friends' account, suffered from 'rheumatic pains.' Statistics with regard to the association of chorea and rheumatism vary considerably, but this is hardly surprising, inasmuch as we are largely dependent upon the histories given by friends, and their ideas concerning rheumatism are apt to be vague; moreover, the symptoms of rheumatism are often less well-marked in children than in adults, and rheumatic attacks may be easily overlooked, or at least may not be recognised as rheumatic. The association of rheumatism and chorea is undoubted, and cannot be a mere coincidence; not only do we see children suffering from chorea attacked with rheumatism, and *vice versa*, but not infrequently

we see a sister suffering from chorea and a brother from rheumatism, or attacks of chorea and rheumatism alternating in the same individual. Rheumatic nodules are present in a few cases.

A **paresis** of hemiplegic or paraplegic distribution not infrequently takes place in chorea ; such cases having been described as *paralytic chorea.* It consists in weakness rather than paralysis, and not infrequently precedes the other symptoms of chorea. A **peripheral neuritis** in rare cases appears to follow chorea, as it does also rheumatic attacks, the principal phenomena being muscular wasting and paresis, indefinite pains such as 'pins and needles,' and in some instances anæsthesia. The reflexes are absent.

In other cases there is sufficient excitement of the brain to merit the name of **maniacal chorea** or **chorea insaniens.** This condition is most common at or about puberty. There may be violent delirium and excitement, so that the patient has to be controlled by her attendants, the attacks resembling acute mania. Often these attacks are closely allied to, or resemble, hysteria. The following case appears to have been of this kind :

Maniacal Chorea ; Hysteria.—The patient was a girl of 14 years of age; both her sister and herself had chorea a year and a half before the present attack, which lasted for some time, and for which she was treated in the Derby Infirmary. She was readmitted with choreic movements of moderate intensity, but they were readily controlled by the will, and she was perfectly rational. She got worse, the movements being more violent ; there was difficulty of speech ; she became extremely emotional and at times maniacal. When she was moved—as, for instance, when her bed was made—she would struggle and run her nails into the attendants. Two months after admission the knees became semi-flexed and rigid, and there was incontinence of urine and fæces. She was so troublesome that she was sent home after about three months in hospital.[1] Some time after she was admitted to the Children's Hospital. At this time she had sordes on her lips and teeth, she was much emaciated ; both knees were semi-flexed and rigid, the hips were semi-flexed and rigid ; the patellar reflex could not be obtained on account of the excessive rigidity. There were slight choreic movements of the arms and face ; she passed her urine and fæces into bed. She was extremely emotional, and there was some hyperæsthesia, especially about the joints and muscles. She gradually began to improve, in a week or two gaining more control over the sphincters, and the legs became less rigid and she made flesh. A fortnight after admission the bedsores had healed, and she was less emotional. In a month she could walk with help, and in three months she was discharged quite well,

In this case there seems to have been aggravated hysteria associated with chorea, although at one time the girl looked very much as if she was suffering from organic brain disease. The emaciation, bedsores, and rigid leg seemed to point to an organic lesion ; this was, however, negatived by her complete recovery.

In some rare cases instead of paresis there is muscular spasm, which may persist for some time after the choreic movements have disappeared. The following case illustrates this :

Chorea ; Muscular Spasm.—A boy, aged 10½ years, was admitted to the Children's Hospital suffering from chorea, which was attributed to a fright, he having seen a 'ghost at a show.' Three sisters had also suffered from chorea, one having died during an attack. His attack was a moderate one ; no bruit was heard ; there was some paresis of his right leg. He was discharged in a month's time quite well. He was readmitted two months

[1] These notes were kindly furnished by Dr. W. Benthall, of Derby.

later, the choreic movements being pretty much confined to the right arm, which was markedly weak: the right knee joint and ankle were rigid, the muscles being in a state of spasm; there was no pain or tenderness. There was a systolic bruit at the apex. He was discharged in six weeks; the choreic movements had disappeared, but the spasm in the right leg persisted. He had another attack of chorea eighteen months afterwards; before this occurred, the muscular spasm had entirely disappeared.

Hemichorea.—In many cases, as already pointed out, the movements are confined to one side of the body, or at all events they are more marked on one side than on the other. Hemichorea is in some instances post-hemiplegic, following some months or more after the hemiplegia, when contractures are present, as in the case of cerebral tumours situated near and involving the internal capsule or pyramidal tracts: choreiform movements may take place on the opposite side. In hemichorea symptomatic of brain disease the movements are vigorous and grotesque, the fingers, hands, feet, and extremities being twisted and jerked about. In one of our cases, in a boy of 5 years of age, who had a cheesy tumour in the right optic thalamus, at first sight the child appeared to be affected with the ordinary form of chorea. His left arm was in constant movement, the result of short, irregular, jerky contractions of the muscles of the forearm and arm, following one another with great rapidity, and closely resembling those seen in a severe case of chorea. When the boy was at rest the arm was quiet, only a sort of fumbling movement of his hand being noticed; but on asking him to sit up or give his hand, vigorous, almost violent, movements began again. Some of the movements were produced by all the muscles of the arm, yet some of the muscles acted more continuously and powerfully than others, so that the arm tended to be held to the side and more or less behind, while the forearm was pronated and the wrist flexed, the fingers being in continual movement. This condition of hemichorea differs from 'athetosis' or 'mobile' spasm already referred to (p. 529).

Morbid Anatomy.—Various minute changes have been described in the brain in fatal cases of chorea, but it is quite certain that no constant and invariable lesion has been discovered. Embolism and thrombosis of the minute vessels of the cortex and basal ganglia have been described; minute spots of softening, changes in the nerve cells, and enlarged perivascular spaces have also been found. We cannot say that any of these observations throw any light on the morbid anatomy of the disease, especially when we remember that on various occasions competent observers have found nothing of importance in their examination of the brain and spinal cord in fatal cases. Many of the changes described are no doubt secondary, the result of hyperæmia of the nervous centres.

The frequent association of chorea with rheumatism and endocarditis suggested to Kirkes the idea that chorea was the result of minute embolism of the brain by fragments of fibrin washed off the mitral valves. This hypothesis, however, is quite inadequate to explain the phenomena presented by the disease; thus chorea has followed within a few hours of a sudden fright, and moreover fatal cases have been recorded (though rarely) in which no endocarditis has been found. Embolism will not explain those cases of 'reflex chorea in which the exciting cause is an acute otitis, or when chorea follows some injury or accompanies pregnancy; we find that pericarditis, and

perhaps endocarditis, act as exciting causes operating through the nervous system, just in the same way as some gastro-intestinal irritation may be the exciting cause of convulsions in infants.

In considering the pathology of chorea we must take into account the associations of chorea, though it cannot be said they help us much in coming to a conclusion. Chorea is associated, on the one hand, with rheumatism and endocarditis, and on the other with hysteria and mania; the former association would suggest a blood-change, the latter simply a functional disturbance of the nervous system. Pathologists in formulating their theories have leaned either to the one or to the other. Sometimes chorea has been explained as secondary to endocarditis, as a result of capillary embolism, or as a result of a 'rheumatic' condition of blood, in which some chemical poison has been present in the blood which has a specific action on the nervous system. At other times chorea has been looked upon as an emotional disease, and, like hysteria, a purely functional disease, or, as it has been termed, an 'insanity of the muscles' or motor region of the brain, just as mania or other forms of insanity affect the seat of the mind.

There has been also much difference of opinion with regard to the seat of the disease; it has been placed in the spinal cord, basal ganglia, and cortex of the brain. The fact that the face is usually affected, and that moreover the choreic movements are frequently one-sided, would almost certainly point to the seat of the disease being within the cranium. The tendency of recent researches in physiology has been to deprive the corpus striatum of its alleged function as an originator or co-ordinator of motor influences, and to assert that it has little or nothing to do with the discharges of motor force. On the other hand, there is strong reason to believe that the choreic movements are the result of irregular discharges from the motor region of the cortex; for the time being the will or the inhibitory influence of the frontal regions is in abeyance, and irregular purposeless discharges are given out from the cells in the motor region of the cortex. There is much reason to believe that the functions of the cortex are impaired in chorea, as shown not only by the spasmodic movements, but also by the paresis which sometimes occurs, and the mental dulness and emotional disturbance so often present. It can easily be understood that if there is impaired nutrition of the nerve centres, a sudden fright, or an irritation at some distant part, may start the irregular discharges from the cortex, which it may soon be beyond the power of the will to control.

With regard to the cardiac complications found in fatal cases we cannot do better than quote the late Dr. Sturges, who sums up as follows: 'Vegetations, new or old, on the auricular surface of the mitral valves, with or without similar deposits on the aortic valves, and sometimes with pericarditis, are met with in the great majority of cases dying of, or with, or shortly after, chorea. This condition, however, does not, as a rule, contribute directly to the fatal issue; it is found equally among those that die *with* and those that die *of* chorea, and in some of the most marked and typical cases of fatal chorea the valves of the heart have been found absolutely healthy.

Diagnosis.—This is not usually difficult, though it must always be borne in mind that the choreic movements present may be symptomatic of some

serious brain lesion, or of some distinct disturbing influence, such as pericarditis. We have seen on one or two occasions, in girls about puberty, choreic movements followed by emotional disturbance and paresis of limbs, attributed not unnaturally to hysteria, where the onset of optic neuritis and amblyopia has made it clear that the case was really one of cerebral tumour. We have seen also the onset of chorea in a girl of 4 years followed in a week by pericarditis and death in a few days.

Any brain lesion which presses upon the pyramidal tract may give rise to movements similar to chorea ; we have several times seen this in cheesy tumours of the optic thalamus which compressed the internal capsule ; in such cases a 'hemichorea' is produced (see p. 520). It must be borne in mind that in true chorea, if at all intense, the movements are general, though perhaps worse on one side than on the other, but they are never confined to one side, as in the case of cerebral tumour.

In some of the special varieties of the disease the diagnosis may be difficult ; thus in the case related (p. 546), where there was contraction of the limbs and bedsores, one might readily assume that chronic meningitis or other cerebral lesion was present. In a case under our care, where tuberculous meningitis supervened in the course of chorea, the diagnosis was uncertain for a few days. The presence of optic neuritis would strongly point to organic disease, though, as already stated, Gowers has observed optic neuritis in a case of chorea. In cases of paralytic chorea the chief symptom may be simply paresis of one arm ; but usually a slight examination will detect short clonic spasms, either in the affected arm or elsewhere.

Prognosis.—Recovery follows in the vast majority of instances. The principal danger is from some heart complication, as pericarditis, and from exhaustion in consequence of the violence of the movements, want of sleep, and nourishment. The more severe the case, the longer will be its duration. Maniacal and hysterical choreic cases are usually very chronic.

Treatment.—The most important element in the treatment of chorea is rest. It is necessary to secure for a patient suffering from chorea complete rest for the body, and complete absence of excitement of all kinds. In all but the mild cases it is well to begin the treatment by keeping the patient for a few days or a week in bed completely at rest. We must bear in mind that voluntary movements of all kinds (in severe cases at least) make the involuntary movements more marked and more completely beyond the control of the will. On the other hand, the movements cease during sleep, and the more quiet a patient can be kept the better chance there is of a better nutrition of the body and the nervous centres. Any excitement or mental effort is certain also to make matters worse, so that all forms of mental work must be avoided, while the surroundings of the patient must be made as agreeable as possible. When the movements are severe, so that the patient cannot sleep, some narcotic must be prescribed, and of remedies of this class chloral is probably the best, but it must be given in full doses to be of use. Ten or fifteen grains may be given, and repeated in four hours if the restlessness continues. Bromide of potassium may be combined with the chloral, though most agree that chloral is more useful than the bromide. Morphia seems at times to add to the excitement present, though in some cases

it acts better than chloral. Nepenthe in fairly full doses for the child's age sometimes answers well in procuring rest. Inhalations of chloroform are often useful to get the patient off to sleep. Great care must be taken to prevent the patient from being injured by tumbling out of bed, and it may be necessary to protect the limbs by wrapping them up in cotton wool, or to surround them with some soft material ; or padded boards may be placed on each side of the bed, or a mattress may be placed on the floor. The patient should be given a fair amount of liquid nourishment, and also stimulants. Frequent spongings are of great value in getting the skin to act and calming the patient.

Even in the less severe cases of chorea it is well to confine the patient to bed for a week or two in the early stages ; the movements are always less when the child is at rest in bed, and these means are almost certain to shorten the duration of the attack. When improvement occurs the patient may be allowed to get up for a few hours a day and be taken out into the fresh air, but too much exercise should be prevented.

The drug which is most used at the present time is arsenic ; D. B. Lees strongly recommends salicylate of soda in full doses, and it is certainly worth a trial. Aspirin is often used. We confess to some scepticism with regard to the value of medicines in chorea, and feel sure they occupy only a subsidiary place in treatment. Arsenic is certainly of use in the dyspeptic conditions which so often accompany chorea, but it requires to be given in increasing doses as the stomach becomes more and more accustomed to it. Two- or three-minim doses may be given three times a day at first, and increased at the rate of an extra minim every week till six or seven minims are given. It is better not to continue the administration for too long together, as a temporary darkening of the skin is apt to take place, and arsenical neuritis of a severe type has followed the administration of this drug. In the later stages iron may be useful, given in combination with arsenic. Great care should be taken to regulate the bowels ; constipation is the rule, and this may be overcome by small pilules of extract of aloes or some elixir of cascara sagrada.

In chronic cases a change of scene, such as residence at the seaside, is perhaps suggested by the friends, but in our experience this change often makes the movements worse and prolongs the attack, in consequence of the excitement attending the change and the patient attempting to do more than her strength permits. A change to the seaside should be deferred till the movements have nearly ceased and can be controlled entirely by the will. The same may be said of gymnastic exercises and rhythmical movements ; they are of the greatest use when the movements tend to become habitual, while the health of the patient is good ; they are certainly not desirable in the earlier stages. Massage has been employed with good result by Goodhart and Phillips, and in some of our own and our colleagues' cases the result has been satisfactory. All through the course of chorea moral treatment is of the greatest importance. Chorea in many cases is closely allied to hysteria, and a firm but kindly demeanour towards the patient is called for ; and she should be encouraged to control the movements as much as possible by an effort of will. In all severe cases a nurse should be provided, as the patient's mother is often the last person who should have charge of her.

In all stages of the attack a nourishing, easily digested diet is necessary ; in severe cases it is necessary to feed the patient ; to such patients fluid food only can be administered.

Epilepsy

Convulsive seizures of various degrees of severity are common during childhood and youth, and when they are idiopathic—that is, without assignable cause, no cerebral or other lesion being discoverable—the term 'epileptic' is applied to them. It is difficult to say in what proportion of cases children who suffer from convulsions during infancy become confirmed epileptics ; certainly many of those who suffer from infantile convulsions lose their tendency to convulsive seizures as they grow older. The popular belief is that children mostly 'outgrow' their tendency to convulsions. But it is certainly true that infants and young children who suffer frequently from fits without any obvious cause are very likely to become confirmed cases of epilepsy. Convulsions due to fever, or indigestion in a rickety child, which only occur once or occasionally, are very likely not to recur, but no definite and certain promise should be given. According to statistics collected by Gowers, in one-fourth of the total number the attacks begin before the age of 10 years, and nearly one-half between the ages of 10 and 20 years These statistics show that there is always the possibility that children or infants who suffer from reflex convulsions may become epileptics ; yet there is a strong probability, if the child does not suffer from any cerebral defect, or has no hereditary tendency in the direction of epilepsy, that he will not grow up an epileptic. Hereditary influences certainly predispose ; a family history of epilepsy or insanity is obtained in about one-third of the cases of epilepsy, in others it may be found that they come of neurotic families in which members have suffered from chorea or hysteria.

Of the exciting causes there is little to be said. The first fit may be described by the friends as being due to a 'sunstroke,' or a 'blow on the head,' or a 'fright' ; but it is unsafe to place much reliance on such statements, as they may be merely coincidences, and certainly are not sufficient in themselves to produce epilepsy. In the large majority of cases, it must be confessed, no immediate cause can be discovered. Epilepsy sometimes commences after scarlet fever and other zymotic diseases, but beyond the fact that these fevers leave a certain amount of weakness behind, and so may predispose, there is nothing to suggest that they act as effectual causes. The approach of puberty is a time when the nervous system is in an excitable state, especially in girls, and epileptic fits are very apt to commence at this period, notably in cases where menstruation does not commence at the usual period, but is delayed by any cause. Constipated bowels and a sluggish condition of liver certainly act as predisposing causes.

Symptoms.—Two forms of attack are usually described : the minor form, or *petit mal*, and the major form, or *grand mal* ; but these two forms insensibly pass into one another, and there is no marked line of demarcation between them.

The precursory symptoms differ very much : frequently the first fits and the succeeding fits come in the midst of perfect health, and neither the patient nor the friends are aware that a fit is imminent. On the other hand,

the child may be unusually irritable, easily put out, and nothing pleases it; it may be feverish, dull, and stupid. In some cases the fit is preceded by some warning or aura, by which the patient becomes aware, by past experience, that an attack is at hand. These auræ are more common in adults than in children, or at any rate adults are better able to describe their feelings and have a larger experience of fits to fall back upon. The auræ are very diverse in character: they may be sensations referred to arm or leg, or to the throat; there may be headache, vertigo, or faintness. In rare cases there are 'flashes of light' or sudden blindness.

Petit mal.—These minor attacks are very slight in character and are often not admitted to be epileptic by the friends, who usually connect 'fits' with the more severe and decided form of seizure. They are often spoken of as 'faints' or 'attacks.' There may be no real convulsion or tonic spasm; the child may stumble when walking from a momentary impairment of consciousness; a peculiar look crosses its face, and for a moment it is dazed and forgets what has happened. Sometimes the face becomes pallid for a moment, and there is a slight convulsive spasm of the facial or other muscles. The urine is rarely passed in these seizures, nor is there any cry. Sometimes the attack is succeeded by drowsiness or stupor. In older children the behaviour may be very peculiar; after one of these minor seizures a mild mania may seize the patient: he becomes mischievous or strikes other children without provocation, or behaves in an hysterical manner.

Grand mal.—The seizure may begin with a sharp cry or scream, as of sudden fright; in many cases this cry is absent, the patient falling precipitately on to the ground in an unconscious state. The face is pallid and tonic spasms of the muscles begin. Sometimes these are one-sided in distribution: the muscles of one side of the face, neck, arm, and leg of the same side are thrown into contraction, the head is usually rotated to the affected side. In other cases the spasms are general. The legs are usually extended and stiff, the elbows partially bent, the wrists flexed, and the fingers in a position of interosseous spasm (Gowers). The respiratory muscles join in the general tonic spasm, and, as the inspiratory muscles are more powerful than the expiratory, the breath is drawn in and held, so that the face becomes congested and the lips blue. There is usually spasmodic contraction of the muscles of the jaw, so that the tongue is bitten and held between the teeth; frothy, perhaps blood-stained, saliva runs from the patient's mouth. Death may take place from asphyxia during this stage. Usually, however, after the stage of tonic spasm has lasted from a few to thirty seconds, the continued spasm of the muscles relaxes, and clonic or intermittent short contractions succeed. The muscles of the face twitch, so that the patient appears as if he were making grimaces; the limbs 'work,' alternately flexing and extending—sometimes so violently that the head and legs are banged about and become bruised and injured. In other cases the clonic spasm is not so vigorous, there being only short, sharp muscular contractions. The urine and sometimes the fæces are passed. The period of the clonic spasm is variable; it may last many minutes, or even hours; the patient gradually recovers consciousness, and has no recollection of what has passed. He probably is dazed and sleepy, goes off to sleep, and wakes up tired and sore.

The fits vary much in intensity : often the stage of tonic spasm is short and not well marked, and the whole duration of the fit is not more than half a minute. In some cases, especially after severe attacks, a temporary paralysis, mostly hemiplegic, is left. We are inclined to attribute this to a meningeal hæmorrhage which has taken place during the respiratory spasm.

Hysteroid Fits.—Some minor attacks closely resemble hysteria in that the spasmodic movements are of a purposeful character, as if directed by the will, and, moreover, the child appears to be conscious or semi-conscious during the fit. This form of seizure is common both in boys and girls. The phenomena which take place are exceedingly various ; the child may commence by barking like a dog, or mewing like a cat, or may attempt to bite its attendants ; the head may be banged about and the legs and arms thrown wildly about, as if the child were directing the movements. The patient may stiffen out and arch his back as in opisthotonos. Sometimes the actions are still more co-ordinated. Thus in a girl of 7 years, in hospital, when an attack came on she would jump up in bed, turn round once or twice, sit down again and arrange the bedclothes, smoothing them carefully down, and yet be unconscious during the fit, and have no remembrance of it afterwards. A sharp word or the prick of a pin will often arrest these fits. That some of these cases are closely related to epilepsy is shown by the fact that they may alternate with true epileptic fits or they may supervene at puberty in children who have suffered from chronic epilepsy.

Post-hemiplegic Epilepsy.—Children who suffer from hemiplegia which dates from birth or within a year or two of birth are very apt to suffer from epileptiform attacks. Convulsions are also very apt to attend the onset of the hemiplegia : the child may continue to have fits, and be subject to them for the rest of its life. In other cases a period of months or years may elapse between the onset of the hemiplegia and the commencement of the epileptic fits. It is often about puberty that they recur. As a rule, the convulsions affect the paralysed side only, but in severe cases the convulsions may be general. An aura or warning of the approaching fit is more common in post-hemiplegic epilepsy than in idiopathic epilepsy. In these cases it is common for mental backwardness to exist (see case, p. 531).

Course.—As already stated, the epileptic fits may date from infancy, the child having suffered in the early months or years of its life from convulsions, and these have been succeeded by chronic epilepsy. More often the child has been free from convulsive seizures during infancy and early childhood, and it is only during the second dentition or as puberty is approached that it has begun to suffer from fits. The health prior to the commencement of the fits may have been excellent, there may be no history of epilepsy in the family, and it may be quite impossible to explain the onset of the epileptic fits. At first the friends are loth to believe the fits to be epileptic, and attribute them to rapid growth, dentition, weakness, or some injury. In other cases the health may have been indifferent or the temperament peculiar, the child having been of a strange disposition, nervous, easily frightened, morose, or backward in mental development, or may have shown signs of idiocy ; then, as puberty approached, the epileptic fits appeared. The health of the child after the commencement of the fits varies according to their frequency and severity. In the milder forms the children may enjoy

the best of health, may be merry, romping children, able to take their part in rough school games, and be of average, or more than ordinary, quickness and intelligence. In other cases, especially when the fits occur frequently, the health suffers, the patient becomes sallow and anæmic, his digestion and appetite are poor, and the liver and bowels sluggish. The memory is apt to fail more or less, and in the worst cases a condition allied to dementia may supervene. The intervals between the fits differ considerably, not only in different patients, but in the same individual ; sometimes many months or even years will pass without a fit, at other times the fits follow one another at intervals of a few minutes, so that the patient is no sooner out of one fit than he is into another. To this latter condition the term 'status epilepticus' has been applied. In the *petit mal* the fits usually occur oftener than in the more severe attacks. Fits may occur at any time within the twenty-four hours, at night or by day, but there seems to be a special tendency for them to recur in the early morning when the patient is getting up.

Prognosis.—The prognosis is bad in those who have suffered from fits from infancy, and who are mentally deficient, or in whom some mental change has taken place. The chance of the entire cessation of the fits is a poor one in those who have fits frequently. The less frequent the fits, the greater is the probability that they may cease altogether. Even in those who have only suffered from fits at long intervals a cautious prognosis must be given, as those who have so suffered are never safe, and a recurrence may at any time take place. The danger to life is least in the minor attacks, but as time goes on the major attacks may supervene. There is always the possibility that the fits may cease when the epoch of puberty is passed, and in the case of girls when menstruation is thoroughly established. It must always be borne in mind that epileptics may at any time meet with a sudden death from injuries received during a fit : they may fall into the fire, or into water, or they may be suffocated in bed at night. Less often death takes place in the fit from asphyxia, due to prolonged spasm of the glottis and respiratory muscles.

Diagnosis.—In some cases of *petit mal* the attack may be so slight that a doubt may exist whether the fits are really epileptic or not ; but all recurring 'faints' or attacks of giddiness must be looked upon with great suspicion, and if there is a loss of consciousness, however short, they are almost certainly epileptic. Difficulty may often arise in distinguishing hysterical attacks from true epilepsy, especially the attacks described as hysteroid. It may be simply a matter of opinion whether some of these attacks are best classed with epilepsy or hysteria ; in any given case careful inquiry must be made for typical epileptic fits, which sometimes occur immediately before the hysteroid fits. The diagnosis is usually easy between typical epileptic and typical hysterical fits ; it is often very uncertain in atypical ones. Loss of consciousness, biting the tongue, or tonic followed by clonic spasms, if present, are decisive in favour of epilepsy. There may often be considerable difficulty in distinguishing between reflex convulsions and epileptic fits. Under 3 years of age, if there are the signs of rickets, the probabilities are strongly in favour of their being reflex. After this age reflex convulsions may occur at the commencement of some zymotic disease, or possibly as the result of cutting the permanent teeth, or from worms ; but the

chances are immensely in favour of epilepsy if they are on the type of those in idiopathic epilepsy; in all cases where the attacks are epileptiform in character, in which there is loss of consciousness, spasm followed by stupor, even though the child is cutting one of the permanent teeth or has worms, we should be inclined to believe they are really epileptic. Parents naturally like to believe that the fits are due to dentition, to rapid growth, to a disordered liver or stomach, especially in those cases where there are no hereditary tendencies present, but we cannot accept these as anything more than exciting causes, and in all such cases there is only too much reason to fear that there may be a recurrence of the attacks. Convulsions may occur as the result of brain disease, recent as well as old. A tumour or syphilis may be present in this case; there may be some marked aura, especially visual or auditory; the convulsions will be mostly one-sided; moreover, there is headache, giddiness, vomiting, paralysis, and optic neuritis.

Treatment.—A child subject to epileptic fits should be placed under the most favourable conditions possible, and should be most carefully guarded from excitement, over-fatigue, and over-feeding. A healthy country life, with plenty of outdoor exercise and sufficient employment for the mind, must be enjoined. A moderate amount of brain work may be allowed, but no forcing of any kind should be permitted. It is well to allow no work and not much exercise before breakfast, as at this time there appears to be an especial liability to fits. The diet should be simple and unstimulating; a mixed diet, moderate as regards quantity, is the best. Meat may be allowed if there are no signs of dyspepsia, but care should be taken it is well masticated. Over-filling of the stomach and all forms of indigestible food should be avoided. How useful a regular life is, is seen by the improvement which nearly always takes place on the child's admission to hospital. It is needless to say that all children subject to fits should be carefully watched: a public or large school is certainly not the place for them, as they require more individual attention than is possible under such conditions. There is always the possibility that they may fall into the fire, or into water, or be suffocated in bed by a fit occurring during the night. The state of the bowels should be most carefully attended to, as there can be no question that constipated bowels predispose to the attacks. Effervescing citrate of potash, magnesia, or cascara, with occasional small doses of calomel, are useful. Of all medicines which check the tendency to fits the bromides take first place. Bromide of potassium or sodium may be given in doses of 10 to 40 grains a day, according to age and to the frequency of the fits. The saline taste is readily covered by well diluting with water, and adding syrup of orange peel, aromatic sp. of ammonia, or liq. ext. of liquorice. (F. 85, 86, 87.)

Sometimes a laxative may be combined with the bromide to counteract its constipating action: rhubarb and nux vomica are useful for this purpose. The bromide should be administered for a month at least after the fits, and then may be reduced in quantity; but it will be well to continue the use of bromide in gradually smaller doses for six months at least after the last fit; it may be combined with digitalis or strychnine. Some prefer the mixed bromides of potassium, sodium, and strontium.

Large doses of bromide give rise to a lethargic heavy condition in the patient; there may be slow drawling speech, and a slow circulation. Acne

is apt to make its appearance after a few doses of bromide in some patients.

There is no other drug that at all approaches bromide in value for epilepsy. Nitrite of sodium, belladonna, zinc oxide or lactate ($\frac{1}{2}$ to 5 grs.), borax (5 to 10 grs.), nitro-glycerine ($\frac{1}{200}$ to $\frac{1}{100}$ of a grain), and strychnine have all been used with more or less advantage when bromide fails.

The question of surgical interference must depend upon the diagnosis; in idiopathic epilepsy trephining or ligature of the carotids is hardly justifiable. If there is reason to believe that a tumour in the cortex exists, an operation may be considered (see p. 523).

Infantile Convulsions. Eclampsia.—Infancy predisposes to those irregular nerve discharges which go by the name of 'convulsions' or eclampsia. The undeveloped state of the cortical centres during infancy, and the consequent absence or imperfection of the controlling or inhibitory influences exercised by these centres in later life, allow the 'lower grade' centres to discharge their stored nervous force, when stimulated, in a way which does not occur in later years. The reflex actions exhibited by the brainless frog are more easily provoked and more vigorous than the reflex actions exhibited by a frog with the brain intact; the higher centres appearing to exercise a controlling influence.

While infancy is the time of life in which convulsions are most easily provoked, yet healthy infants do not become convulsed unless the stimulus is strong; it is the delicate ones who are most likely to suffer, and especially those who have inherited neurotic tendencies. That hereditary influence plays an important part as a predisposing cause there can hardly be a doubt, the infants of those who have suffered from epilepsy or who are of a highly nervous disposition certainly more often suffer from reflex convulsions than do the children of strong, healthy parents. The commonest predisposing cause, however, is rickets, though in what way it acts is uncertain; yet it is certain that all the tissues in rickets are badly nourished and built up, and the nervous system is no exception to this: the nerve centres appear to be in a condition of unstable equilibrium, and are apt to discharge their nervous force in a purposeless and irregular manner. Very probably some toxin is formed in the alimentary canal, which produces a sensitive state of the nervous centres. In the large majority of children who suffer from convulsions between the ages of 6 months and 3 years the signs of rickets are present. An anæmic condition, great exhaustion from any cause, as well as hereditary tendencies, predispose to convulsions during the whole period of childhood, but more especially during the first few months of life.

The *exciting* causes of convulsions are mostly *reflex*: the irritation takes place at some distant part, the stimulus passes up to the nerve centre along some afferent nerve, giving rise to a discharge from a nerve centre or centres, the impulse travelling along the efferent nerves to the muscles.

Reflex convulsions may be said to be disorderly physiological reflex acts. In a normal reflex act the nervous mechanism is properly controlled and a useful movement takes place: in a convulsion there is an irregular and wasteful discharge of nerve force which fulfils no useful end. An infant's movements consist almost entirely of reflex acts of the simplest character, the nerve centres in action being of the 'lower grade' group, situated in the

spinal cord, medulla and pons : such are the acts of swallowing, sucking, crying, breathing ; in each case there is some form of irritation, or a stimulus acting on the nerve centre and transmitted to it by an afferent nerve, and an impulse is sent along an efferent nerve to a muscle or group of muscles, and a definite, perhaps complex, act is performed. In morbid states of the nerve centres an afferent impulse calls forth a series of irregular and muscular movements, mostly in the form of clonic spasms, which may be limited to one group of muscles, or may implicate almost all the voluntary muscles in the body. Thus the presence of undigested curd in the stomach or bowels gives rise to acute pain or griping, and acts as a stimulus over a wide area, and some distant nerve centre, or perhaps many nerve centres, are thrown into activity. As a consequence of this the facial muscles may twitch, the legs be drawn up, the eyes roll about, the fingers be clenched ; there may be spasm of the respiratory muscles, and all the muscles of the extremities may be thrown into a clonic spasm ; or the infant suffers from whooping cough, and the spasm of the glottis passes into a general convulsion. Possibly the respiratory muscles only may be involved, and spasm of the glottis and of the respiratory muscles may result. Dyspepsia or the presence of indigestible food is a fertile source of infantile convulsions in the newly born ; newly-born infants when fed on artificial food frequently suffer from convulsions, which disappear at once when a wet-nurse is obtained. In making *post-mortems* on infants and young children who have died in convulsions it is no uncommon thing to find the stomach to be overloaded, or possibly to contain pieces of meat and other indigestible food.

Dentition is another cause ; the pressure of the advancing tooth upon the gum, or the tension of the tooth in its socket, may, through the branches of the fifth nerve, produce general convulsions. Bronchitis or pneumonia may be the exciting cause, though the latter sometimes produces convulsions in consequence of the high fever that is present.

The exciting cause of the convulsions may act directly on the centres themselves. Thus the onset of meningitis or encephalitis may be marked by convulsions ; an infant has a series of convulsions which are perhaps more or less one-sided, and when they cease it is noticed to be paralysed, the hemiplegia being due to inflammation, softening, thrombosis or hæmorrhage. The acute stage of infantile paralysis may be attended with convulsions, though only in rare instances. Convulsions may be caused by chronic brain disease. A poisoned condition of blood may be the exciting cause ; thus a temperature of 104° or 105° is exceedingly likely to be accompanied by convulsions, the convulsions ceasing when the temperature falls, and being perhaps repeated when it rises again. Heat-convulsions are exceedingly apt to be fatal. A hypervenous condition of blood excites convulsions, as seen in infants born in a condition of asphyxia. The onset of some zymotic disease, as scarlet fever, measles, or influenza, is sometimes marked by convulsions.

Symptoms.—The convulsive attacks vary greatly in their severity, and in the extent of the muscles involved. They may simply be slight jerky movements of the head and neck, or a limb, or they may be slight twitchings of the muscles of the mouth or eyelids. The fingers may jerk and the thumbs turn in, the toes become flexed, movements to which the name of carpo-pedal contractions has been applied. Such slight convulsions are often spoken of

by nurses and parents as 'inward fits'; they are most common in young babies with dyspepsia, or those who are suffering from distended bowels.

A typical convulsion closely resembles an epileptic fit, but the stage of tonic spasm is usually shorter, while the clonic spasms or muscular twitchings are more prolonged and vigorous. The commencement of a fit is frequently marked by a spasm of the glottis, so that the nurse thinks for the moment the infant is choking; at other times the rolling upwards of the eyeballs and twitchings of the facial muscles first call attention to the child. The face becomes pallid, the eyes are turned up so as to show 'the whites,' the limbs are extended and stiffened, the hands are clenched, the neck and back are arched, the jaw closes spasmodically; in a few moments the lips and face become of a bluish tinge from the respiratory spasm; the tonic spasm quickly passes into clonic, the hands, feet, and face 'work' for a few seconds or more, and the child becomes quiescent and the fit is over. The child becomes unconscious during the fit, and may remain dazed for a few minutes to half an hour after.

The fits may be severe, much of the type of a major epileptic fit, the tongue being held tightly between the gums or injured by the teeth, the child frothing at the mouth and becoming cyanosed, and remaining comatose or drowsy for some time. On the other hand, the convulsions may be partial only: one side may be affected, the leg, arm, and side of the face twitching, or the laryngeal muscles or respiratory muscles alone may suffer. The frequency with which fits occur differs very much: a child may have a single one, and it may never be repeated; or they may recur daily, or there may be a constant succession of fits for twenty-four or forty-eight hours, the child never becoming conscious. Some of the most severe convulsions we have ever witnessed have been in connection with whooping cough. The child begins to cough and forthwith a general spasm of the respiratory muscles takes place, with spasm perhaps of the muscles of the limbs. The child becomes dusky or pallid, and appears to be dead. Perhaps by the aid of artificial respiration it comes round, but such attacks are, we need not say, exceedingly fatal.

In some cases of uncertain origin, the child has a series of convulsions and then passes into a deep coma, which lasts some days or even a week or more. These cases are apt to be associated with hemiplegia (see p. 530) and are presumably associated with some brain lesion as meningitis or hæmorrhage.

Death may take place in the fit from spasm of the glottis. In other cases death seems to be caused in some way through the nervous system, as after death no evidence of asphyxia can be found. Convulsions in older children are indistinguishable from epileptic fits, and doubtless many of such cases for which no cause is found are really epileptic, or at any rate showing a tendency in that direction.

In not rare instances after the infant becomes again conscious it is found to be blind. The pupils act normally, but it has no appreciation of light. Recovery mostly takes place in the course of a few weeks or months.

Convulsions may be associated with idiocy or some mental defect, and it is not always easy to say to what extent the convulsions depend upon the presence of some cerebral lesion or malformation, or whether the mental

defect is produced by the frequently recurring fits. It is not uncommon to see children of a few months to a year old who are frequently convulsed, and who are evidently idiots, not able to sit up or hold anything in their hands, and not recognising their friends. In these cases the prognosis, as far as the mental development is concerned, is grave, though the fits often become less frequent or cease as the infant develops.

Prognosis.—This must always be uncertain, and naturally depends upon the exciting causes. The first fit may prove fatal through spasm of the glottis ; on the other hand, it is common to get a history of children who as infants were constantly convulsed and yet have grown into comparatively strong children. Naturally much must depend upon what the exciting cause of the fit is : if it suggest commencing meningitis the prognosis is necessarily bad ; if there is hyperpyrexia and commencing pneumonia it is very grave. Convulsions following on some exhausting disease, as diarrhœa, are mostly fatal. Convulsions associated with laryngismus are always serious, and the prognosis must be very guarded. In those cases where the fits in young infants are frequently repeated, it must be borne in mind that they may prove to be epileptic or associated with mental deficiency, and a guarded prognosis must be given. If there is reason to believe that the convulsions are due to dyspepsia or are symptomatic of rickets, the prognosis as far as the cerebral development of the child is concerned is good, but there is always the risk of its dying in a fit.

Diagnosis.—The exciting cause of the convulsions may be difficult or impossible to determine. Convulsions in infants shortly after birth may be due to a hypervenous state of the blood resulting from congenital heart disease or atelectasis, or to a meningeal hæmorrhage, which has taken place during birth. Much more commonly the fits are due to some digestive disturbance, especially if the infant is being artificially nursed. In infants over six months old, with the symptoms of rickets, the fits are in all probability reflex and due to some alimentary troubles such as flatulence, or griping in order to expel undigested curd ; but the possibility of their being due to commencing meningitis or to the presence of tubercles in the brain must always be borne in mind, even in the case of fat, healthy-looking infants. Vomiting, irregularity or hesitation of the pulse-beat, or an unnatural softness of the abdomen would suggest meningitis. The possibility of the convulsions in infants being followed by a hemiplegia or a paralysis of one or more limbs must not be forgotten. In convulsions in young children the chest should be carefully examined and the temperature taken, and the skin inspected to ascertain the presence or absence of a rash. In frequently recurring fits there is a possibility that the child may grow up mentally deficient, and a careful inquiry should be made as to the child's intelligence.

The fact that infants often suffer from one-sided convulsions, or that the convulsion begins on one side, must not be taken to indicate that there is brain disease of the opposite side, inasmuch as reflex convulsions due to intestinal irritation may be one-sided in the first instance.

Morbid Anatomy.—Convulsions *per se* leave no trace in the dead body, though usually there are the signs of death from asphyxia, the latter being most marked in those dying suddenly in strong health. The veins on the

surface of the brain are full of dark blood, there are punctiform or larger hæmorrhages, and the brain may be unusually full of blood and wet from excess of cerebro-spinal fluid on the surface and in the lateral ventricles; but these conditions are due to death taking place through stasis of blood in the lungs and a consequent engorgement of the general venous system. The *post-mortem* examination of the state of the cerebral vessels gives us no clue to their condition, whether of engorgement or anæmia, during the fit itself, except such as are produced by venous obstruction. In many cases the autopsy throws no light on either the cause of the fit or the conditions which accompanied the fit. In others the appearances of commencing bronchitis or pneumonia or acute intestinal catarrh may be found. Difficulties are, however, likely to be met with at the *post-mortem* in distinguishing between early pneumonia and the sodden and œdematous lung often present which is due to the manner of death—namely, asphyxia from obstruction to the entrance of air into the larynx.

In making an examination for medico-legal inquiries as to the cause of death, whether from a convulsion or from some other cause, great caution must be exercised in coming to a conclusion, especially in infants. An infant may have been 'overlain,' i.e. suffocated beneath the bedclothes in consequence of the mother going to sleep with the infant at the breast, the mother perhaps alleging that the infant had died in a fit. In both cases the after-death appearances may perhaps be much alike—namely, those of death from asphyxia. In many cases, however, a distinction may be made between a rapidly produced asphyxia as in death from a fit, and a more slowly produced asphyxia, as in slow suffocation beneath the bedclothes; in the former the lungs are simply gorged with dark fluid blood, in the latter case the lungs are sodden and œdematous, containing a large amount of frothy fluid. In any case where the tongue is held between the teeth and has been injured, and there are signs of rickets, the lungs gorged with dark fluid, and the veins on the surface of the brain overfull, there is a strong probability that the child has died in a fit. It must not, however, be too hastily assumed that a convulsion has not been the cause of death because the typical signs of asphyxia are not present; death appears to take place in some cases probably through the nervous system, before asphyxia and not from asphyxia.

Treatment.—The treatment of convulsions must necessarily be chiefly directed to removing the cause. During the convulsion itself, if there is a high temperature (104°–106°), no time should be lost in placing the infant or child in a tepid bath and pouring cold water over it and into the bath in order to lower the temperature, which is probably exciting the convulsions, and it may be also necessary to give antifebrin or quinine. In reflex convulsions in a robust child, especially if there is colic or abdominal disturbance, a warm bath, or a mustard bath so as to redden the skin, is likely to prove of service, or the child's socks may be wrung out of mustard and water and placed on the feet, or hot flannels may be placed on the abdomen. If there is reason to suppose the convulsions are due to cerebral disease, or the convulsions come on at the end of an exhausting illness, the warm bath is not likely to be of any service and may be injurious. If the child has taken any indigestible food, which is lying in the stomach or in the bowels, an emetic or one or two grains of calomel should be administered

according to the effect desired. If the gums are swollen and tender, an incision, or simply scarifying them, will often do good. If there is otitis, it may be well to puncture the membrane.

The inhalation of a few drops of chloroform or nitrite of amyl will usually check the violence of the convulsive spasms, and should certainly be tried if the convulsions last any time or are violent. Of medicines which diminish the irritability of the nervous centres, the bromides, chloral, and belladonna hold the first place. Bromide of potassium or sodium must be given freely if the convulsions recur time after time. If the child can swallow, three to five grains may be given to an infant of six months to a year old, and repeated every hour or two for several doses, according as the convulsions are present or not ; smaller doses, less often repeated, should be given if improvement takes place. No harm is likely to ensue by pushing the bromide. The bromide may be given by the rectum if necessary. Chloral is in some cases more useful than bromide, but it must be used more sparingly ; a two- or three-grain dose may be given to an infant under a year, and repeated in an hour if the convulsions are still present, but its soporific effect must be watched. Chloral, we are inclined to think, is more useful than bromide in convulsions due to colic or whooping cough. Bromide, chloral, and cannabis indica are often given in combination with advantage in convulsions. (F. 88, 89, 90.) Cold to the head in the form of ice or wet cloths should be used if meningitis is suspected, and the infant should be carefully protected from all excitement. In severe and continued convulsions in an infant or child over 6 months, an injection of morphia $\frac{1}{100}$ gr. to $\frac{1}{50}$ gr. is often of great service.

Convulsions in infants a few weeks old, who are artificially fed, are due in the large majority of cases to dyspepsia, and no time should be lost in procuring a wet-nurse, or at any rate in giving the infant the most suitable food that can be procured. The bromides will have but little effect in stopping the convulsions as long as acute dyspepsia or colic is present.

Tetany

The term ' tetany ' is applied to a form of tonic spasm, mostly affecting the extremities, which, like spasm of the glottis, consists in a reflex contraction of a group of muscles, the result of irritation in some distant part. Tetany may affect both children and adults, though it is commoner before the age of 3 years than after this period. It is mostly associated with rickets, in this respect resembling convulsions and laryngeal spasm ; it frequently occurs in connection with laryngismus. It rarely makes its appearance in healthy children, but in those who have suffered from some exhausting disease, especially some affection of the alimentary canal, as diarrhœa or acute enteritis ; prolapse of the rectum may be an exciting cause. Difficult dentition appears to be an occasional cause. One of the most severe cases we have seen was associated with a fatal attack of acute enteritis. It has been observed in rare instances as an early symptom in pneumonia and other diseases, in this respect resembling convulsions, and tonic contraction of the muscles at the back of the neck. It has sometimes prevailed

epidemically among schoolgirls, but in such cases the muscular contractions were no doubt due to hysteria.

Symptoms and Course.—The attacks consist in spasms of the muscles of the extremities, more especially of the forearms and feet. There is no loss of consciousness, and usually no spasm of the facial muscles, though there is mostly an expression of pain on the face when the cramps come on. In the severer cases the arm is adducted at the shoulder and fixed to the side, the elbow is flexed at right angles, the forearm pronated, the wrist flexed, the thumb turned in, while the fingers are in the position of interosseous spasm, forming what is known as the 'accoucheur's hand'; in other cases the fingers are spread out (see fig. 124).

In the lower extremities the foot is in the position of talipes equinus or equino-varus, the plantar surfaces being hollowed out and the toes bent. The knees may be semi-flexed and the thighs adducted. The muscles of the calf are hard and rigid, feeling as if gathered up into a ball. There is usually

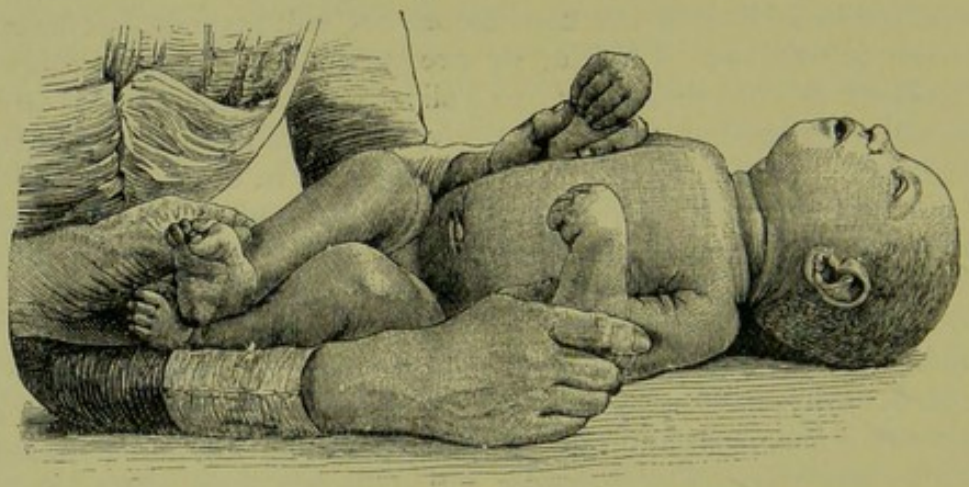

Fig. 123.—Tetany affecting limbs, also muscles of neck.

œdema of the dorsum of the feet and hands, from interference with the venous circulation.

The contractions are evidently painful; the infants scream when they are handled or interfered with; the spasms may intermit, but usually last a considerable time. In rare cases, notably those recorded by Cheadle, the muscles of the face are thrown into spasm; in other cases the muscles of the jaw, abdomen, neck, and back have been affected (see fig. 123). More commonly the spasm is confined to the hands and feet, or the hands only may be affected. The spasm lasts from a few minutes to many hours or even days, then disappearing and perhaps appearing again. Most of the muscles of the body are in a condition of irritability, especially those of the face. This is evidenced by the readiness with which they contract when the facial nerve is irritated. If the finger be passed smartly over the angle of the mouth, a sharp contraction of the levator follows: or the finger is brushed across the outer side of the orbit, and a contraction of the orbicularis ensues. This 'facial phenomenon,' however, is not peculiar to tetany.[1] The same irritable

[1] J. Loos, M.D., *Wiener klin. Wochenschr.* No. 49, 1891; 'Laryngismus,' Dr. W. Gay, *Brain*, January 1890.

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condition of muscles can sometimes be demonstrated by compression of the large nerve trunks of the arm, which may give rise to muscular spasm in the hands and fingers. This is sometimes referred to as 'Trousseau's phenomenon.'

Tetany never threatens life *per se*, as it only affects the muscles of external relation, though the child may die from the effects of the gastro-enteritis, of which the muscle cramps are only symptoms. The only case which terminated fatally, which we have seen, was that of a boy aged 6 years, who died in a few days from the effects of a gastro-enteritis; the principal symptoms were constant vomiting, cramps in the stomach, and tetany of both upper and lower extremities. The *post-mortem* showed the brain and cord to be normal to the naked eye; the mucous membranes of the stomach and intestines were injected, and evidently in a state of acute catarrh. In another case, somewhat similar, Hadden could find no changes in the cord.

Fig. 124.—Tetany of the Hands and Feet (from a photograph by Dr. L. W. Crowe).

Tetany is apt to return from time to time after a considerable interval; this may be noticed in cases received into hospital: these mostly get well quickly and go home, but in another week or two are as bad as ever.

Diagnosis.—Tetany may be mistaken for cerebro-spinal meningitis, but it can only thus be mistaken when the constitutional symptoms accompanying the tetany are severe. In tetany there is an absence of cerebral symptoms as well as of vomiting and fever. In tetanus the spasm of the masseters is an early symptom; it is absent in tetany, or comes on late in the attack. The position of the fingers is different in the two diseases. In girls or older boys hysterical contraction might resemble tetany, but the former usually affects one limb, or an arm and a leg only, while the latter is always bilateral.

Treatment.—The treatment must be directed in the first place to the exciting cause. A dose of calomel or grey powder should be given if there is any gastro-intestinal disturbance, or undigested food lodging in the intestinal tract, and the greatest care be taken to give only the blandest food. Warm baths may be given to relieve the spasm, and hot laudanum fomentations applied to the hands and feet. Bromide of potassium is likely to relieve the symptoms if given in full doses. Chloral, belladonna, digitalis, and

Calabar bean have all been used with benefit. Cheadle found the $\frac{1}{36}$ to $\frac{1}{30}$ dose of Calabar bean of use in one case.

Nystagmus.—Nystagmus is common during both infancy and childhood and accompanies very different conditions. It usually consists in short rapid oscillations of the eyeballs in a lateral direction, the head sometimes moving also. In some cases the ocular movements are vertical instead of lateral. It may be present in congenital cataract, tumours of the brain, hydrocephalus, and hereditary ataxia ; but it is also present in children who are not suffering from any organic disease. It may be present in some forms of clonic spasm of the neck.

Head-nodding and **Head-shaking,** going on constantly as they sometimes do in infants and young children, are the result of a chronic reflex spasm of the sterno-mastoids, either both acting together and making a nodding movement, as in expressing assent, or acting alternately and shaking the head as if expressing dissent. The movements may be constant or intermittent, perhaps ten or twelve times a minute. Nystagmus may be present. These curious spasmodic affections appear to be allied to laryngismus. Dr. S. Gee records an instance of this association, and in one case of 'head-nodding' mentioned by A. Baginsky, the child suffered later from convulsions and laryngismus. Head-shaking in older children Dr. S. Gee connects with epilepsy. The prognosis is good ; like laryngismus, these affections appear to be due to some reflex irritation in the alimentary canal or to dentition, and mostly occur in rickety children.

'Head-banging' in children has been described by Dr. S. Gee. It consists in a peculiar habit, to which some children are liable, of turning over on to their face at night and banging their heads into the pillow. Dr. Gee records three cases : two of these were $2\frac{1}{2}$ years of age, and one was 5 years. One child used constantly, nearly all night, to bang his forehead into his pillow. No cause was found to account for this strange habit. It appeared very intractable, but one child much improved whilst living in the country.

Hysteria.—Functional nerve disturbances, in the form of sensory derangements, paresis, contractures, or eclampsia, are by no means uncommon in children. Hysteria when it occurs during early life mostly affects girls, but it occurs also in boys ; the approach of puberty is the most common period.

A tendency to hysteria runs in families, and is transmitted from parents to children, but the foolish way in which children are often brought up, their weaknesses pampered and their ailments intensified by injudicious sympathy, often tends to aggravate an hereditary disposition to nerve disorders. While it most frequently happens that hysterical children come of neurotic families and belong to the well-to-do classes, yet such children may be found in country districts among country folk, where neurotic tendencies might be least expected. 'Fasting girls' who have had a temporary notoriety, 'cataleptics,' and religious maniacs have been found in cottage homes and among surroundings that one would have supposed were little likely to foster hysterical affections.

Hysteria in its milder or severer forms is often associated with other diseases, such as epilepsy, chorea, and various mental affections ; it may also

be engrafted on to organic brain disease, such as meningitis or some spinal affections. Hysterical phenomena are rare before the age of 6 years and are most common about puberty, especially in those cases where menstruation has failed to become established.

Symptoms. Sensory Disturbances.—Perhaps the most common form of hysteria in girls is hyperæsthesia ; there is a complaint of tenderness or pain which cannot be accounted for except by neurosis. There is some local tenderness about the spine or one of the joints, especially the hip, the girl screaming with pain when the joint is moved ; the thyroid gland or front of the larynx is sometimes hypersensitive. Headaches are very common : these may be frontal or occipital, or may take the form of the 'clavus' of adults. Hysteria is apt to mimic various diseases which are normally accompanied by severe pain, such as peritonitis, pleurisy, rheumatism ; it must, however, be always borne in mind that there may be some actual disease present, and that the sensory disturbance is only an exaggerated condition of what would normally exist.

Fig. 125.—Hysterical Spastic Hemiplegia.

Anæsthesia is much less common in children than hyperæsthesia ; but hysterical hemianæsthesia, in which the special senses are involved, occasionally occurs. Sleeplessness is not uncommon ; the patients assert that they cannot sleep, and only perhaps doze off when it is time to get up.

Motor Disturbances. — Paralysis, or rather paresis, is common; the larynx is perhaps most frequently affected, but paraplegia is not infrequent. Hysterical aphonia in girls has the same characters as in adults : there is loss of voice, the patient always speaking in a whisper ; sometimes the voice is entirely lost. We have seen once or twice a condition of hysterical hypotonia or flaccidity of all the muscles of the body. The child was semi-conscious, slavering, and all the muscles of the body were soft and flabby as if paralysed after a series of fits. Recovery may take place quickly.

Paraplegia may come on suddenly after a convulsion, or the legs may gradually give way under the child, until she can no longer stand, and is therefore confined to bed. There may be loss of sensation, but in our experience this is uncommon. The loss of power is never complete : the

patient moves the legs in bed, and often some attempt will be made to stand with help, or she may draw up the legs to prevent them touching the ground, and will sink to the ground rather than support her own weight. The electrical reactions are normal, and usually the knee-jerk is also normal, and there is no ankle-clonus. In other cases, more especially those which have lasted some time, there is more or less tonic contracture of the legs; the hip and knee joints are semi-flexed, and the foot takes the position of equino-varus. In this condition, if the spasmodic contraction is not too marked, there may be excessive knee-reflex, and ankle-clonus may be present; if there is marked contracture, no knee-reflex can be obtained on account of the rigid contracture of the opposing muscles. The contracture is present during sleep, but usually goes off when the patient is under chloroform.

Hemiplegia is perhaps less common. In one of our patients, a girl æt. 7 years, there was a history of a fright from a cat jumping on her bed; immediately after the right arm and leg were affected. The elbow became bent, the wrist flexed and fingers bent over the thumb; the right leg was similarly affected, but in less degree. The flexor muscles were in a constant state of spasm, except during sleep, when they were relaxed (see fig. 125). When the girl's attention was directed away from herself, she would use the arm to some extent, raising her hand to her mouth or head.

In hysterical paraplegia there is no incontinence of urine or fæces; this is certainly the rule, but retention of urine will occur, and in some conditions, such as 'hysterical chorea,' both urine and fæces will at times be passed involuntarily. We have seen on various occasions girls who were suffering from hysteria, simulating hip disease or peritonitis, pass their water in bed, so that the bed and linen have been saturated with stinking urine, rather than use a bed-pan, as they were afraid of being moved on account of the pain it caused. In such cases bed-sores may form and the patient become emaciated. Meteorism is not common. We have seen one case, which we believe was hysterical, in which for months the patient's abdomen was enormously distended. She suffered no pain and the bowels acted well, but the intestines were always greatly distended with gas.

Convulsive Attacks.—These are of the usual hysterical type. There is a fit of screaming or crying or violent laughter, tonic contraction of the muscles, more especially of the back, so that opisthotonos is produced; the arms and legs are dashed about, and the head perhaps made to strike the pillow or bed violently. The patient remains conscious during the attack, and she rarely injures herself, and the tongue is not bitten. Epilepsy and hysteria are apt to alternate in the same patient.

Mental Symptoms.—Hysteria is closely allied to some forms of insanity, and various forms of hysterical insanity occur in girls about puberty. One of the commonest of these is a refusal of food. The girl's appetite becomes poor, she gradually grows thin, and this excites the sympathy and alarm of her friends. The morbid craving for sympathy becomes intensified. She resists all their entreaties to take food, and clenches her teeth when it is offered, or only takes the smallest quantities, and frequently is guilty of deceit, concealing food in her clothes. She gradually wastes till she becomes a perfect skeleton, the skin is rough and harsh, the abdomen flattened, and

the breath foul. Bedsores not infrequently form. In other cases, though refusing all food at meal times, she will surreptitiously obtain cakes or confectionery, which she will eat readily. In some of these cases there is melancholia or eclampsia. Morbid conscientiousness is sometimes present; the girl perhaps takes away marks from herself at school, or accuses herself of having told untruths or of having stolen her schoolfellows' things.

Vomiting and *spasm of the pharynx* are not uncommon; one or other of these may be present for months and lead to wasting. Usually the food returns at once or within a few minutes of taking. Sometimes the food will be retained, but there is nausea and retching.

Diagnosis.—The first step in diagnosis is necessarily to attempt to exclude organic disease which hysteria so often mimics. In sensory hysterical disorders, such as headaches, and in various forms of paralysis, the question is whether or not there is cerebral or spinal disease. Probably the commonest mistake is to assume that organic disease exists when the condition is one of hysteria only; but, on the other hand, we have known the symptoms in the early stages of a cerebral tumour attributed to hysteria. It is often necessary to wait before a definite diagnosis can be arrived at. But it is always necessary to bear in mind that an organic lesion may exist and yet undoubted hysterical symptoms be present. Some of the cases of paralysis of the spastic type which relax during sleep or under chloroform are very difficult cases for diagnosis. They improve from time to time and are called hysterical, but they remain uncured in spite of treatment. Insular sclerosis is very difficult to distinguish from a hysterical spastic paralysis, but it is rare in early life.

Treatment.—The treatment of hysteria in its various forms is principally moral. The management of the patient must pass from the parents to a suitable nurse, or, better still, the patient should be removed to hospital or into lodgings away from her friends. If once the child is under firm control, is deprived of the morbid sympathy it craves for, and is at the same time encouraged to put forth all its voluntary power, an improvement in its condition will immediately begin. In cases of paralysis, in addition to isolation from the parents and all sympathising friends, massage and faradisation are of much advantage. The patient must be made to use the weakened limbs in moderation, and encouraged to believe that they will get entirely well.

In less severe cases change from city to a healthy country life is of great importance. Life at a farm with its many outdoor attractions and occupations is perhaps the best adapted for hysterical children. Effort must be made to interest them in many things outside themselves in order to break the vicious habit of dwelling inordinately on their own feelings and ailments. In many of these cases the general health is poor and menstruation delayed. In such, iron in the form of bromide of iron, as in Fletcher's syrup, is useful, while the bowels should be regularly acted on by small doses of aloes, or some mineral water such as Rubinat or Hunyadi Janos.

Headaches. — Children, especially girls of 7 years of age on to puberty, are very liable to headaches, sufficiently severe to lay them up for part of a day or perhaps longer. These headaches may arise from various causes, and it is important to try, if possible, to ascertain their origin; diagnosis is frequently by no means easy, as pain is referred to the forehead

in many different morbid states and conditions. Frontal headache is by far the commonest form of reflected pain. It is important in the first place to exclude hypermetropia as a cause of frontal headache. Straining the accommodation of the eyes, especially when the subject is below par, may give rise to frontal headache, aching being referred to the eyeballs, while at the same time, when an attempt is made to read, the letters run together and the eyes easily water. A diagnosis is easily made with the ophthalmoscope, examining the retinal vessels by the direct method, as well as by the use of test types.

Headaches are very common in rapidly growing children, who are, to use an ordinary expression, 'outgrowing their strength.' Such headaches may be due merely to weariness or to the irritable state of the nerves which comes on when over-tired or fagged ; or they may be due to anæmia or dyspepsia. The latter is probably the most frequent cause. The appetite may be good or capricious, more food is taken than the digestive organs can cope with, and dyspepsia or a subacute gastric or intestinal catarrh is the result. A sick headache is complained of, the child looks heavy and dark about the eyes, there is nausea or actual vomiting, perhaps some fever, and it takes a day or two to regain the ordinary state of health. Headaches due to overwork of the eyes and brain are especially common in schoolboys and girls when preparing for examinations and taking too little exercise and recreation. With the headache there is often sleeplessness at night, anæmia, and more or less dyspepsia. There is usually no difficulty of diagnosis here, as the history of the case will render its nature plain.

There is a form of headache which is by no means uncommon, which is distinctly neurotic, and which does not appear to be connected in any way with dyspepsia, sluggish liver, overwork at school, or organic disease. The child is usually a girl of 10 or 12 years of age, who suffers with a severe headache, often accompanied by sickness, once or twice a week, perhaps oftener, which comes on at irregular times, and is sufficiently severe for her to take to bed or lie on the sofa for most of the day, and to incapacitate her for all work or play. Such headaches are made worse by noises and exertion ; at times there is violent sickness or retching, and perhaps giddiness in the erect posture. The bowels are usually constipated, the tongue clean, and in the intervals between the attacks the child is in good health and able to go to school and take moderate exercise. The causes of such headaches are very difficult to discover ; a tendency to such is often hereditary, and, while worse during the period of puberty, the tendency may remain throughout life. They are often very obstinate, and medicine fails to relieve as long as the patient remains at home, leading a sedentary town life ; they are almost always better during the holidays spent away at the seaside, or whilst leading a healthy country life, but recur again when a return is made to town life, with school and the ordinary home routine.

In some other cases the headaches are more distinctly hysterical, the pains being described as of a 'shooting' or 'boring' character, and coming on when the spirits are depressed or when there is some unpleasant duty or distasteful study to be undertaken. On the other hand, all headaches are forgotten if the patient is roused by some excitement or the prospect of some unusual pleasure. When the headache is present, the patient demands the

sympathy of all her friends, and is apt to lapse into a chronic invalid, expecting to receive the commiserations and attentions of the whole household. She objects to exertion of any kind ; the least noise or loud talking brings on the headache. The appetite perhaps becomes poor, she becomes thinner, and the whole health suffers, or, on the other hand, in some cases the appetite is not affected. These hysterical headaches are commonest at or about puberty, when menstruation is commencing, but they may be present in boys and in girls of nine or ten years of age.

The most important question in connection with diagnosis is with regard to the presence or absence of organic disease. Are tubercles forming in the meninges of the brain? Is there a cerebral tumour, or are the headaches either reflected from the digestive system or purely nervous in character? The diagnosis between cerebral disease and functional disease is usually not difficult if the history given by the friends can be relied upon, or if there is an opportunity of watching the patient for a few weeks. The headache accompanying the early stages of tubercle of the meninges is associated with irritability, wasting, hectic fever, loss of appetite, shivering, and cough ; and a few weeks more or less will almost certainly see developed more marked cerebral symptoms, such as squint, vomiting, and involuntary passage of fæces. The headache due to cerebral tumour is mostly constant, though worse at times than at others ; it is always made worse by movement ; there are erratic and apparently causeless vomiting and optic neuritis.

In all cases of persistent headache it is necessary frequently to examine the optic discs for any evidence of optic neuritis. We have known several cases in which headaches were after a while accompanied by optic neuritis followed by loss of sight and without any definite cerebral symptoms—the headaches getting well in the course of many months, but there was blindness from optic atrophy.

Treatment.—The treatment of headaches is naturally directed to removing the cause. In rapidly growing children it will mainly consist in the avoidance of over-exertion or fatigue, and in ordering a very moderate amount of brain-work, a healthy country life, and a careful regulation of the diet. The digestive organs are probably being given more work than they are able to perform, a gastric or intestinal catarrh is set up, and the disordered state of digestion is expressed by a frontal headache. Vomiting in these cases nearly always relieves the headache ; if it does not take place, perhaps there may be feverishness, nausea, and headache for a day or two. When these headaches are coming on, the simplest and best remedy is an emetic such as a teaspoonful or two of ipecacuanha wine, to be followed by a little judicious starvation or the lightest possible diet for a few days. For the avoidance of such sick headaches meat should be allowed only in moderate quantities ; it must be well cut up and masticated slowly, and care should be taken to regulate the bowels from time to time with some effervescing citrate of potash, Rubinat or Carlsbad water, before breakfast. In the neurotic forms of headache, arising independently of digestive derangements, the treatment is often very unsatisfactory. When the attack comes on, and is evidently severe, bed is the best place, with a wetted handkerchief to the head in the hope of getting the child to sleep ; coffee, effervescing citrate of caffeïn (1 to 2 grains of the pure salt), monobromide of camphor

(1 to 2 grains), ext. guaranæ liq. (10 to 15 drops), ext. cannabis indicæ, or bromides are often beneficial. Phenacetin (2 to 5 grains) has been used with good effect. In the intervals between the headaches the most important treatment relates to regulating the bowels and to insisting on a simple but nutritious diet. In some cases good has followed the entire avoidance of butcher's meat (Haig). A healthy country life or change of scene is often of the greatest service and generally effectively cures, for a while at least. In hysteriçal headaches the patient should be encouraged to take an active interest in some work or play.

Night terrors.—These attacks are allied to hysteria and are common in neurotic girls and boys. The child, who has perhaps been sleeping quietly for a few hours, suddenly sits up in bed, its face the picture of horror and fright, while it shrieks and points at some imaginary object. The appearance of the friends on the scene does not pacify it; it cannot be aroused, but continues to be affrighted by some apparition. After a while it wakes up or goes off quietly to sleep again, and in the morning knows nothing of the night's disturbance. These attacks occur several times during the same night, or there may be weeks without an attack. Whenever night terrors occur, the child's diet should be carefully regulated, especially as regards the evening meal. Any indigestion should be treated; a dose of bromide at night may be given. The prognosis is good.

CHAPTER XXV

DISEASES OF THE NERVOUS SYSTEM—*continued*

Speech Anomalies

DURING the first year of life the infant does not make much progress in understanding what is said to it, nor is it able to express itself by means of intelligent speech. A cry is the first sound uttered by the infant; it is a reflex act, the stimulus being some form of discomfort or pain. Within the first two months (five weeks, according to Preyer) variations in the tone and strength of the cry occur, indicating pain or hunger or impatience. Later still the cry becomes more distinctive and expressive, and the cry of anger or disappointment may be distinguished from the cry of hunger. Smiling may be observed by the end of the second month or earlier (twenty-third day, Preyer), but really noisy laughter is not heard till several months later. Other facial expressions, such as frowning, rage, sulkiness, are noted later in the first year. From the earliest months the infant 'babbles' or 'crows when pleased or in a good humour; this doubtless is a sort of instinctive exercise of the speech organs. It seems to take a pleasure in exercising its organs of speech, in much the same way that it derives pleasure from lying on its back and kicking vigorously in an aimless sort of way. Both consonant and vowel sounds are produced in great profusion, but in an irregular and inco-ordinate fashion. Preyer noticed that in one of his babies all the vowel sounds and all the consonant sounds were used during the first seven months except *w*, *s*, *z*, *f*, and *sh*; all the latter were postponed till the second year. By the end of the first year some of the easier consonant sounds, such as *mam-mam*, *ba-ba*, *dada*, *na-na*, are repeated in a meaningless fashion, but before long they are applied to persons and things. Some of the earliest sounds acquired are those made by domestic animals, and the child quickly uses the sound to name the animal. The understanding of spoken words precedes by some months the ability to express ideas in language. In answer to a question the child will use 'gesture language' in preference to articulate speech. It will point to the object named or express assent or dissent by nodding or shaking its head. Many feeble-minded children, and also many of the lower animals, as the dog, will understand spoken words, but have not the power of expressing ideas in words. During the second year the vocabulary increases fast, the child quickly imitating and repeating the word it hears, so that by the end of the second year it not only uses a number of words correctly, but can string a few nouns and adjectives together, and has learned the meaning of short phrases. Thus we find such

short sentences used as '*Kennie come in mummy's bed*,' or '*Kennie no liky pudding*.' At this period, and for the next year or two, words are indistinctly or improperly pronounced, with a tendency to clip them short or to drop consonants. Some consonants present greater difficulty to the young child than others, and are constantly dropped out of words ; thus *s*, especially when it precedes another consonant, is omitted, as *cool* for *school*, *kwēk* for *squeak*, *nō* for *snow*. Difficulties often arise with the *th* and *sh* : *Ruth* becomes *Roof* ; the vibratory consonant *r* is a great stumbling-block, and the distinct pronunciation of it is, perhaps, never acquired : *grub* is apt to become *gwub*, and *roof*, *woof*.

To learn to speak intelligently there must be :

(*a*) A perfect hearing apparatus to transmit the vibrations of sound to the auditory centre ; (*b*) An auditory centre which translates vibrations of sound into ideas ; (*c*) 'Think organs' or perceptive centres ; (*d*) Motor speech centre (Broca's convolution) ; (*e*) Speech apparatus for converting motor impulses into articulate speech.

Some children are more backward in talking than others, and are at the same time behindhand with walking and cutting their teeth, and it is only after the end of the second year is passed that they begin to make progress. This frequently happens with rickety children, or those who have had some serious disease to contend with. Other children not only do not begin to talk when the usual time arrives, but as months and years go on make no attempt, or their articulation is indistinct and imperfect for their age. In another but smaller class the child learns to talk fairly well or imperfectly, then an illness comes on and it loses the power of speech. The principal causes of imperfection or absence of speech may be tabulated thus :

1. The child may be deaf ; it is mute because it is deaf (*a*).
2. The child does not speak distinctly ; there may be some defect in the organs of speech (*e*).
3. The child is feeble-minded ; the 'think' organs are at fault (*c*).
4. There is motor or auditory aphasia (*b* or *d*).
5. There is 'stammering,' due to failure of co-ordination.

1. **Deaf-mutism.**—Deaf-mutes are those who cannot speak because they cannot hear : the deafness may be due to hereditary defect, or they may become deaf through illness before they have learnt to talk ; as a rule, if the child becomes deaf before he is 7 years of age, dumbness results. The **primary** variety appears mostly to be the result of hereditary taint, congenital deafness having occurred previously in the same family. It is doubtful if the marriage of cousins has anything to do with it. The morbid anatomy is very uncertain, as the *post-mortem* records are few ; in such cases there is probably a failure of development of certain nerve centres. How early is it possible to detect deafness? The diagnosis is necessarily very difficult during the first few months of life, especially when we remember that congenital deafness is rarely complete, the ringing of bells, whistling, &c., being heard when the ear is quite incapable of detecting articulate sounds. During the first few weeks after birth the healthy infant gives no response or signs of recognising sounds, but loud noises will wake it up. It is only during the third or fourth month that the infant appears to recognise sounds and voices, but, as some infants are more backward than others with

regard to perceptions, it is only after 6 months, or from that to a year, that a definite knowledge can be come to with regard to deafness. When the infant is a year old, and has never uttered an articulate sound, while it shows no want of intelligence in other ways, and its muscular power and growth are in accordance with the normal standard, there is strong reason to believe that its speech defect is due to deafness. The diagnosis between a failure to speak due to partial deafness or failure on account of mental feebleness is often extremely difficult, perhaps, in certain cases, for a time impossible, in the absence of other signs of mental defect. The infant may be tested by means of a loud whistle, bell, or clapping hands, care being taken that it cannot see the performer, while its face is watched for any sign of recognition on its part. A confident opinion cannot well be given before the sixth month, often much later. Parents will often not detect deafness till the child is much older than this. On the other hand, parents will constantly assert that a feeble-minded infant is deaf or blind.

In the following case the diagnosis was very difficult at first :

Annie M. C., 2 years 9 months. First child, healthy infant, took notice in the usual way at 2 or 3 months old, sat up at 6 months, late in walking at 15 or 16 months. She 'jabbered' and 'babbled' like any other infant; at 9 or 10 months said '*dad dad*,' '*mam mam*,' '*bab bab*'; at 12 months said '*dada, dada*,' '*ya, ya*,' '*mam, mam*,' and later called her cousin 'Sam' '*am, am.*' Some difficulty in teaching her cleanly habits. The child when tested is absolutely deaf, cannot hear loud whistles or voices.

Presumably the articular sounds made by this child were the result of 'instinct' aided by watching the lips of its friends. Many deaf-mute children seem to delight to make shrieking or other unpleasant noises with their vocal organs.

Testing the hearing of some mentally defective children is often very difficult. They will not pay attention to the whistling and 'cat-calling' which goes on for their benefit, and it is easy to conclude that they are deaf, when as a matter of fact their attention is riveted elsewhere.

Acquired Deaf-mutism.—When a child under 7 years loses its hearing in consequence of disease, its speech becomes indistinct and more or less unintelligible, and it loses the power of speech altogether, either quickly or gradually, according to its age and intelligence. The loss of speech will necessarily depend to some extent upon the amount of deafness. According to Hartmann, it is possible, if the child is intelligent, and great care is taken to correct its mistakes in talking and to induce it to talk, that speech may be retained.

The lesion which commonly produces deafness is an inflammation of the labyrinth, either idiopathic or secondary to meningitis, scarlet fever, typhoid, or whooping cough. The difficulty of distinguishing between labyrinthitis and meningitis has already been pointed out, and consequently the extent to which deafness is produced by one or the other is uncertain. Attacks of cerebro-spinal meningitis undoubtedly frequently produce deafness, as does also scarlet fever. In this country scarlet fever plays a more important part than other diseases in destroying the auditory apparatus. Hartmann believes that an inflammation of the labyrinth and consequent injury to the terminal apparatus of the auditory nerve, and not suppuration

in the middle ear, is the cause of deafness ; though the latter frequently takes place, it is not necessarily present. A naso-pharyngeal catarrh seems to be an occasional cause of labyrinthine disease. Hereditary syphilis is not an uncommon cause of gradually increasing deafness about puberty.

The hearing power of deaf-mutes is usually tested with a bell and tuning-fork, the two ears being tested separately. Statistics collected by Hartmann show that in 865 cases of deaf-mutism in different institutions 60 per cent. were totally deaf, about one-fourth (24·3 per cent.) heard sounds such as the ringing of a bell, while 15 per cent. heard words or vowel sounds when pronounced loudly close to their ears.

2. **Physical Defects in the Mouth.**—Parents not infrequently bring a child to consult a medical man with regard to his backwardness or indistinctness in speech, which is attributed to his being tongue-tied or to some deformity of the mouth or palate. In the majority of such cases no physical defect can be detected, the defect being rather in the nervous mechanism of speech. It is possible that a more than usually attached frænum may interfere, however slightly, with the movements of the tongue, and explosives of the second stop position, *t*, *d*, *s*, may be badly pronounced. It is doubtful if a highly arched or deformed palate renders speech imperfect, and it must not be forgotten that weak-minded children often have high palates, but their defective speech is due to mental feebleness. Defective speech is present in those with large tonsils and post-nasal adenoids ; there is a characteristic 'stuffiness' about the voice, and difficulties with the nasal resonants *m*, *n*, *ng*, inasmuch as in the pronunciation of these the air is allowed to escape through the anterior nares. Paresis of the soft palate may be present, especially after diphtheria, the voice having a nasal twang and difficulty being experienced in pronouncing the explosive labials *p* and *b*, as the air escapes into the nasal cavity, the soft palate failing to act.

Cleft palate, paresis of the soft palate, deficient teeth, and well-marked adenoid overgrowths are practically the only physical defects in the mouth likely to interfere with speech. It must be borne in mind that for years after a successful operation for cleft palate, the speech may remain defective unless special pains are taken to overcome the defect.

3. **Mental Defect.**—The commonest form of defective speech is connected with the nervous mechanism. The child appears intelligent and bright, no defect can be discovered in the mouth, yet his pronunciation of certain sounds is defective, as if he had not perfect control over his lips, tongue, and vocal cords. He may have especial difficulty with the consonants of the third stop position, as *k* and *g*, while the fricatives *th* and *r* are often great stumbling-blocks. Backward children, or those of intelligence below normal, are especially apt to have difficulties in pronunciation, in other cases the intelligence is fully up to the average. The fault lies perhaps in Broca's convolution. A boy of 8 years whom we examined used the vowels fairly well, but the only consonants he used were *p*, *m*, *t*, *n*, and *w* ; Sam Brown was 'Pam Pown,' &c. ; he could add up simple sums, and write his name, but he was generally backward. He could not pronounce *b*, *d*. All degrees of difficulty of speech may exist : it may be so marked that the child avoids conversation as much as possible, and expresses his assent or his wants by signs. Some children talk a sort of gibberish which

perhaps their brothers or sisters understand, but no one who has not been with them a great deal can make out. Several children of the same family may have defective speech; while there is usually some mental defect the imperfect speech may be by far the more marked of the two conditions.

If, however, instead of imperfect speech the child of 5 or 6 years of age does not talk at all, there is probably some mental defect, the child failing to understand what is said, or although it may understand the speaker, yet there is a failure in the process of converting thoughts into words.

4. **Aphasia.**—Children, like adults, may suffer from aphasia due to organic disease, or from a functional aphasia. In the former the aphasia may be the consequence of embolism of the left middle cerebral artery, and be associated with a right hemiplegia, or a tuberculous tumour may compress the left third frontal convolution.

Functional aphasia is not uncommon and occurs usually after exhausting fevers; as, for instance, in typhoid after the febrile stage is passed many months may elapse before the child speaks. It may occur after pneumonia; thus a child of 2½ years suffered from inflammation of the lungs in October; his mother said his talking left him while getting better. He did not speak a word till the following April, when he said 'Drink'; the following month he began gradually to talk again.

In another case, kindly sent us by Dr. Hodgson of Oldham, a boy aged 2½ years had whooping cough and was convulsed continuously for four hours; he talked as usual for a day or two after this attack, then ceased to talk, though once in his sleep he said 'mamma.' He expressed assent when spoken to and pushed his plate if asked if he would take more food; he appeared to understand what was said to him. He remained in this state without saying a word for two months, then he said a word or two and a day or two after completely regained his speech, and shortly became as great a chatterbox as ever. A boy under our care with spastic paralysis (see fig. 112) could not speak or make anyone understand except by signs, and if asked his name he pointed to where it was written on his bed card or on the lid of a toy box.

The power of speech is lost suddenly at times in consequence of a nervous break-down. Dr. Langdon Down records the cases of two brothers, who had spoken well and understood two languages, completely losing the power of speech at the period of the second dentition.

A few cases of congenital aphasia have been recorded, i.e. children of apparently normal intellect and normal hearing yet unable to talk, and children of 6 or 7 years with inability to talk associated with comparatively slight mental defects are not uncommon.

Treatment of Defective Speech.—The treatment necessarily depends on the cause of the defective speech. Surgical treatment may be required in the first place, enlarged tonsils must be excised and post-nasal adenoids removed, defects in the hard or soft palate must be remedied as far as possible by surgical and mechanical means. Special instruction in articulation, especially directed to the difficult sounds, must then be practised. For this purpose the teacher faces the pupil, showing him by exaggerated movements of his own lips, tongue, or larynx the positions they should assume to form the desired sounds, and practising the pupil in these movements. In fact, the

oral method now so commonly in use for the instruction of deaf-mutes must be practised in all cases of defective speech.

The education of deaf-mutes has received much attention of recent years, and schools are now established throughout the country where their education is carried on on the oral system. By this system the senses of sight and touch are made as far as possible to take the place of the defective sense of hearing.

If the patient has become deaf after he has learnt to speak, everything must be done to assist him to retain the faculty of speech and to discourage the use of sign-language. The child must be encouraged to speak, the words that are wrongly pronounced being corrected as far as possible by showing the child the exact position of the mouth, lips, tongue, or larynx, and by making it repeat the word until it has pronounced it correctly. New words are taught in a similar manner, and by showing the child the objects, or pictures of the objects, which are the subjects of the lesson.

The instruction of congenital deaf-mutes is usefully commenced at 6 years of age ; before this time it is difficult to fix the child's attention for sufficiently long together ; indeed, many children do not manage to learn much till they are 7 years of age. It need not be said that the training of deaf-mutes in the use of oral language is a tedious and difficult process, requiring a special training and much patience on the part of the teacher. The deaf-mute has not only to learn to speak, but also to understand what is said to him by watching the movements of the speaker's lips. After many years of training the clever deaf-mutes are able to leave school and converse with others sufficiently well to enable them to learn a trade and earn their living. Their speech is necessarily laboured, each syllable is emphasised and the tone disagreeable ; we, however, know one boy of 16 years of age who has been completely deaf since 4 years of age who speaks really well and with a Lancashire accent ! He was taught by the oral method at the Old Trafford Schools, Manchester ; well-educated and intelligent deaf-mutes will notice the difference in the accent of people speaking different dialects, as, for instance, between a Londoner and one hailing from Cumberland.

5. **Stammering** is a speech neurosis which is not uncommon in quite young children before they have learnt to speak fluently, but is much more common during school age. Most of those affected are of a neurotic constitution but mentally bright. Boys are much more commonly affected than girls. The stammering is always worse under excitement, the child has some important news which he is very anxious to communicate at once, there is a flow of energy to the lips or other stop position, then a failure of inhibition at the proper moment and as a result he cannot get the words out.

The immediate cause is a failure of co-ordination of the muscular mechanisms which are thrown into operation when speech is attempted. The mechanisms are the following : (1) The respiratory mechanism supplies the air blast which throws the vocal cords into vibration. (2) The true vocal cords which by their vibration give rise to voice and the false vocal cords which control the exit of the breath (Wyllie). (3) The lips, tongue, and soft palate which supply the stops and mould the voice.

For normal speech there must be perfect co-operation between these mechanisms, contraction and inhibition taking place at the proper time. In

the majority of cases the difficulty is with the initial consonants, especially *p*, *b*, *t*, *d*, *k*, *g*, less often with the consonants such as *l*, *r*, *m*, *n*, *s*, *w*, *y*, with continuous voice sounds and also with the vowels. The stammerer closes his lips to form the stop for *b*, and instead of the closure being momentary—the lips being burst open for the following vowel sound, as, for instance, *oo*—the lips are kept tightly closed, so that the explosion does not take place ; greater and greater efforts are used and the surplus energy overflows into the muscles of the face and into the formation of grimaces. In other cases a series of small explosions take place at the lips without the vowel sound following. The energy is misdirected, being thrown vigorously into the lips, instead of the lips being inhibited and the vowel mechanism being operated. In less common cases the difficulty occurs when a vowel begins the sentence ; here the spasm is at the false cords (Cathcart); there is spasmodic closure at this spot ; the stammerer has his mouth open trying to get out his vowel ; when he has succeeded and has drawn another breath, the difficulty begins again.

In young children stammering comes and goes much according to the state of their general health ; worms or some reflex irritation may play their part in causation ; all such causes of irritation should be removed, but we have less faith in circumcision as a cure for stammering than some authors appear to have ! A bad habit has to be broken, and the process is long and laborious in proportion to the time the habit has been in existence and the extent to which it has been neglected. Lessons of half an hour daily are long enough ; in the first place give exercises in controlling the entrance and exit of air in and from the chest. Ascertain the difficult consonants or vowels and practise them slowly and frequently in appropriate sentences (see APPENDIX). The teacher may well remember the truism that 'Habit is a cable. We weave a thread of it each day, and it becomes so strong we cannot break it.'

Mental Affections in Childhood—Amentia

The word *amentia* implies mental defect arising from a *failure* or *arrest* of development of the brain and covers all forms and degrees of such defect. The terms idiot, imbecile and mentally-feeble are used to distinguish varying degrees of mental failure. It must, however, be constantly borne in mind that there are all degrees of mental weakness from the low-grade idiot to the normal child.

Comparatively little is known regarding the morbid anatomy of the brain in amentia. In one class the nerve cells of the cortex and the association fibres fail to reach their full development, with the result that the child never attains normal mental power. The cause of this is neither failure of the supply of suitable nutrition nor yet disease ; the fault lies in the germinal plasm and the *failure* of development is what is known to biologists as a reversion to some ancestral type. In other cases there is an *arrest* of development, due to toxins in the mother's blood such as syphilis, and the stunted brain bears traces of a chronic inflammatory or sclerotic process. In the former case when the fault lies in the germinal plasm the amentia is called **Primary** or **Hereditary** ; when there is an arrest as the result of disease it is **secondary** or **acquired.** It must not be forgotten

that man's life does not begin at birth, but at conception, and the diseases of intra-uterine infancy cannot be separated from those of extra-uterine infancy. Thus the term primary is applied to that form of amentia in which there is developmental failure ; and the term secondary when the amentia is due to disease occurring either before or after birth. The term congenital, i.e. dating from birth, is best avoided, as it is used in different senses by different writers.[1] One or two important questions remain to be answered. Assuming the sperm-germ inherits from its progenitors a tendency to developmental failure of the nervous centres, is this tendency influenced by the conditions of nutrition, disease, &c. during intra-uterine life ? No doubt the germ with abnormal tendencies is as subject to disease as the normal germ, and probably some cases of amentia are both primary and secondary. How far these tendencies are aggravated by maternal malnutrition or nervous shock is a more open question.

But besides developmental failure during intra-uterine life there are those which *appear* to develop normally for months or years and then a gradual process of degeneration and decay supervenes. Such are cases of infant cerebral degeneration and certain forms of family spastic paralysis. Epilepsy and convulsions are hereditary, and yet there may be no manifestations for long after birth. This inherited tendency to degeneration has been termed by Gowers **Abiotrophy.**

Primary or hereditary amentia includes by far the largest number of idiots, imbeciles and feeble-minded, at least 75 per cent. ; the moral imbeciles, the Mongols, and most of the slighter forms of defectives and epileptics, belong to this primary group. To the secondary class belong the cerebral diplegias, hemiplegias and syphilitic cases, and those due to injury at birth or at other periods.

We have already made it clear that the essential pathology of the brain in primary amentia is a developmental failure ; the germ plasm set apart for the formation of the brain is insufficient to form a normal brain, or development proceeds on the lines, more or less, of some ancestral and less complicated type. If the failure takes place in the earlier stages of fœtal life, the result is a monster ; if only the last stage lapses, the higher mental faculties of the future child may be wanting. The brain is perhaps small ; the nerve cells imperfectly formed or deficient in numbers. Failure of development of the same type occurs affecting the heart or other organs, such as the external ear. The normal infant is a recapitulation of its parents and ancestors ; it is not a close copy but a variation, and the feeble-minded infant is a variation in the direction of regression.[2] It is a matter of common knowledge that nerve instability, epilepsy, insanity, hysteria, feeble-mindedness run in families, and especially if members of such families marry there is a tendency for these to appear in their offspring. We see the same hereditary tendencies in hæmophilia, diabetes, asthma, achondroplasia and other diseases.

Both tuberculosis and alcoholism have been credited by some writers with being important factors in the production of cases of amentia. No

[1] The term congenital in its strict sense should apply to lesions occurring during intra-uterine life, while hereditary applies to the germinal plasm before conception.

[2] See the *Principles of Heredity*, by G. Archdall Reid, M.D.

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doubt it is common to find both consumption and drunkenness in neurotic families ; there is certainly a frequent association, but we doubt very much if they are related as cause and effect. Both tend to bring disaster on the individual, but there is no reason to think they affect the germinal plasm. Doubtless the fœtus may be adversely affected by the drunkenness of the pregnant mother, but we doubt very much if the effect is to give rise to developmental failure or disease of the brain.

All degrees of amentia are met with during infancy and childhood, ranging from complete idiocy to mere backwardness or dulness of the mental powers. The terms idiot and imbecile imply varying degrees of marked amentia. The term mentally defective is applied to children who, not of so low a grade as imbeciles, yet have intellectual powers much below the average child, who are unable to take their place in an ordinary class with any chance of benefit, but require special education in kindergarten classes.

Children who are imbeciles or markedly deficient usually show within a few months of birth that they are not like ordinary children. The mother notices that her infant when a month or two old does not take notice as it should do ; it pays no attention to a bright light or sound, it does not recognise its friends by a smile, or appear to hear its nurse's voice. As time goes on it makes no attempt to sit up or hold toys in its hands, its muscular system is weak, and its face wears a vacant expression. At a year or eighteen months old it has made little or no progress in walking or in using its limbs, or perhaps it cannot utter any articulate sound ; it slavers continually, the saliva running from its mouth on to its frock, and it has no control over its urine and fæces. As development proceeds, it learns to walk, perhaps to say a few words, and, if carefully looked after, to become cleanly in its habits. At 3 or 4 years of age it can understand a good deal of what is said to it, it takes but little notice of objects in its daily walk, and only uses a few words or picks up a few phrases like 'Oh dear!' which do duty on many occasions. Often such children are uncertain in their temper and mischievous.

The physical characters as well as the degree of intelligence possessed by imbeciles and idiots are very various. They often have coarse, harsh skins, slow circulations, and suffer from constipation. They are exceedingly apt to suffer from various tuberculous manifestations. They nearly always remain stunted in growth. There is perhaps a peculiar formation of the skull, corresponding roughly to the configuration of the brain inside ; while some crania are small, it must not be supposed that small heads are constantly present ; in some cases the head is symmetrical and well shaped, and of average size. Idiots may have microcephalic (Aztec type) or small heads, macrocephalic or large heads, dolichocephalic or long heads, brachycephalic or broad heads. Sometimes there is want of symmetry on the two sides of the cranium, or there is a deficient development of the frontal or occipital region. Various conditions of the mouth found in imbeciles have been especially emphasised by some authors ; these, it is needless to say, are not universally present. The palate is inordinately high and arched, or more decidedly V-shaped, and often unsymmetrical ; the tongue is usually large, and its movements are apt to be badly co-ordinated and awkward ; the fungiform papillæ are hypertrophied ; the mucous membrane of the

pharynx is apt to be thickened and congested, the tonsils hypertrophied, and post-nasal adenoids may be present. Slavering due to paresis of the muscles of the lips and tongue, as well as to the hypertrophy of the glands of the mouth, is very common. The teeth are late in appearing and quickly become carious. The semilunar or epicanthic folds are often present at the inner canthi of the eyelids, especially in Mongols, the eyes may be set too close together or too widely apart, there may be strabismus, nystagmus, or coloboma iridis present. The position and shape of the ears are worthy of attention ; they may be large and stand out from the head, may be planted abnormally far back, adherent, the pinna may be crumpled, or the lobule defective. While there has been an arrest of the development of the brain, other malformations may also be present, such for instance as cleft palate, or some malformation of the heart, as an open foramen ovale, or imperfect ventricular septum. The fingers may be webbed or stunted. We have already noted that nearly all idiots have poor circulations, suffering from cold feet and hands and chilblains, and it may be added that their sensation is defective and wounds of the extremities are long in healing. 'The dyscrasia which accompanies or causes genitous idiocy,' says W. W. Ireland, 'affects both the constitutional vigour and the symmetrical growth of the frame, though not equally in every part. Nature works like a bad sculptor, who fails to give the proper form sometimes to one member of the body and sometimes to another. There are errors, now here and now there ; and some parts are more happily shaped than others. Occasionally, however, genitous idiots are strong and good-looking, with well-formed heads, good teeth, and no deformities whatever.'

With regard to the sensory and mental deficiencies of idiots and imbeciles, space will not allow us to enter into detail, and the reader is referred to special treatises on the subject.[1] Among idiots there are those who live out their lives giving but scant evidence of the possession of any intellectual powers ; they are absolutely helpless, and would starve if food was not actually put into their mouths. They can hardly be said to be conscious, or their consciousness is of the indistinct kind ; they heed neither sights nor sound, they make no voluntary effort. While some imbecile children are exceedingly good-natured and can be easily managed, others are very much the reverse. As infants they are constantly crying without apparent reason, and wear out the patience of nurses and mothers. When a little older and able to crawl or walk—though always late in doing so—they are everlastingly in mischief. They are not still for a moment, and it is at least one person's business to manage them. When they cannot have what they want there is an unearthly shriek, quite unlike a normal child ; they will eat dirt or the wool off the blankets, and are apt to masturbate. They will bite or pinch or kick or scream for hours if not allowed their own way. It is exceedingly difficult to get their attention for many moments together.

We have already referred to some of the 'stigmata of degeneration' which are frequently seen in cases of primary amentia. These are of interest and importance, but any *one* of them by itself cannot be taken as evidence of mental defect, and it would be unwise to exaggerate their

[1] See *Mental Affections of Children*, W. W. Ireland, 1898, and *Mentally-deficient Children*, by G. E. Shuttleworth, 2nd ed. 1900.

importance. When present in association with mental defect, they are valuable evidence that the amentia is of the primary type. As regards the ears, the outstanding or wing-like ears (see p. 586) are common among feeble-minded children. As Wiedersheim remarks, this position is the physiologically correct one, and this arrangement with ear muscles under voluntary control would be of service to primeval man. To quote the same author, 'The human pinna, as compared with that of the apes, would appear to be a degenerate structure ; and in reality it is much reduced in size, being rolled over in such a way as greatly to modify the upper edge of the helix and part of the antihelix.'

The ear-folds of the human embryo at the fourth and sixth months somewhat resemble the ears of the Macacas (one of the primates), there is an

Fig. 126.—Joseph B., aged 2½ years, Mongol Imbecile. He could not walk nor talk, and understood very little of what was said to him. He did not care for toys unless they made a noise. His head measured 18½ inches. He died of pneumonia. The brain weighed 37 oz. ; the convolutions were fairly well marked.

edge of the helix which is not rolled over and a distinct tip. From the eighth month the human earfold enters upon a degenerative process, which consists in the rolling over of the edge of the ear and the turning in of the tip, Darwin's 'tubercle.' Thus the deficient helix and antihelix (see fig. 130) are the result of an arrest of development or regression towards an original type. We may have also deficient lobules, crumpled and irregular ears of various shapes.

The epicanthic folds, usually well-marked in Mongolian imbeciles (see fig. 127), may be seen also in their brothers, and sisters who are not mentally deficient. These folds are present also in children in whom there is no suggestion of mental feebleness, and are well-marked in the Japanese and

other Eastern nations with flattened noses. According to Wiedersheim they are due to an arrest of development during fœtal life.

The V-shaped palate, with narrow protuberant upper jaw, is very common among mentally feeble children and among neurotic individuals generally. A high rounded arch is not uncommon. These deformities are hereditary and not due to post-nasal obstruction as some believe.

The chubby hand with incurved little finger is common in imbeciles; in others the fingers are long and thin.

While the majority of cases of primary amentia all agree in being mentally feeble in varying degrees, yet they differ so much in mental and

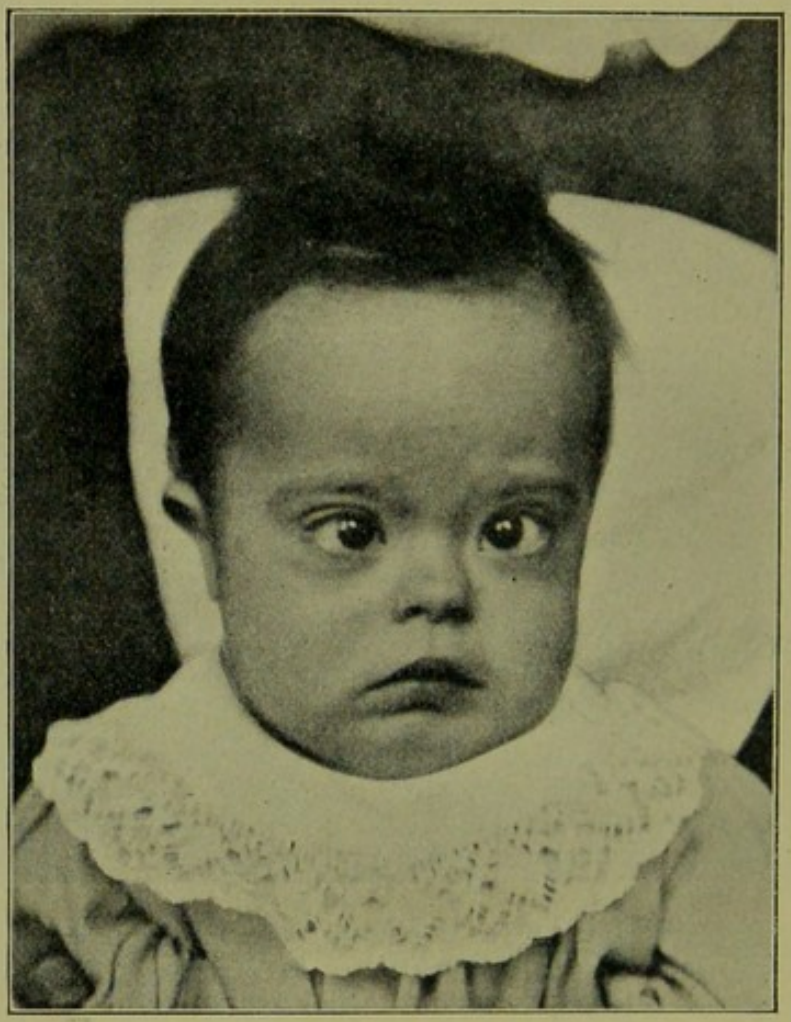

Fig. 127.—Mongolian Imbecile, aged 16 months, showing adherent epicanthi. There was internal strabismus and nystagmus.

physical characteristics, that it is exceedingly difficult to classify them or sort them into groups. The Mongols are an exception to this statement, and form a group with much in common. Other groups less well-marked include the 'microcephalic'; then we may distinguish the 'epileptics' and the 'moral imbeciles.' We must content ourselves by giving a short description of each group.

Mongolian Imbeciles.—Langdon Down was the first to point out the peculiar physical features of this type of imbecile and to note their resemblance to the Kalmuc or Tartar tribes of Asia. It has been pointed

out by several writers that in some cases Mongols are the children of mothers who have already had large families or are well on in years. This is certainly not universally true ; the child, fig. 127, was the first-born of a young mother. There is often a family history of insanity or nerve instability. The appearance of these children is quite characteristic from the first few weeks, as pointed out by J. Thomson. The physiognomy is peculiar and a glance is mostly sufficient for a diagnosis. The head is of

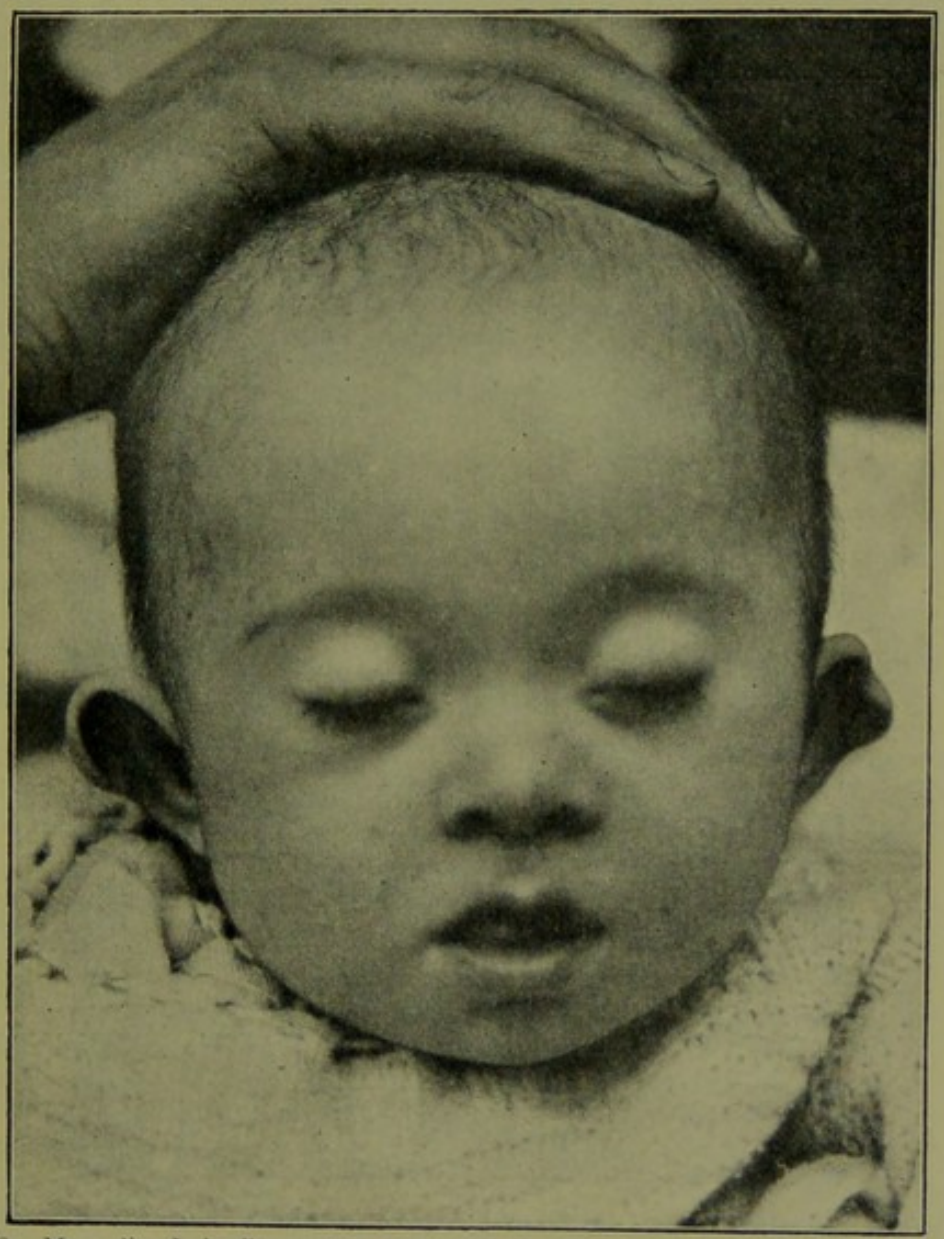

Fig. 128.—Mongolian Imbecile, aged 10 weeks, showing outstanding and deficient development of ears.

a round shape, seen best from above downwards, being more or less deficient behind. The epicanthic folds are well marked and give the eyes the appearance of being half closed and obliquely set. (See fig. 127.) We have seen the epicanthic folds well marked in the brothers of the same family, but who were not Mongols. The bridge of the nose is flattened, a peculiarity due apparently to foreshortening of the base of the skull. The tongue is large and fissured, and the mouth kept half open in consequence ;

the hands are broad and squat. Mongolian babies are late in holding up their heads, sitting up, and learning to walk and talk. They are good-natured infants, and as children the higher grades are often lively and amusing ; they practically remain always children, and rarely if ever learn to read or write, but can be trained to do work. They suffer much from nasal and respiratory catarrh and readily succumb to bronchitis, measles, or pneumonia. Many die of tuberculosis, and only a small proportion reach adult life. In a few instances congenital heart disease is associated with Mongolism.

Microcephalic Imbeciles in typical instances belong to the primary group, that is the small head is due to some developmental brain failure.

Fig. 129.—Girl aged 7 years. Mentally defective ; congenital double ptosis ; probably defective development of nuclei of third nerves. Head measures 19 in. in circumference.

But many cases of cerebral diplegia, due to syphilis or other intra-uterine disease, have very small heads (see fig. 105). As a large proportion of imbeciles and defective children have smaller heads than normal children, we may ask what degree of diminution should be present in order to allow of the child being described as microcephalic? It is well to remember that the average circumference of the head in *well-grown* children is 18 in. at a year old, 20 in. at 2 years, 21 in. at 4 years, and

21½ in. at 10 years. Ireland suggests that the name 'microcephalic' should be reserved for imbeciles whose heads measure 17 in. in circumference or less, but the word is commonly used in a wider sense than this. The important points are the following: If a child's head is 3 in. under the average circumference for its age the child will be an imbecile. If 2 in. under the average the child will probably be feeble-minded in more or less degree. Thus a child from 7 to 10 years with the head measurement of 19 in. or under, and at the same time fairly well grown for his age, is almost certain to be of weak intellect.

The *prognosis* as regards education is in proportion to the size of the head (Shuttleworth). There is in many cases a characteristic form as well as size of microcephalic heads; the forehead is narrow and rapidly recedes, the vertex is pointed, and the occiput flat. The frontal and parietal lobes are on a small scale, but the most striking arrest of development is in the occipital and temporo-sphenoidal lobes (Shuttleworth). While this is true of the extreme cases, it is perhaps less marked in the slighter forms. In most cases the size of the cranium is in marked contrast with the size of the face. Imbeciles of the microcephalic type are for the most part good-natured, and though childish are capable of more or less education and training. The following cases will serve as examples:

A girl of 7 years has a head measurement of 17½ in.; the vault of the cranium is small, but in proportion to the face, the forehead also is in proportion, but the occiput is deficient. The nose is aquiline, the teeth irregular, the palate gothic, the ears stand out, the right being longer from above downwards than the left. She cannot talk, but chatters to herself; or stand, but goes about on all fours. She has been trained to make signs for her wants, and she is clean in her habits. Such a girl is clearly an imbecile, though capable of some training.

A girl of 7 years has a head circumference of 19 in.; there is congenital double ptosis, presumably due to a failure of development of the nucleus of the third nerve. She can talk and go messages, but learns very little; is improving in a special school. (See fig. 129.)

Amentia with Epilepsy.—There is more epilepsy among feeble-minded or imbecile children than among children with normal mental power, or, to put the same fact in another way, children who suffer from epilepsy are often abnormal mentally, or feeble-minded. Defective brain development is often associated with unstable nerve centres, but we know too little about the nature of epilepsy to say in what the pathological state consists. Epilepsy may be associated both with primary and secondary amentia. Mongols seem rarely to suffer from fits. Convulsions commencing in the first few weeks of life without obvious cause and continuing for weeks together are always suggestive of amentia in minor or major degree. If, as time goes on, the fits continue and the infant fails to show signs of intelligence, the outlook is full of anxiety. In some other cases the child seems to be developing normally for some months or perhaps years, then there are a series of fits, to be followed by others, and the child's mental progress appears to be checked. In many cases of 'infantile hemiplegia,' and also 'cerebral diplegia,' epilepsy is associated with mental feebleness.

Moral Imbecility.—While the mentally feeble child is deficient alike in wits and morals, it is by no means uncommon to find children—quite as

sharp as normal children—who are moral imbeciles, in the sense that they are given to lying, thieving, deceit, and indecent acts to an extent that cannot be tolerated at school or in the family. In some cases these unpleasant ways are well known to their parents from bitter experience ; in others the facts only leak out during school life. The normal school-child, as he grows older, acquires an 'educated conscience' ; he is ashamed to take money out of somebody's pocket, and he can readily conjure up in his imagination the shame and disgrace which would be his in case he were found out. He is

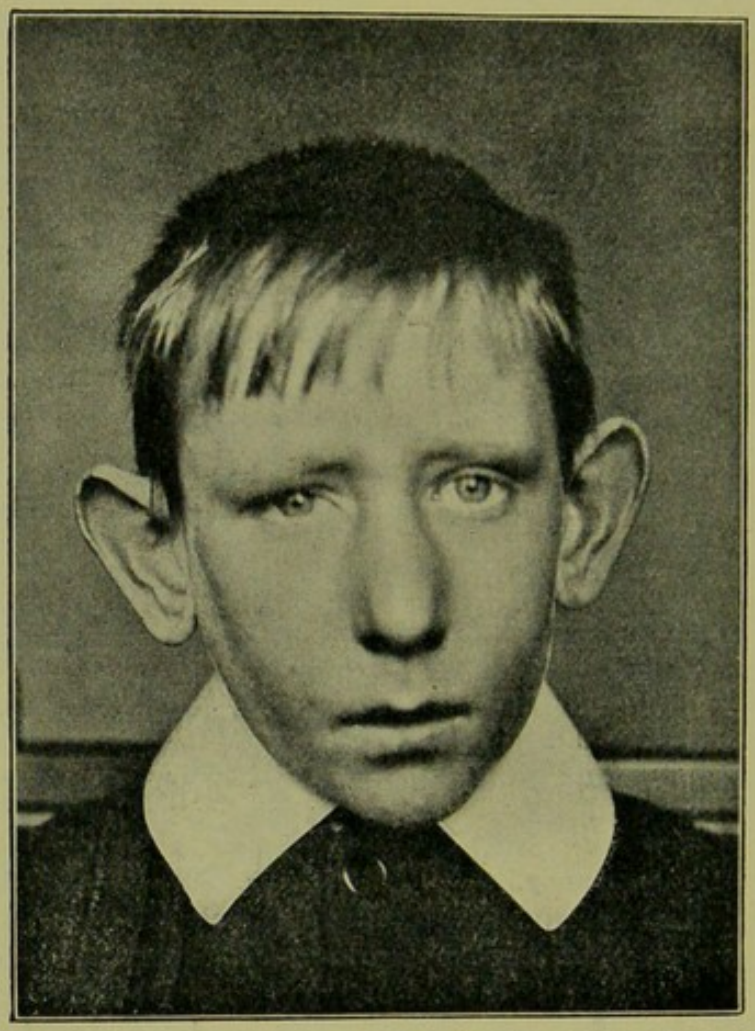

Fig. 130.—Epileptic Boy of 11 years ; mentally defective, showing ' wing-like ' ears with deficient helix. Mother is an epileptic of a severe type. This boy is the sole survivor of a family of six children ; five children died under 2 years of age ; all suffered from convulsions.

ashamed to use filthy language or be guilty of indecent acts. He acquires by imitation a sense of right and wrong, and a recognition of a social bond between himself and others. The moral imbecile, in spite of favourable surroundings, punishment, or disgrace, never takes this to heart and never learns by experience. There is something wanting in his powers of self-restraint and ethical sense. Such children are perhaps the most difficult to deal with, and they are only too likely to become criminals-at-law.

Leaving the further consideration of idiots and imbeciles for want of space, we will confine our remarks to children of a higher grade, who,

though mentally defective, yet are capable of a considerable degree of education and training.

The mentally defective child, as compared with a normal child of the same age, has a poor memory ; the multitude of sensations which are constantly pouring in from the external world make but a weak impression on his mind, and he holds but little of this material for future use. If the memory-images are weak, all mental processes must be feeble, viz. apperception, association of ideas, and assimilation. The feeble-minded child has very little in the way of experience or knowledge to fall back upon. He fails more or less to combine the incoming sensations into perceptions and ideas, or associate these together so that he can recall the past and add to these the constantly recurring incidents of his daily life. When set to write from copy he manages fairly well ; perhaps he will write his name from memory, but ask him to write 'cat,' 'dog,' and he is puzzled, and perhaps writes 'tca' and 'god,' and this after years of time spent at an elementary school. He may recognise letters, but not small words, though he can recognise the object when he sees it, and is familiar with the object's name. He knows well enough what a dog is, but fails to recognise the word. He cannot appreciate the meaning of figure 5, or if shown five objects he has to count them, and cannot add 3 and 2 together either mentally or when the figures are put before him ; he can only perform this calculation by taking three objects, and then two more, and counting the total ! Very often his intellectual powers are very unequal ; there may be 'word-blindness' or 'figure-blindness' ; the child may be fairly good at sums, though more backward than the average, and yet be unable to recognise a single word in a school primer. Or he may read simple sentences fairly well and be unable to add correctly two or three figures.

In many cases the failure is chiefly in the use of symbols, such as words and numbers. He may draw from copy, or do carpentering, make mats or baskets with commendable neatness. He may be very useful in the household, in making beds, cleaning up, or minding the baby, and show common-sense in his conduct. He may be a very poor scholar, but a good workman when directed aright, and may have a fair idea of the value of money. On the other hand, weak intellectual powers for scholastic attainments are mostly combined with poor intelligence in the matter of conduct and action in daily life. The normal child quickly learns by imitation, and stores up his experiences ; that is, he has a mental picture on his mind which is equivalent to the feeling of the movement he desires to make, and when a certain situation arises he knows how to act. The mentally-feeble child has but few 'equivalents' to fall back on, and fails to act as the situation demands ; in other words, he is wanting in intelligence. His will is weak, he follows out any suggestion made to him, he does not deliberate and act upon reflection as regards consequences ; he fails to inhibit or restrain himself when roused to anger. His instincts may be strong, he fails to keep them in check.

The mentally-feeble child is long in acquiring habits of self-control and learning to conform to the unwritten rules of daily life. Many other abnormal traits may be noted in some, such, for instance, as destructiveness, cruelty to animals, dangerous displays of temper, masturbation. Some show

amazing energy: they are always doing something, mostly mischief, requiring much looking after, and are unabashed in the presence of strangers; others are inordinately shy and do nothing but cry if an attempt is made to test their intelligence. It will be very certain that those to whom the above description is applicable will be no scholars: learning will be a great difficulty, and when grown up they will never earn their own living, though they may be trained to work and contribute to their support in an institution or colony.

In the slighter forms of feeble-mindedness, the feebleness rather applies to a difficulty in acquiring abstract knowledge, of recognising words and numbers, and quickly forgetting everything learnt. This class of child often has sufficient intelligence to be of use in a household, and may be perfectly competent at all kinds of mechanical work. Such children make little progress in school work, and yet in later life may support themselves.

Secondary or Acquired Amentia.—To this class belong those who do not necessarily inherit any neurotic tendency, and whose brains would develop along normal lines, but for the presence of some toxin or syphilis or some disease or accident. This arrest of development may occur either during intra-uterine or extra-uterine infancy. Most of the cases of diplegia and hemiplegia with amentia belong to this class. We have already referred to these cases. (See p. 526 *et seq.*)

We give the following cases as typical examples:

Idiocy with Athetosis.—William H. D., aged 4 years. Birth easy, has never been right, cannot sit up, or walk or talk. Is a well-nourished boy, head small (18 in. circumference), small development in front. He smiles when he sees a watch, understands when asked if he will have a drink. Lies quiet when undisturbed; when moved, or when he tries to sit up or reach out his hand for anything, the movements begin. If he tries to pick up a coin, his hands and arms, legs, face are thrown into erratic and vigorous movement. He perhaps seizes the coin after several attempts, then it is flung out of his hand. Tries to speak and makes a puffing noise with his lips. He manages to get out 'ma,' 'ta,' 'ye,' 'na,' &c.

Idiocy with Athetosis.—Miles G., aged 10 years. Birth difficult and instrumental. He has always held his limbs more or less stiff; this was more noticeable at 10 months than before. He cannot speak, but makes a grunt for 'yes' and another different grunt which means 'no.' He understands something of what is said to him. The head is rather small, being flattened in the parietal regions, and also narrow in front. He lies quite quiet and helpless in bed when left to himself; when disturbed, or when anyone goes near him, the movements begin. He arches his back, moves his head, makes grimaces, arms and hands are extended and flexed alternately, the wrists are flexed, there is spasmodic opening and closing of the fingers. The legs are crossed, the knee extended, the foot points, the great toe is dorso-flexed. When left to himself the movements quieten down. He cannot feed himself, or, indeed, in any way attend to his wants.

Juvenile General Paralysis.—We have already referred to one form of brain syphilis (see p. 507) which occurs during intra-uterine life, and also during early infancy, and is fatal at an early period. There is another form which occurs later, and corresponds to the tertiary period of acquired syphilis. These cases were described some years ago by Clouston and also by J. S. Bury, though it is only of recent years that they have received the name of Juvenile General Paralysis.

The history usually obtained is that the child had been well and attended school like a normal child up to 7 or 8 years of age. Then it was

noticed that the child was getting weak on his legs, his memory was failing, and he was becoming more and more babyish in his ways. Often there is a history of fits. On examination, the patient is seen to walk badly, there being a certain amount of paresis in the legs, the knee-reflex is exaggerated, and perhaps the plantar reflex is of the extensor type. The pupils are sluggish, and the speech is thick and indistinct. There is dementia of a mild type ; the memory is weak, almost everything learnt is gradually for-

Fig. 131.—Juvenile General Paralysis, showing pegged and notched teeth. Boy aged 11 years.

gotten, but for a time at least the child is pleased with picture-books and toys, but very easily upset if crossed in any way. His behaviour is eminently babyish ; he is very pleased with being praised, and asks questions and makes remarks which amuse the other children in the ward. As time goes on there is steady mental deterioration and bodily weakness. He becomes bed-ridden on account of the increasing weakness, dirty in his habits and perhaps noisy and troublesome. The legs perhaps become paralysed and

contractures ensue. The course extends over some years usually; death results from exhaustion or some intercurrent disease.

Most of them show signs of past syphilis, in the form of keratitis, scars about the mouth, and pegged teeth.

The following case will illustrate some of these remarks:

Juvenile General Paralysis.—Leonard B., æt. 11 years. Father dead, is the only child living, one was still-born. Rash when a few months old. Was a perfectly normal boy till 7 years old, went to school and learnt quickly. About this time began to lose his memory, had a fit some eighteen months ago. He is a well-developed boy; old keratitis, pegged teeth, scars at angles of mouth. Pupils dilated and sluggish, can walk, but is weak on legs; knee-jerks exaggerated, no ankle-clonus, big-toe Z-shaped, plantar reflex is of the extensor type. Mentally he is quite childish, calls the nurses 'aunts' and the doctors 'uncles'; is very affectionate and wants to kiss all the nurses. As a rule he is very contented and happy, and likes being taken notice of, but if he is asked about words and figures he gets sulky. He is fond of picture-books, but won't lend them, and cries if they are taken from him. He says he has a pony at home, and tells everybody that 'Uncle Charley' put him to bed last night. He scribbles when asked to write, and doesn't recognise words or figures. Mentally he is a baby. He calls a dog seen in a picture-book 'god' and a horse a cat. (See fig. 131.)

Education and Training.—Space forbids us to describe in any detail the methods best suited to the training of imbeciles and feeble-minded children. Not only devotion and patience, but high intelligence and restraint, on the part of parents is required, and a determination to look facts in the face. These children are babies and tend to remain babies, and in consequence are often allowed their own way, everything is done for them, and they are not encouraged to make efforts to help themselves or use what latent powers of intelligence they may possess. Necessarily in the first line comes training in cleanly habits, to give signs or calls when their wants require attention; and to feed themselves in a decent way. Care must be taken in the matter of clothing and protection from cold, as well as to the state of the bowels; sluggish circulation and constipated bowels are very common in this class of child.

Speaking generally, education and training are far more successful in a well-equipped institution or residential school than at home. Parents rarely have the aptitude for such work, and dull or feeble-minded children are far more easily trained when there are several together than by themselves or with clever children; and moreover specially trained and suitable teachers are required. Physical exercises, breathing exercises, and drill are of special importance in teaching them precision in coarse movements and command over their muscles. Fine movements are practised by means of 'peg-boards,' cribbage, prick-work, splash-work, and drawing, and gradually they are trained in some form of mechanical work.

Special day schools have been instituted in many cities in this country where mentally defective children are taught largely by kindergarten methods; while at the same time some useful mechanical work such as mat-making, basket-making, &c. is learnt. These schools are of most service to the mentally defective or dull and backward children of the better class.

Unfortunately, in this country, there is little provision for the worst class of defective or imbecile. These should be segregated in working colonies,

where they could in part contribute to their own living and be kept for life. It is important that they should not be let loose on society and have the chance of recapitulating their kind.

Juvenile Myxœdema. Sporadic Cretinism.—Cretinoid idiocy differs from the forms of amentia which we have been discussing inasmuch as there is arrested mental and bodily development, which is due to a deficiency of the secretion of the thyroid gland. Experience shows that a marked improvement follows the introduction of thyroid extract into the system, both as regards intelligence and body growth. No other form of idiocy is influenced for the better by this extract. The belief that juvenile myxœdema is due to a failure of development or degeneration of the thyroid gland rests upon definite pathological evidence. What causes are in operation to bring about this failure of development is quite unknown. There is no evidence to connect it with syphilis, alcoholism, drinking water, climate or insanitary life conditions. We have known it to occur in families of good social position, in the families of medical men, country farmers, as well as among the poorest classes in a manufacturing city. It does not appear to have any marked tendency to run in families, though it seems in a few instances to have been associated with achondroplasia and infantilism in the same family (J. Thomson). The only association we have met with has been with congenital deaf-mutism, and this has been noticed by others. In one family we know of the eldest daughter is a deaf-mute, the second is more or less deaf, the third is also a deaf-mute, and suffers from juvenile myxœdema. It is curious that the eldest daughter has an enlarged thyroid, and so had her mother when younger. There is a history of deaf-mutism on the father's side. This history of myxœdema is interesting, as deaf-mutism is not uncommon in the same districts where cretinism is endemic, as in the mountainous regions of Europe and America.

At birth there is apparently very little wrong, but skilled observations on this point are few, inasmuch as it would rarely occur to any medical man to critically examine an infant with cretinism in his mind. As time goes on the infant is more dull and lethargic than most babies, it suffers from obstinate constipation, and the tongue may be larger than normal. It is certain, however, that for the first year or two of life it is easy to overlook cases of juvenile myxœdema and to attribute the symptoms to backwardness. In all cases of obstinate constipation in young infants, it is well to have cretinism in mind and examine the infant for any backwardness in intelligence, note the condition of the tongue, the hands, and the absence or presence of the thyroid gland.

When the child is older the appearances are far more striking and the physiognomy is very peculiar and characteristic. Such children are dwarfs, being stunted in growth: one of our own cases, that of a boy aged 12 years, measured 34 in. high and weighed 28 lbs. In two cases of Hilton Fagge's, one, aged 16½ years, was only 32 in. high; another 20 years old, was only 28 in. in height. The heads are large and broad, often flattened at the vertex; the face is broad, the eyes wide apart, the nose flattened, and the lips are large and pouting. The tongue is strikingly large and thick, and sometimes hangs from the mouth; the belly is tumid, the umbilicus protruding and low down in its position, the lower limbs are

disproportionately short as compared with the body, the gait is awkward and waddling. The skin is coarse and thick, and of a sallow colour; in some the subcutaneous tissues are thick and myxœdematous. Usually no thyroid is present, or, if present, is very small, but in almost all cases described peculiar fatty tumours are present in the posterior triangles of the neck behind the sterno-mastoid muscles and immediately above the clavicles. These tumours are soft, movable, and lobulated; they send processes behind the sterno-mastoid muscles and also beneath the clavicles.

The degree of intelligence in these cases differs: mostly they are childish in their ways rather than imbecile. They are late in learning to sit up and

Fig. 132.—A Cretin 4 years of age. She could not stand without help.

Fig. 133.—Cretin. Walter P., aged 4½ years, height 31 in., weight 28 lbs.

walk, and late also in talking; in the worst cases they are completely imbecile. They are mostly good-humoured and easily controlled. In one of our cases the boy was employed by his father, who was a butcher, to stand outside the shop on Saturday nights and shout out the price of meat. His peculiar appearance and quaint remarks always attracted customers. Cretins are apt to suffer from tuberculosis both of the bones and internal organs, and also from rickets.

Fig. 133 represents a boy of 4½ years, the subject of cretinism. He was never right from his birth; his brothers and sisters were healthy. He has never talked, only utters

grunting sounds. Hardly understands anything said to him, but laughs if amused. The skin is coarse and the subcutaneous tissues thick. He has large lips and tongue; his hands and feet are disproportionately large. No thyroid gland can be felt; the supraclavicular pads are present. He has caries of the ethmoid bone and a chronic discharge of pus from the left eye. He remained in hospital ten months, during which time his left eyeball was excised on account of suppuration; he was treated for awhile with subcutaneous injections of a glycerine extract of sheep's thyroid, but they had to be omitted from time to time on account of subcutaneous abscesses. He was discharged improved. He was lost sight of

Fig. 134.—Walter P., aged 7 years.

for two years, when he came under the care of Mr. W. Barker Bale in the Stockport Workhouse (see fig. 134); he was treated with thyroid and greatly improved (see fig. 135). We are indebted to Mr. Bale for the photographs.

All degrees of severity may be met with in congenital myxœdema, and the slighter cases are very apt to be overlooked. In the mild cases there may be little else to note except that the child or the young adult is a dwarf; probably also there is mental dulness and backwardness.

Treatment.—While thyroid extract is of the greatest value in all forms of congenital myxœdema or 'sporadic cretinism,' there is good evidence to show that the earlier in life it is taken the better will be the result of its action. We usually begin in young patients with 1½ gr. of the dried sheep's thyroid glands given in the form of tabloids daily, increasing to two or three grains daily according to circumstances. It is necessary to watch the patient care-

Fig. 135.—Walter P., aged 8 years, after 9 months' treatment with thyroid extract.

fully, inasmuch as the thyroid extract is a powerful remedy, and individual susceptibility to its influence differs considerably. It is important to watch the pulse and temperature; if there is an evening rise of two or three degrees, it will be well to omit the drug for a while. Cretins for the most part have a subnormal temperature, and an evening rise of over 100° is likely to be due to 'thyroidism.' With this evening fever there is usually irritability and shortness of temper; this we have noticed again and again

in hospital patients. There may be vomiting, jaundice, diarrhœa, and marked depression of the heart's action. Of these symptoms vomiting, irritability, and fever are the commonest signs of early thyroidism, and should always be taken as danger signals and the drug omitted. In a later stage there is pallor, and faintness on exertion ; we have seen this in one case so marked that it seemed likely a fatal result might ensue. This continued depression and tendency to fainting may last for many weeks. With the continued administration of thyroid extract and rapid growth which may take place, the child

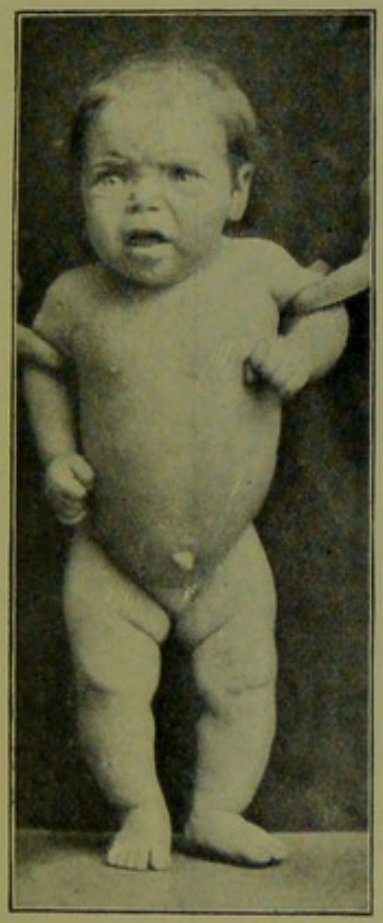

Fig. 136.—E. A. W., aged 2 years ; height 24½ in., weight 16 lb. 2 oz.

Fig. 137.—E. A. W., aged 4½ years ; height 33 in., weight 30.5 lb.

is apt to become thin and limp, with a tendency to knock-knees and lateral spinal curvature.

Under the influence of moderate doses of thyroid extract—that is, doses so regulated as not to produce any symptoms of thyroidism—the improvement in the patient is most striking. The facial expression entirely changes, the dull heavy look disappears and is succeeded by a brighter and more lively expression, the lips are no longer thick, the tongue diminishes in size. The skin becomes soft, the abdomen less tumid, and the child begins to grow. The change is generally observable within a few weeks of the commencement of treatment. Loss of weight occurs at first. With the omission of the thyroid treatment there is almost a certainty of a relapse, and we have

seen relapses frequently among out-patients, though perhaps the patient has not gone back quite to his former condition. It is necessary to continue the treatment, though the amount of the drug may be diminished to, say 5 grs. a week, for years. It can confidently be predicted in a given case, if the symptoms of cretinism are present, that improvement will take place under the thyroid treatment, but how much improvement time only will show. The physical improvement in many cases outruns the mental improvement, the experience of most being that average mental power is only exceptionally attained by cretins under treatment. Unfortunately, so many of

Fig. 138.—Facial Hemiatrophy. Girl aged 11 years.

our patients among the poorer classes are lost sight of and do not persevere with treatment.

Facial Hemiatrophy. Local Panatrophy (Gowers)

This curious affection, known as facial hemiatrophy, local panatrophy, localised scleroderma, morphœa, is apt to begin in childhood, but may last a lifetime. It is characterised by patches of atrophy of the skin in various parts of the body, involving also the subcutaneous tissues, including muscles and bones. In some cases it is confined to the face, hence its name, facial hemiatrophy.

In most cases no cause can be assigned, in others hereditary transmission can be traced (A. Bruce) ; trauma has been credited with being an exciting cause (Savile, Stanley Barnes).

The first sign is that certain areas of skin on the side of the face, trunk, or limbs are noticed to be whitish in colour, while the surrounding area of skin is pigmented ; later the surface of the skin has a shiny parchment-like feel and appearance resembling scleroderma. Beneath these patches the subcutaneous tissues disappear, and the muscles become wasted. When it occurs on the face the muscles on that side, including the corresponding side of the tongue, become smaller, and also the bones, such as the malar, frontal, and maxillary, including the teeth. The bones of the feet seem also to have been involved in one case (H. Campbell). There is no change in the electrical reactions of the muscles, and no paralysis. The pathology is unknown. No treatment is known to influence the progress. Massage, galvanism and arsenic may be tried.

The girl (fig. 138) had patches of atrophy on the left side of the face and also on the trunk.

CHAPTER XXVI

DISEASES OF THE NERVOUS SYSTEM—(*continued*)

Spina Bifida

SPINA BIFIDA is a congenital malformation in which there is non-union of the laminæ of one or more vertebræ, together with a protrusion of a sac composed of the spinal cord or its membranes through this opening. The deformity may be considered as due to a failure of the mesoblast to interpose itself between the spinal and cutaneous epiblast, with or without lack of coalescence of the medullary folds themselves. The protrusion may occur at any part of the spine, and may extend throughout nearly its whole length ; usually only three or four vertebræ are involved, and the lumbar or sacral region is the part most commonly affected.[1] Very rarely the bodies of the vertebræ are divided, and the hernia projects forwards or laterally. In some instances there is no protrusion, though the laminæ have not united ('spina bifida occulta'), and occasionally there is more than one hernia.

Three kinds of spina bifida are recognised :

1. Protrusion of the spinal membranes only : 'spinal meningocele.'

2. Protrusion of the membranes together with the spinal cord and nerves : 'meningo-myelocele.'

3. Protrusion of the membranes and cord, the central canal of the latter being dilated to form the sac : 'syringo-myelocele.'

To these should be added the cases where the medullary plates fail to coalesce—'myelocele'—and the central canal opens upon the surface, a condition incompatible with life for more than a few days. Also a meningocele may co-exist with a 'syringo-myelocele,' constituting a 'syringo-meningocele' ; and finally there is 'spina bifida occulta.'[2]

The second kind of deformity is much the commonest, forming 63 per cent. of all the cases.

In the first form the swelling is usually small, and may protrude merely between two almost normal spines ; the cavity of the sac is the subarachnoid space, the swelling is often covered with well-formed skin, and paralytic complications are often absent.

The vertebral laminæ vary much in development ; the gap may be very wide and the laminæ much stunted, or they may form prominent everted borders to the orifice.

[1] Eighty-nine cases out of 125 collected by the Clinical Society were lumbar or sacral.

[2] *Vide* Bland Sutton, *Lancet*, February 25, 1888.

The central canal of the cord is often dilated in the first two forms as well as in the third, and the position of the cord in the sac varies ; it may be slung up in the sac by a sort of mesentery, but in any case is very imperfectly developed, and is occasionally transfixed by a bony process crossing the canal.

Syringo-myelocele is very rare ; the sac is composed of spinal membranes *plus* the cord, and the cavity being the dilated central canal, the nerves are embedded in the sac wall and do not cross the cavity.[1]

The fluid in a spina bifida consists of 98·9 per cent. of water with soluble salts and a trace of sugar, or at least some copper-reducing substance ; also small quantities of globulin ; it is, in fact, cerebro-spinal fluid. Where, however, the cavity of the sac is continuous with the subdural space, no sugar will be found.[2]

In meningo-myelocele, the commonest form, the sac is formed of dura mater lined by arachnoid (both 'layers'), hence the cavity is the subarachnoid space. The spinal cord traverses the sac and blends with its roof ; from the flattened thinned-out cord the spinal nerves arise and pass across the sac to their respective foramina. The surface of the sac may be covered entirely with skin, or may be thin and transparent, only consisting at its upper part of the membranes, or membranes covered with an imperfect epidermic layer, while at the sides the skin is usually better formed. Sometimes a dimple or longitudinal furrow in the middle line marks the attachment of the cord and shows its presence in the sac, an important point in the question of treatment. Sometimes the sac is loculated.

The tumour resulting from spina bifida is median in position, usually sessile, fluctuant, and translucent in varying degree, according to the amount of healthy skin covering it. Lateral meningocele has been, however, met with. The contents can be partially reduced into the spinal canal, unless the communication has been shut off (false spina bifida). The surface not uncommonly is ulcerated, and is sometimes marked by nævoid tissue, as in the case of meningoceles. The swelling becomes tense on the child crying, and there is often some associated deformity ; hydrocephalus, meningocele, talipes, hare-lip, a peculiar webbed condition of the thighs ('siren'), or other deformity may co-exist, and the subjects of spina bifida are often marasmic and soon die ; in other cases, however, they are fat and hearty. We have seen them too fat, the subject of a sort of diffuse lipomatous condition such as is sometimes seen in cases of talipes. On the whole, paraplegia, talipes, and hydrocephalus are the three commonest complications. 'Trophic' ulcers are sometimes seen on the feet.

Diagnosis.—The diagnosis of spina bifida can only be doubtful where there is a complete skin-covering to the tumour. In such cases congenital, sacral, or other tumours—hygroma, teratoma, or lipoma—may be mistaken for spina bifida, and the possibility of the communication with the spinal canal having been shut off must also be borne in mind. The presence of solid masses in a median tumour and the absence of general fluctuation would

[1] A case of this sort has been recorded by Morton in the *Bristol Med. Chir. Jour.*, March 1892.

[2] A case of this nature was reported by Pearce Gould in the *Clin. Soc. Trans.* 1882. Injection cured the patient.

point to a teratoma or lipoma, while a hygroma is more spongy, usually flatter, and often not exactly median. The presence of nævus-stains may raise the question of whether the whole swelling is not nævoid. The fixity of the tumour to the spine, its reducibility, the possibility of feeling the edges of the opening in the laminæ, and the co-existence of other deformities may throw light upon a doubtful case. In some instances puncture with a fine needle and examination of the fluid drawn off may be required; a highly albuminous fluid would be inconsistent with spina bifida. Non-congenital tumours cannot, of course, be confounded with spina bifida. The persistence of communication with the meningeal cavities can be determined by variations in the size of the swelling. The term 'false spina bifida,' usually limited to cases where the sac no longer communicates with the subarachnoid space, is sometimes applied to any median congenital tumour along the spine.

Prognosis.—Nearly all cases of spina bifida left to themselves die, mostly from meningitis after rupture of the sac, or from marasmus; some, however, recover completely, the sac shrinking up and forming a mere puckered cicatrix. Occasionally spontaneous cure takes place *in utero*, and even rupture is not universally fatal. Cure of the spina bifida, it must be remembered, does not imply cure of paralysis or other complications.

Treatment.—Though simple repeated tappings, pressure, ligature, and excision have all occasionally proved successful in the treatment of spina bifida, the Clinical Society's report showed that the safest and most generally applicable plan is that of injection, and probably Morton's fluid [1] is the best for this purpose. Ligature is almost necessarily fatal where the case is one of meningo-myelocele, and as this is the most common form,[2] and it is impossible to be sure in any given case that a simple meningocele is present, the plan is rarely applicable.

The method of excision has grown in favour in recent years and has been successful even in some cases with cord or nerves embedded in the sac wall. In such circumstances the part of the sac containing the nerve structures must, of course, be preserved and covered in. It is the difficulty of doing this that makes excision still a doubtful method. It is quite satisfactory in pure meningoceles. Nicholl, of Glasgow, has recorded some cases of cervical meningocele treated by excision successfully, and others have had similar experience.

Treatment by injection is managed as follows: The child should be held back downwards, and a fairly fine injecting syringe should be charged with Morton's fluid; the needle is then passed in obliquely through the skin and from fifteen minims to a drachm of the fluid injected. Care must be taken that the puncture is made through skin and not through thin membrane, and that it is well away from the middle line, both to diminish the risk of subsequent leakage and to avoid injury to the cord or nerves. After the injection, the child must be kept upon its back, the puncture sealed with collodion, the tumour packed well round with absorbent wool, and a flannel

[1] Iodine gr. x, iodide of potassium gr. xxx, glycerine ℥i. The amount of iodine may be increased up to gr. xxx.

[2] Prescott Hewett found only one case out of twenty in which there was no nerve element in the sac.

bandage applied. It is perhaps better to withdraw some fluid before injecting, and the child must be kept entirely in the supine position, to prevent the fluid from passing into the spinal canal. If the tumour does not shrink and no ill effects follow, the injection should be repeated at intervals of a fortnight. Occasionally the tumour does not begin to shrink for a month or two after an injection, as in a case related to us by Dr. Wallace, of Longsight.

Injection may fail to produce any effect, may result in immediate death, or may be followed by leakage or hydrocephalus ; a single injection may cure, or several may be required. This plan should be employed in most cases unless the child is obviously marasmic or dying from rupture of the sac, or unless the tumour is quiescent and giving rise to no trouble ; of course, if it is shrinking spontaneously, no treatment should be adopted.

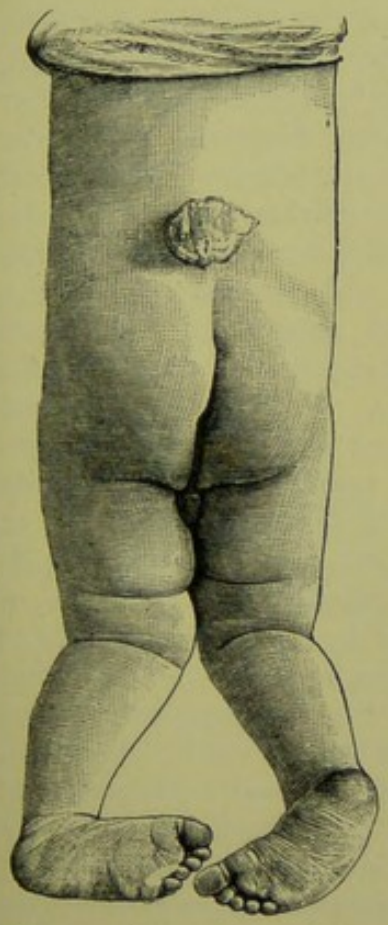

Fig. 139.—A case of cured Spina Bifida (by injection) with co-existing Talipes.

Sometimes a spina bifida is ruptured at birth, or sloughs shortly afterwards from pressure ; nothing can be done for such a case except to dust it over with iodoform and protect it carefully from pressure and contamination with the child's discharges. We have not seen a case recover when the sac has been ruptured in this way, though recovery does occasionally occur (Maylard). Superficial ulceration is less serious and should be managed in the same way. Even if the spina bifida is cured by injection, it is not rare for hydrocephalus to appear later ; hence the mortality, direct or indirect, among these cases is very high.

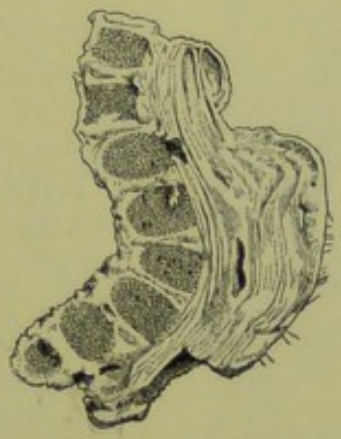

Fig. 140.—Shows a section through a Spina Bifida cured by injection. A small cavity still remains. The child died some time after of scarlet fever.

As already mentioned, in certain cases the sac becomes shut off from the general cavity of the membranes and the cyst remains without communication with any important structures : such result can only occur in meningoceles ; the tumour then usually requires no treatment ; it may, however, be tapped or injected and excised with probable impunity. These cases and sacral spina bifida are the ones most likely to be successfully treated by excision.

In connection with spina bifida must be mentioned the so-called sacral or coccygeal dimple described by Lawson Tait and others. This is a small dimple or depression in the skin over the lower part of the sacrum or upper part of the coccyx; it can often be obliterated by traction upon the skin. It probably results from imperfect obliteration of the dorsal furrow, a sort of incomplete spina bifida. Fig. 141 shows a more marked condition of the same thing, which was associated with talipes. It has been pointed out by Dr. Dunlop, of Jersey,[1] that the dimple may be associated with bending back of the coccyx. Another view of the origin of this little depression, which is quite commonly to be found, is that it represents the 'posterior umbilicus,' or 'blastopore.' It has been supposed to be the remains of the neurenteric canal. Congenital sacral fistulæ are a more marked condition of the same thing: they may cause trouble by retention of sebaceous secretion and require removal; a tuft of hair or 'caudal appendage' has been found in the neighbourhood of these fistulæ (Terrillon, Gueniot, &c.). The case here figured (fig. 141) appears to be an intermediate condition between the ordinary spina bifida and 'spina bifida occulta,' in which the laminæ of one or more vertebræ are deficient, but there is no hernial protrusion. In 'spina bifida occulta' the site of the deficiency is marked by a local overgrowth of hair, and there appears to be usually a co-existing (resulting) tendency to the development of perforating ulcer of the foot and pes varus. We have noted an overgrowth of hair and a formation of trophic ulcers in cases of spina bifida cured by injection; both the hypertrichosis and the ulcer developed only when the tumour was more or less completely shrunken. In such cases endarteritis and neuritis of the affected foot have been found, with great hypertrophy of the muscular coat of the arteries. In cases of spina bifida, both manifest and 'occult,' paralyses and contractures of the lower extremities have been relieved by operation, and the removal of bands and fibrous, fatty, or bony masses pressing on the cord or nerves.

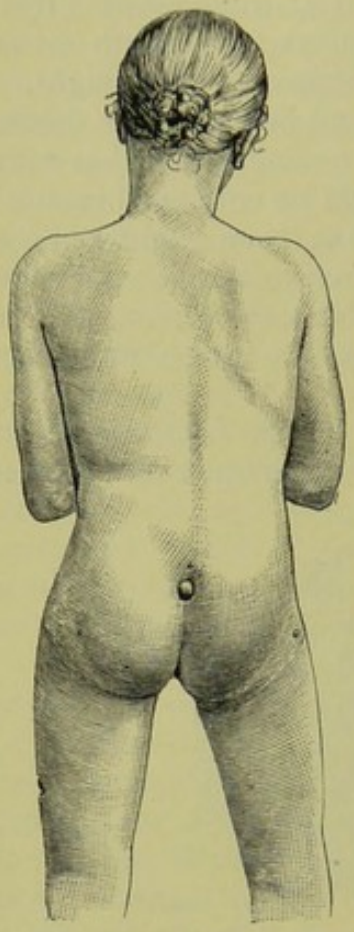

Fig. 141.—Slight sacral Spina Bifida which has undergone spontaneous cure. The girl had also Talipes, and was mentally dull. There was an ulcer on the dorsum of the foot.

Meningocele

Malformations corresponding to spina bifida are not rarely met with in the head. The most common form is a hernia of the meninges forming a meningocele, the cavity of which is the subarachnoid space. In other instances the protrusion contains brain substance as well—encephalocele,

[1] *Lancet*, May 6, 1882.

or hydrencephalocele, or meningo-encephalocele ; the last is, according to Treves, the commonest, and pure meningocele the rarest form.

These herniæ are most common in the occipital region, the protrusion taking place through a median opening corresponding to the space between the centres of ossification of the supra-occipital bone. In other instances it occurs at the root of the nose, through the suture between the frontal and nasal bones, or at one or other angle of the orbit, or at other parts,[1] the pharynx, &c. The general characters of these cysts need no further description here ; they are precisely those of a spina bifida, except that the skin over a meningocele is more often normal. The fluid is often partially or wholly reducible, and its reduction may give rise to pressure symptoms ; the swelling becomes more tense when the child cries, and is more or less translucent according to its contents, whether fluid or cerebral. The course of these cases is often the same as that of a spina bifida : the swelling grows and ruptures, and the child dies ; sometimes, however, the cyst shrinks after, or without, rupturing.

Diagnosis.—The diagnosis is in most cases easy : the swelling is in the position of a weak spot in the skull ; it is congenital. The opening in the

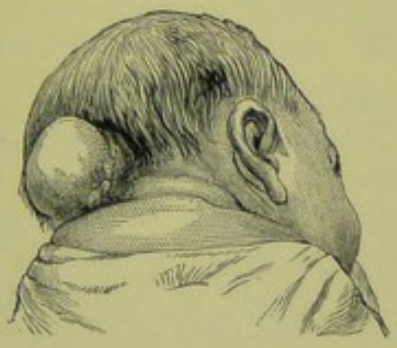

Fig. 142.—Occipital Meningocele.

Fig. 143.—Frontal Meningocele. Spontaneous cure, with resulting deformity of the nose. (Dr. Moritz's case.)

skull can usually be felt, and the other characters mentioned suffice to distinguish it. Sometimes, however, especially when small, it is difficult or impossible to distinguish meningoceles from dermoid cysts, or cysts connected with nævi, especially as nævoid patches are common on the surface of meningoceles. Dermoid cysts sometimes cause perforation of the skull beneath them, and hence are very difficult in such cases to diagnose with certainty ; they are, however, usually more mobile and less affected by pressure than meningoceles. The deformity is often accompanied by idiocy, paralysis, or spastic contractures, and other malformations. In some cases the protrusion may attain enormous bulk, the greater part of the cranial contents being lodged outside the skull. Most museums contain specimens of this sort, which have, however, no practical surgical bearing.

Treatment.—Unless the tumour is enlarging, no treatment except protection is wise ; should anything be desirable, repeated tappings or injection,

[1] The late Dr. Carrington recorded a case of interparietal hydrencephalocele (*Clin. Soc. Trans.* 1881) ; and the protrusion sometimes takes place through the foramen magnum (Holmes, *St. George's Hospital Reports*, 1866) : in this case the cyst was loculated.

as in the case of spina bifida, is the best course for meningoceles. Attempts have been made to excise the tumours, with sufficient success to encourage further trials, in selected cases. We have successfully excised an occipital meningocele in which the tumour did not communicate with the membranes ; but in the operation the membranes, or at least another sac, were opened. No ill result followed. If excision is attempted the skin should be as far as possible dissected back from the membranes, and the latter either tucked into the skull or removed and their edges stitched together. We have also excised an occipital meningo-encephalocele in which a piece of the cerebellum of the size of a walnut was removed ; the child recovered, though it developed hydrocephalus after the operation.[1] But we have had two or three fatal cases of excision of meningoceles since.

Schatz reported favourably of the treatment of occipital meningoceles by puncture and pressure, and recorded a cure in three cases by constriction of the pedicle with clamps.

Much deformity is sometimes produced by the presence and shrinkage of a meningocele. (See fig. 143, kindly given us by our friend Dr. Moritz.)

Occasionally meningoceles protrude through the roof of the pharynx or nasal cavities : in such cases mistakes as to the nature of the swelling have led to speedily fatal results after operation.[2]

Spinal Meningitis

Spinal meningitis mostly occurs in its acute form in association with cerebral meningitis, and in its chronic form in connection with spinal caries. Acute cerebro-spinal meningitis has already been referred to (p. 506), and the symptoms of spinal meningitis, when superadded to those of cerebral meningitis, discussed. The dissociation of the symptoms of each is not easy, as cerebral disease gives rise to symptoms closely resembling those caused by a spinal lesion. Thus, basal meningitis, especially when it occurs low down around the pons, medulla, and cerebellum, will produce tetanoid rigidity with spasms of the muscles of the back and neck. A tumour of the middle lobe of the cerebellum may produce acute pain referred to the spine, and spasm of the erector spinæ (see p. 519). On the other hand, spinal meningitis, either tuberculous, simple, or purulent, may be found *post mortem*, having given no definite symptoms during life, certainly not those usually associated with spinal meningitis.

The most characteristic symptoms of spinal meningitis are shooting pains down the limbs and round the body, with hyperæsthesia of the skin, rigors, quickened pulse, and fever. There are rigidity about the limbs, retraction of the head, and tenderness about the spine. The diagnosis is often difficult : hysteria, tetany, and the cramps associated with acute intestinal catarrh, as well as cerebral meningitis, may be mistaken for it. Synovitis of the vertebral joints may resemble meningitis of the cord. If

[1] Mr. Jessop, of Leeds, also records a successful case of excision, but there was no distinct communication with the interior of the skull ; hence it has little bearing on the general question.—*Brit. Med. Jour.* December 30, 1882.

[2] For tables as to the frequency of different varieties, &c. *vide* Treves' *Manual of Surgery*, vol. ii.

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the spinal meningitis pass into the chronic stage, paresis of the upper and lower extremities may come on. Syringo-myelia may produce very similar symptoms.

Spinal meningitis is a disease which tends to a fatal termination, but not so certainly as cerebral meningitis: certainly, cases diagnosed as spinal meningitis recover. Cases such as the following are not altogether uncommon:

A girl aged 13 years complained six days before admission of pain in the back; her head was drawn back, she could not sleep for the pain. On admission she was evidently acutely ill; she lay on her side in bed, with her legs drawn up, and there was great retraction of the head; there was much pain along the spine, aggravated on movement; pain shooting along the arms was complained of; the pulse was 108, the temperature varied from 98° to 102° Fahr. She was given chloral hydrate, and an ice-bag was applied to the spine; for five or six days she continued acutely ill, the temperature varying from 97° to 102°; there were several rigors on succeeding days: the head was retracted, any forcible movement forward caused pain, there was exaggerated knee-jerk, and ankle-clonus was present. The symptoms gradually subsided about a week after admission, leaving her very weak and emaciated. In six weeks she was discharged well.

Such cases may be open to the suspicion that the inflammatory lesion present was in the vertebral joints or spinal muscles rather than in the spinal canal; but, on the other hand, none of the other joints or muscles were affected, and there is no reason why a spinal meningitis should not occur and get well again. Epidemic cerebro-spinal meningitis can hardly be excluded in such cases. A case in which laminectomy, incision, and drainage of the theca was done successfully is recorded by Rolleston and Allingham in the 'Lancet' of April 1, 1899.

Treatment.—Rest in bed, in perfect quietness, is essential. Ice to the spine is probably the best local application that can be used. The pain must be relieved by small morphia injections, or opium may be given by the mouth. Instead of opium, bromides and chloral may be first tried.

Paraplegia

By far the commonest cause of paraplegia during childhood is compression of the cord from caries of the bones of the vertebræ; in rare cases the cord is compressed by a tumour, growing from the sheath of the cord. Other forms of paraplegia occur which may be due to myelitis, following measles or other zymotic disease, an acute atrophic paralysis affecting both legs, and some other anomalous paralyses of uncertain origin. There is also the spastic paralysis of cerebral origin and hysterical paraplegia.

Compression of the Cord from Spinal Caries.—It is important to bear in mind that the paraplegia which occurs in association with caries of the spine is less often due to direct pressure from the deformity produced by the falling together and bending of the vertebræ than to the inflammatory products which are thrown out around the cord. We may therefore have a paraplegia without the slightest external deformity of the spine, and, moreover, a perfect recovery may issue in a given case by absorption of the inflammatory products—a result that could hardly be expected if the compression was due to the direct pressure of a bent spine. The inflammatory process

which commences in the body of a vertebra is apt to spread, so that lymph or curdy pus is effused outside the dura mater, between the latter and the bone, or inside the dura mater, and the cord is compressed, or the cord may also be affected by the inflammatory process. Pressure on, and inflammatory changes in the cord itself may take place at any part of the cord—cervical, dorsal, or lumbar region. Pressure is also exceedingly likely to affect some of the nerves, the latter being surrounded and compressed by inflammatory products as they pass through the dura mater and foramina.

Symptoms.—Symptoms of compression of the cord or its branches may come on early or late in the disease. In the majority of cases the early symptoms are those connected with deformity of the spine and perhaps irritation of the sensory nerves, and it is only late in the disease, when the deformity has been well marked for many months, that symptoms of pressure on the cord supervene. In the minority of cases it is the weakness and paresis of legs with exaggerated knee-jerk that suggest the onset of spinal caries. It is important to bear in mind that a paraplegia may exist for many months without any deformity of the spinal column being present, the latter eventually supervening, and explaining the cause of the paraplegia, which had remained in doubt. Gowers mentions the case of a patient who had complete paraplegia for six months ; an experienced surgeon who examined him was unable to detect the existence of spinal caries, and yet a few months later undoubted symptoms of bone disease appeared.

The motor paresis usually comes on gradually : the child is weak upon its legs, quickly tiring, and supports itself whenever possible by the help of chairs or tables. When the dorsal cord is compressed the reflexes are exaggerated ; if the sole of the foot is tickled as the child lies in bed the foot is sharply withdrawn ; there is exaggerated 'knee-jerk' ; ankle-clonus can usually be readily obtained. Gradually a spastic paraplegia comes on : the child cannot walk, or later cannot stand, without help, and when lying down in bed the knees tend to draw up and the feet to be extended in consequence of the rigidity of the calf muscles. Usually there is no loss of sensation. The sphincters may be affected, and bladder troubles may ensue if the lumbar cord become involved by descending inflammation. Prior to the onset of motor or cord symptoms, there may be various shooting pains experienced along the intercostal nerves ; children with commencing caries of the spine will complain of 'belly-ache' or refer the pain to the pit of the stomach or sternum. Thus pain referred to the umbilicus suggests that there is irritation of the tenth dorsal nerves (eighth dorsal vertebræ), to the ensiform cartilage irritation of the sixth and seventh nerves (fourth and fifth dorsal vertebræ), or pain referred to the thorax irritation of the upper dorsal nerves. There may be hyperæsthesia or anæsthesia of the skin.

When the cervical region of the cord suffers the symptoms are apt to be more marked than when the dorsal region is affected ; there may be pains shooting down the arms, shoulders, neck, and scalp, according to the position of the lesion ; hyperæsthesia and later anæsthesia of the skin. The sensation of pins-and-needles is often complained of. There is gradual loss of power in one or both arms, and wasting of the muscles. The shoulder muscles, serratus, flexors of the elbow and supinators are affected when the fifth and sixth nerves are involved ; the extensors of the wrist and fingers when the

sixth and seventh ; and the extensors of the elbow, flexors of the wrist and fingers, and pronators, when the seventh and eighth are involved. A spastic paraplegia may come on, as in disease of the dorsal cord.

When the lumbar enlargement is compressed, or its branches, there is paraplegia, the reflexes are not exaggerated, but are abolished, and no knee-jerk can be obtained—that is, if the inflammatory material compresses the cords of the cauda equina. The sphincters, both of the bladder and rectum, are likely to become paralysed if a compression myelitis of the lumbar cord takes place.

The course of the disease varies exceedingly, and depends upon the extent and chronicity of the inflammatory processes in the bones. Recovery from the paralysis may take place after the patient has been bedridden and helpless for many months and even years, and where recovery was hardly thought to be possible. On the other hand, the progress may be from bad to worse, there being a gradually extending myelitis, so that the sphincters become paralysed and the patient suffers from incontinence of both urine and fæces. Sensation may become impaired, and the patient at last dies of exhaustion or the results of cystitis, or not infrequently of tuberculosis or lardaceous disease. For treatment see DISEASE OF SPINE.

Myelitis.—By far the commonest inflammatory lesion of the cord in children is that form which is localised in the grey matter of the anterior horns, which has received the misleading name of 'infantile paralysis.'

An acute transverse myelitis occurs in children as well as in adults, but it is apparently less common. Disseminated or focal myelitis appears sometimes to occur during some of the zymotic diseases, as typhoid fever, influenza, measles. Transverse myelitis is rare before the age of 10 years ; it seems mostly to follow exposure to colds or accidents such as occur to schoolboys in the football field. In one of our cases, that of a boy of 8 years of age, it followed paddling in the water. It is very probable that 'catching cold' or an accident is only the predisposing, the effective cause being a toxin formed by the action of micro-organisms.

The *symptoms* are much the same as in adults ; the ultimate chance of recovery is, however, greater, as the cord seems to recover itself more readily in early life than in later years. There is usually a feeling of 'pins-and-needles' in the feet, and sometimes rheumatoid pains followed by loss of muscular power. At first this may be slight, but after a few hours it becomes more marked, and within twenty-four or forty-eight hours it has reached its height. There is loss of sensation as well as of motion, varying in extent according to the length of cord affected. There is also incontinence of urine and fæces ; if the lesion is above the lumbar enlargement, the sphincters contract normally, but the control exercised by the will is cut off. The commonest part of the cord to be affected is the dorsal region ; often there is some feverishness.

All degrees of motor and sensory paralysis may be present. In severe cases almost all power is lost and the legs fall about in a helpless way, though usually some power of movement is retained in the toes. The reflexes may be completely absent. After a variable period, if the lesion is above the lumbar enlargement, the reflexes return and become excessive ; there is ankle-clonus, the knee-jerk is abnormally vigorous, and a condition

of spastic paraplegia comes on. Sensation, if it has been absent, usually returns before recovery of motor power.

The amount of recovery which takes place is variable ; we have seen complete recovery eventually ensue in cases where, from the amount of motor and sensory paralysis present in the first instance, we had not thought it possible. Many months in bed are necessary to effect this ; the intense spastic paralysis gradually lessens and may eventually disappear.

If the lumbar enlargement is affected, not only is there complete motor paralysis, but the muscles waste rapidly, the rectal sphincter is completely relaxed, and the urine dribbles away from paralysis of the sphincter of the bladder.

If the cervical enlargement is affected, the arms are paralysed, the pupils may be dilated, and death is apt to ensue from interference with the nerve supply to the muscles of respiration.

As instances of what were probably cases of subacute myelitis, one occurring after measles and another after what was said to be a 'cold,' we may mention the following cases :

Myelitis following Measles.—Gertrude H., aged 4 years, was quite well till she contracted measles in August 1882 ; when convalescent it was noticed she could not stand by herself. She remained bedridden till admitted to the hospital in December. At this time she could not bear the weight of her body without help ; the knee-jerk was exaggerated, the front-tap contraction was present, there was no ankle-clonus. She slowly improved, and by February 1883 she could stand alone and walk with help, throwing her legs forward. She finally entirely recovered after some months.

Myelitis.—George C., aged 13 years, was quite well till May 1882, when he caught a cold and had a feverish sore throat ; after this his legs became weaker, though he could always walk with help. He was admitted September 1882 ; both his legs were weak, but he could walk, swaying from side to side, bending both knees very much ; no loss of sensation, muscles reacted normally to both continuous and faradic currents ; knee-jerks exaggerated, the slightest touch producing a jerk ; there was no evidence of any spinal disease. He remained much in the same condition till January 1883, when he went home. He finally completely recovered, after attending as an out-patient for some months.

It is difficult to account for the symptoms in these two cases except on the supposition that they suffered from either compression or disseminated myelitis, which eventually got well.

Sir Thos. Barlow records a fatal case of disseminated myelitis [1] occurring during an attack of measles, which proved fatal on the eleventh day of the disease. He quotes two cases of children, aged 2 years and 3 years respectively, who suffered from paralysis apparently due to myelitis when convalescent from measles. We have seen several similar cases of paralysis apparently due to myelitis following measles ending in recovery.

Treatment.—Perfect rest in bed is of the greatest importance in the inflammatory stage, all movements and excitation of the spinal cord being avoided as much as possible. The patient should lie on his side or his face in preference to his back, so that the spine should not be the most dependent part. Of local applications the spinal ice-bag is probably the best, though some prefer the application of moist heat with counter-irritation, such as

[1] 'On a case of early disseminated myelitis occurring during measles.'—Sir Thos Barlow, *Proc. of the Royal Med.-Chir. Soc.*, vol. ii. p. 146.

mustard poultices, so as to redden the skin. Probably there are no medicines which can control or moderate the inflammatory lesion. Aconite, ergot, the bromides, have all been used with varying success. Both mercury and iodide of potassium have also been prescribed.

Great care must be taken to prevent bedsores : perfect cleanliness must be observed, and pressure taken off any spot where the skin becomes red. The incontinence of urine and fæces is always a source of difficulty, as the urine and damp bed-linen fret the skin and give rise to sores. The best position for the patient is on his face, so that the urine as it dribbles away may be received into a bed-pan. Boric or iodoform cotton wool may be used to surround the genitals and absorb the discharges. If there is retention of urine, the catheter must be used. No good can be expected from the application of the faradic or galvanic current in the early or inflammatory stages ; indeed, harm may not improbably be done by exciting and frightening the child. The more at rest the cord is allowed to remain, the better chance is

Fig. 144.—Pes Cavus ; early case of Friedreich's ataxy.

there of absorption of the inflammatory material and recovery of function of nerve elements.

In the chronic stage good may be done by gentle friction applied to the muscles, and by the application of blisters or the actual cautery over the region corresponding to the disease. A change to the seaside, the patient being wheeled out in the open air in a recumbent position, is likely to expedite recovery by improving the general health.

Hereditary Ataxic Paraplegia or **Friedreich's Disease** is the name given to a form of ataxia which commences for the most part during early life, and which tends to affect several members of the same family. It most commonly appears during the period of the second dentition or from that on

to puberty. The most characteristic feature of the disease is a reeling gait, the patient swaying about both in walking and standing, a condition made more apparent by the closure of the eyes. The knee-jerk is quickly lost or it may be absent in a still earlier stage; though in some cases resembling this form of ataxia the knee-jerks have been described as present. The plantar-reflex is readily evoked and is of the extensor type. Failure of muscular power in the legs gradually comes on and the feet assume the shape and position called 'pes cavus.' There is hollowing of the sole of the foot, humping of the dorsum, and the great toe assumes the Z-shape position. (See fig. 144.)

Lateral curvature of the spine takes place in some cases. Nystagmus is a frequent symptom. The intelligence is not affected, but speech in some cases is indistinct. The progress of the disease is slow and the patient may be bedridden for years. The movements of the hands, head, and trunk are apt to become jerky or tremulous when movement is attempted. Late in the disease the hands, like the feet, become deformed, developing a more or less claw-like condition.

Nothing is known about the etiology of the disease, but it is remarkable that it is apt to occur in several members of the same family.

The lesion in the cord consists of a sclerosis of the posterior columns, but the lateral and anterior may also be affected. The cells in Clarke's column have been found wasted; and the posterior roots degenerated. The cerebellum has been described as small.

The diagnosis is not always easy. The facts that the disease begins between 6 and 10 years of age and affects several members of a family may help to distinguish it from disseminated sclerosis. In the latter disease the deep reflexes are exaggerated. The resemblance between Friedreich's ataxia and hereditary cerebellar ataxy is very close, but the latter does not usually commence till 20 years of age, and the knee-jerks are active and there is usually ankle-clonus.

Anterior Polio-myelitis. Acute Atrophic Paralysis. 'Infantile Paralysis'

Etiology.—The disease, which is usually known by the name of 'infantile paralysis,' occurs most frequently during early childhood; but, as a form of paralysis exactly similar occurs during the later years of childhood and also during adult life, the name certainly ought to be abandoned. It most frequently occurs during the first three years of life, at least four-fifths of the cases occurring at this period (Gowers). It is less frequent during the first six months than it is during the last half of the first year and during the second. It is by no means a rare disease in older children.

Very little is known as to its cause, and, while it occurs both in the strong and weakly, in the majority of cases in our experience it has been met with in typically healthy children, with a good family history, and who could not be said to ail, and no reason could be assigned for its onset. It certainly appears to be commoner during the warm quarter of the year than at any other period, and is associated in many cases with gastro-intestinal disturbance. It follows occasionally as a sequela of measles, scarlet fever,

typhoid, pneumonia, and acute diarrhœa. There has been a growing belief during the last few years that the inflammatory lesion in the cord is due to the action of toxins produced by micro-organisms. No specific micro-organism has at the present time been isolated; the evidence of the bacterial origin of this disease rests upon the fact that limited epidemics have been observed, and that other diseases—such as posterior basal meningitis, tetanus, and diphtheritic paralysis—are due to toxins formed by bacterial action. Epidemics have been described by Medin, W. Pasteur, Buzzard, and others, but it is a noteworthy fact that in some of the cases neither the symptoms nor the *post-mortem* findings exactly corresponded with typical cases of anterior polio-myelitis. It is important to note that some of the patients suffered from the prevailing fever, but not from paralysis. In a case of our own recorded below there was a feverish attack from which the patient recovered, followed by a similar attack, associated with paralysis of one leg.

Symptoms.—The course of the disease may be conveniently divided into stages, and, following Gowers, they may be stated thus :

1. An initial stage, during which the paralysis occurs, usually preceded or accompanied by fever, and lasting a few hours to a week. 2. A stationary period, which lasts from a week to a month. 3. A period of 'regression,' during which the paralysis disappears in certain of the affected muscles, leaving others still paralysed ; this stage usually occupies one to six months. 4. A chronic stage, during which atrophy occurs and deformities and contractures are developed. Some improvement may take place during this stage.

1. The initial stage is usually accompanied by fever and often by severe pain ; in some cases there is gastro-intestinal disturbance. We have known the attack to commence with convulsions, retraction of the head, and coma, and a diagnosis of posterior basal meningitis made. Indeed epidemics of cerebro-spinal meningitis have been associated with unusual prevalence of anterior polio-myelitis. The severity of the attack differs much in different cases ; it has rarely been closely observed, being usually attributed to dentition or gastric disorder, and only when the paresis has supervened has the importance of the attack been recognised. The acute attack may be entirely absent, or, what is more likely, ill-defined, so that it is overlooked by the friends, and the only history obtained is that the child was put to bed well, and that in the morning a limb or limbs had become powerless and limp. The paralysis is usually first noticed after the acuteness of the attack has passed, and in infants it is very likely to be overlooked at first, or thought to be due to weakness only. The paralysis may come on suddenly without warning ; in one case we know of, the boy fell down in the street when out for a walk, and in another a small girl fell down immediately after paddling in the sea at Blackpool. It is difficult to say what proportion of cases die in this stage, for probably the nature of the disease would not be recognised, and the attack attributed to the early stage of some acute disease. Nevertheless, such cases have been recorded, and lesions found in the grey matter of the spinal cord.

It sometimes happens that two members of a household are attacked with fever, &c. ; one gets well and the other is seized with characteristic

'infantile paralysis' affecting some group of muscles. In other instances two or more members of a household within a few days of one another suffer from attacks associated with paralysis of the anterior polio-myelitis type.

There seems to be no relation between the severity of the initial attack and the extent of the paralysis which follows it, some of the most extensive and severe paralyses being accompanied by hardly any febrile disturbance.

In some cases there is an acute attack, which passes away, leaving no definite paresis; another similar attack follows, and when this clears up a paralysis is noted. This was the case in the following instance. A boy aged 2 years was quite well and running about, when one day he was taken suddenly ill, crying, vomiting, and feverish; the following evening he was convulsed; he was put to bed and continued ill for two or three weeks with apparently some brain trouble; this attack left him very weak; but he gradually recovered and was able to run about again. He continued well for two months, when the same symptoms returned; he cried with pain, there was vomiting and fever, followed by convulsions; he remained ill for fourteen days, and just as he was getting up and about again it was noticed that his right leg was paralysed. When seen two months after, there was wasting and paresis of the right buttock, thigh, and dorso-extensors of the foot.

While in typical cases there is more or less complete loss of motor power without the sensory nerves being affected, yet it sometimes happens there is severe pain, and in rarer instances anæsthesia. It is certain in these exceptional cases that the lesion is not absolutely confined to the anterior horns. There may be severe shooting pains before the onset of the paralysis, or the pains may remain and there may be hyperæsthesia or pain in handling the limb. Such cases readily pass muster as 'hysterical,' especially in girls, but the definite paralysis which remains makes the diagnosis only too certain. The following case of severe anterior polio-myelitis commenced with severe pain:

Alice D., æt. 10½ years. Quite well till October 1896, when she had two boils on her back which troubled her a good deal. On October 31 she did not feel well and had headache; the next day she was seized with violent pains in the back, arms, and legs, and had a temperature of 103°; this continued for three days, when it was noticed there was almost complete loss of power in her back, arms, and legs; the pain was worst in the legs, making her scream loudly. She gradually regained power in her back and arms, so that she could sit up and feed herself; the left leg remained completely paralysed from the rotators of the hip downwards; the right leg has regained slight power.

In another case seen with Dr. Sheldon of Macclesfield, a girl of 10 years had an indefinite febrile attack, followed during convalescence by loss of power in the muscles of the right hip; there was some pain complained of, and there was hyperæsthesia. The paresis of the muscles affected was permanent. It is important to remember that if seen during the first week the faradic irritability of the muscles may be excessive, and a vigorous knee-jerk obtained.

2. After the paralysis has set in, a period during which the paresis of the muscles is stationary ensues, varying from two weeks to six weeks or two months. At this time the affected muscles are limp and powerless, so that the limb or limbs hang quite useless and flail-like. In

the more severe cases almost all the muscles in the body appear to be involved ; the child cannot sit up, its head falls to one side through paresis of the muscles of the neck, its cry is weak or almost lost from weakness of the diaphragm and intercostals, its respiration is shallow and rapid, and its limbs relaxed and motionless. The paralysis may be confined to one limb or a group of muscles in a limb : thus an arm may hang useless by the side, and if raised above the head falls flail-like by the side. One or both legs may be powerless, and may be flexed, extended, or rotated without any resistance from the tonus of the muscles. The muscles of the neck, back, and intercostals may be affected. Hemiplegia is rare. The reflexes, both superficial and deep, are lost, so that tickling the sole of the foot or percussing the patellar tendon meets with no response. It is difficult to judge if there is any loss of sensation or at least sensory paralysis. In the most severe cases we have noticed that sensation is not as acute as usual : a spoon which, to a normal skin, is unbearably hot can be borne without eliciting any expression of pain on a recently paralysed foot, and in the same way a painfully severe application of faradism will be borne without flinching. It must be remembered, however, that the circulation in the skin is interfered with by the lesion of the cord, and, moreover, it is much more difficult to test the sensations of an infant 6 or 8 months old than it is those of an adult. The functions of the sphincters of the bladder and rectum are rarely interfered with. We have, however, seen one case of a boy aged 4 years where for a few days after the onset of the paralysis, which affected both legs, a catheter had to be used twice a day on account of paralysis of the bladder.

The irritability of the muscles to the faradic current becomes lessened during the course of the first week or ten days, and is usually entirely lost in those muscles where a permanent paralysis has taken place, and thus the careful testing of the muscles may be of importance for prognosis. To the continuous current the muscle irritability is increasing during this period, though it gradually is lessened as the muscles waste, and may disappear during the atrophic period. The quality of the muscle irritability differs from normal, presenting the 'reaction of degeneration'[1] due to the degeneration of the nerves to the affected muscles.

In the majority of cases one limb only is affected, and the muscles of one group or groups are more affected than others ; in some few cases the paresis at first involves not only the limbs, but the diaphragm and intercostals. The most severe case coming under our notice was the following :

A girl of 9 months was quite well and healthy till June 21 ; she was able to raise herself up in her cradle, and could support herself with help on her feet. She was suddenly

[1] In a normal condition the weakest galvanic current which causes contraction of a muscle is a descending one—i.e. when the anode or positive pole is on the spine, while the kathode or negative pole is on the muscle, the contraction occurring on closure of the current. This is the kathode closure contraction, K.C.C. When there has been degeneration of nerves, contraction may occur more readily with an ascending current—that is, with the anode on the muscle : the anode closure contraction, A.C.C. Normally, K.C.C. is greater than A.C.C. ; in nerve degeneration A.C.C. may be equal to or greater than K.C.C. Normally, the opening anodal current, A.O.C., is greater than the kathodal opening current, but this may be reversed in disease.

seized with convulsions in which her face and arms twitched; this was followed by a discharge from one ear, and at the same time she was completely prostrated, her voice was hardly audible, she lay in bed perfectly motionless, except a rolling of the head from side to side. She was admitted to hospital on July 30, when the following notes were made by Dr. Kershaw: 'She is a well-nourished child; lies in bed quite helpless; the lower extremities are completely paralysed; there appears to be some loss of sensation, as only the application of the strongest faradic current appears to cause pain. She can bear without crying the contact of a hot spoon, too hot to be held in one's own hand; can move the right arm at the shoulder and elbow, but not the hand; the left arm is completely paralysed, though she seems to be able to move the fingers slightly. There is paresis of the intercostals, respiration mainly abdominal. No reactions to the strongest faradic current were obtained in the legs; some response could be obtained in the flexors of the forearm. She died of pneumonia on August 7, forty-seven days after seizure' (see p. 616).

3. The *stage of 'regression'* or improvement now commences, the improvement continuing for several months, many muscles being completely restored, while others become more and more flabby and atrophic. In rare instances all the paralytic muscles may recover. The child's health at this time is usually good; it is as bright and cheerful as usual, and there is apparently nothing amiss except the paralysis. The muscles, which are gaining in power, respond more readily to the interrupted current than at first, while the atrophic muscles fail entirely to react.

4. After some months improvement ceases, or, at least, any improvement which takes place six months after the onset is usually very slight indeed. The atrophy mostly goes on, and certain contractures, especially affecting the leg below the knee, leading to deformities, are apt to take place. At this period it is possible to make a forecast of the amount of paralysis which is likely to be permanent, and take stock, as it were, of the real damage which has taken place, which is probably much less than at first appeared likely. This permanent paralysis may affect a whole limb, though it rarely does this, some groups being entirely powerless, others only slightly weakened or not affected at all.

Sometimes the groups affected are associated together in their actions, as when the *upper arm type* of Erb is present, the deltoid, spinati, biceps, and supinators being affected, while the muscles of the forearm, excepting the supinators, escape, the lesion in the cord being situated on a level with the fifth and sixth cervical roots (see fig. 146). The deltoid is especially apt to suffer severely and if the muscles attached to the head of the humerus are also affected, the head of the humerus may easily slip out of the socket. In rarer cases the *lower arm type* is present, the muscles of the forearm and small muscles of the hand being involved. It is important to remember that the groups have no relation to their peripheral nerve supply, such as would be present if the paralysis was extra-spinal. Very often the muscles paralysed have no relation to one another, being picked out, as it were, at random.

In the *lower limb* the muscles below the knee usually suffer more complete paralysis than those of the thigh or buttock. The peronei usually suffer most, the result being that the heel is drawn up and the foot turned inwards (talipes equino-varus) by the unbalanced action of the gastrocnemius; as time goes on the contracted condition of the calf muscles, aided by the shortening of the leg, becomes permanent in consequence of a fibroid

degeneration taking place, and the foot can no longer be dorso-flexed. In the same way talipes valgus may be produced by paralysis of the tibialis anticus, more rarely talipes calcaneus by the paralysis of the gastrocnemius. Both legs below the knee may be paralysed, both extensors and flexors; and the patient cannot stand, but progresses by crawling on his hands and knees, dragging his wasted legs after him.

Of the thigh muscles, the rectus, vasti, and adductors are more often paretic than the hamstrings, and thus flexion of the knee may result and become permanent. The gluteal muscles and rotators of the hip are often weak, so that the child in walking gives way at the hip.

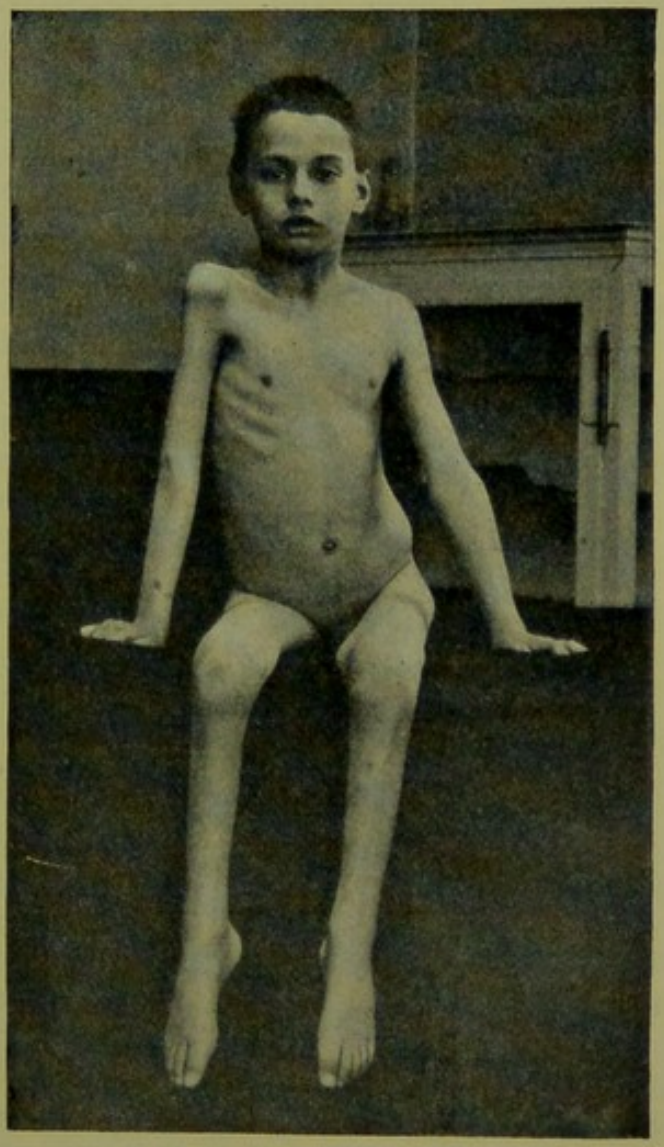

Fig. 145.—A. H., aged 9 years. Acute Atrophic Paralysis legs, back, and arms affected.

The muscles of the *spine*, sacro-lumbalis, &c., and those of the neck and diaphragm, are sometimes permanently paralysed. Lordosis is present if the sacro-lumbalis is weakened. Lateral curvature may be present. In severe cases the paralysis is very extensive, rendering the patient very helpless. Thus in the case of the boy figured in 145 and 146, he could manage to sit up for a short time, if helped, by supporting his trunk with his hands and arms. Both legs were almost completely paralysed. The intercostals were partially paralysed, and so also were the arms.

One or both sides of the abdominal walls may be paralysed, with bulging of the abdomen, especially noticed when the patient sits up. If one side only is affected there is loss of the abdominal or epigastric reflex, which contrasts markedly with the movement obtained on the other side.

The paralysed muscles are always atrophied, though at times much subcutaneous fat may give a delusive appearance of solidity to the muscle. In the most wasted muscles there is a complete loss of faradic irritability: there is usually more or less present in those only partially paralysed. The irritability to the continuous current gradually disappears as atrophy progresses and in the wasted muscles becomes completely lost.

Arrest of development of the limbs which are paralysed also takes place; the bones appear to grow more slowly on the paralysed side. Other bones such as ribs and pelvis may be affected. The *joints* often become more movable from relaxation and stretching of the ligaments, as well as from the loss of support afforded by the normal muscles; the articular ends may become deformed. The circulation through the skin of the paralysed limbs becomes slow, the surface has a blue or purplish appearance and feels cold to the touch. Chilblains and ulcers are apt to form on the paralysed limbs, and be slow to heal. The bones themselves frequently degenerate; in some cases little true bone may remain, fat taking the place of the osseous tissue. Injuries, operative or accidental, of such limbs are slow in healing; on the other hand, acute inflammations rarely attack the tissues.

Pathology.—There is an acute inflammation, the greatest stress of which falls on the anterior cornua of the grey matter in the cervical and lumbar enlargements. In severe cases the grey matter of the dorsal cord is also affected. Observations made in recent cases by Rossiter, F. E. Batten, and others, have shown that the branches of the anterior spinal artery are thrombosed, there is an effusion of leucocytes and the nerve cells in the anterior horns are degenerated. Minute extravasations of blood are frequently seen. Many degenerated nerve fibres may be seen in the root zone and other tracts. In our own case (p. 613), similar changes were visible in the grey matter of the lumbar, dorsal, and cervical cord. In the medulla there was an engorgement of the vessels. During the next few months an absorption of inflammatory material and perhaps also repair of damage by the formation of new nerve fibres or cells goes on, while a certain amount of muscular power which has been lost is regained. Finally a sort of cicatrisation or shrinking takes place, leaving a permanent paralysis of the muscles supplied by the nerve centre which has been destroyed.

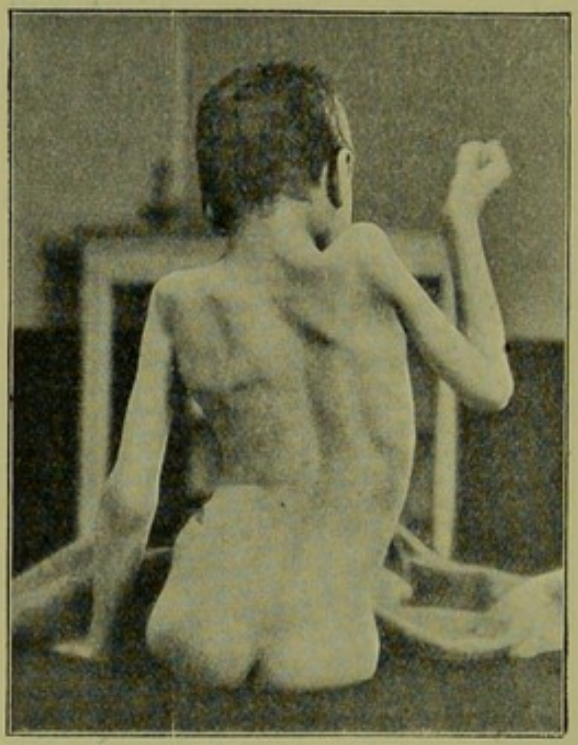

Fig. 146.—A. H., aged 9 years. Acute Atrophic Paralysis; he can sit up by help of hand; right shoulder muscles paralysed (upper arm type).

Degenerative changes take place in the nerves which are connected with the damaged centres in the cord; the muscles also waste; their connective tissue becomes hypertrophied, so that in extreme cases very few muscular fibres are left. The muscles which antagonise the paralysed muscles mostly also waste, their muscular fibres becoming replaced by connective tissue.

Prognosis.—In ordinary cases prognosis as regards life is favourable. As regards muscles, there is a strong probability that partial, not complete

recovery, will take place. It is very difficult at first to estimate how much this will be, but it is often more than is anticipated.

Diagnosis.—The diagnosis during the acute attack is always difficult, mostly impossible ; the fever, delirium, and convulsions sometimes present naturally suggest some cerebral disease such as meningitis or the onset of scarlet fever or pneumonia. It is only when paralytic symptoms present themselves that the diagnosis is made ; even then the paralysis may be overlooked, especially in young children, it being supposed that the child is simply weak as the result of the acute attack. When once the paralysis has set in, diagnosis is easy, though when paraplegia is present the distinction between transverse myelitis of the lumbar region and polio-myelitis may be difficult, but we must bear in mind that anterior polio-myelitis is infinitely the more common disease during early life. We have once or twice when seeing the patient within a day or two of the onset of the paralysis noted an exaggerated knee-reflex, and in consequence excluded anterior polio-myelitis, but later the knee-reflex has disappeared, and the wasting of the limb made it certain we were mistaken. Under similar circumstances the faradic irritability is well marked, but disappears later.

We have several times known the mistake made of diagnosing anterior polio-myelitis when the condition of immobility was due to periosteal tenderness caused by infantile scurvy. In one case we saw, where there was a slight facial paralysis, associated with paralysis of most of the muscles of the opposite arm, accompanied by severe pain, it was thought to be a case of neuritis, and a moderately good prognosis given. The facial paralysis disappeared, but the arm only partially recovered.

In cerebral paralysis there is no loss of faradic irritability, and no muscular wasting takes place.

Treatment.—The treatment of anterior polio-myelitis in the early stages is that of an acute inflammatory lesion of the cord. The child must be kept as quiet as possible in bed, given a milk diet, and good may possibly be done by applying mustard poultices to the spine. If there is fever, aconite and bromide of potassium may be given. When the acute stage has passed away, and the child is left in a prostrate condition, the greatest care must be taken to keep the child at rest as much as possible, all excitement of every kind being avoided. It must be borne in mind that, in patients dying many weeks or even two or three months after the onset, evidences of the inflammatory lesion may still be found in the cord, and during this period absorption of inflammatory material is going on, and the object to be aimed at in treatment is to secure the recovery of as much of the damaged cord as possible. A variable amount of nerve tissue has been certainly irretrievably damaged, but some recovery is certain, and the more the general health is maintained and the child kept at rest, the more it is likely that recovery will take place.

It may be doubted if there are any medicines which have any direct influence over the nutrition of the cord or directly influence any morbid processes going on. Perhaps the most likely drugs to be of service are sedatives such as belladonna and bromides in combination with iron or quinine.

The question of how soon should massage or electrical treatment be begun is an important one ; for on the one hand, the paralysed muscles are quickly

wasting on account of their nerve centres being damaged, but on the other hand the disturbance of the child, the fright and excitement of the daily application of the battery, are not unlikely to do harm. The application of the battery current is hardly likely to modify or favourably influence the lesion of the cord, but it may help to maintain the nutrition of the muscles while recovery is taking place in the cord. Gentle rubbing or massage of the paralysed limb or limbs may be practised from the first, and voltaic currents may be used within a month or six weeks. It is wise to begin with a very weak current, at first using large wet sponges as electrodes, and frequently interrupting the current, which after a few applications should be just strong enough to secure a contraction. The application should be made daily for many months, especial care being taken to select the paralysed muscles in the limb.

An important part of the treatment is to encourage the patient to put forth as much voluntary power as possible, and he should constantly try to use the weakened limb. We believe that systematic attempts to use the paretic muscles, combined with shampooing of the limb, are of more value in promoting recovery than any electrical applications. The circulation in the paralysed limb is certain to be slow and defective ; friction of the skin, with kneading of the muscles, is certainly beneficial ; while a well-selected series of movements attempted on the part of the patient, or carried out by an attendant, assists the return of power in the muscles. These measures must in most cases be persevered in for many months, if not years, in the hope of improvement. The paralysed limbs must be warmly clad and carefully protected from cold.

Much may be done in the chronic stage by means of mechanical devices such as the application of artificial muscles and splints to prevent and correct deformities and support the limb. Division of the tendo Achillis, plantar fascia, and other resisting structures is often required. Some progress has been made in recent years in muscle and tendon grafting. For useless flail-like limbs the question of excision of joints to procure greater stability, or even of amputation, has to be considered. (*Vide* also chapter on TALIPES.)

Chronic Spinal Muscular Atrophy. Progressive Muscular Atrophy.—This disease for the most part belongs to adult life, and but rarely occurs in children ; the progressive muscular atrophies most common during early life are those classed with the muscular dystrophies (see p. 620). The following case illustrates this somewhat rare disease.

Peter L., aged 10 years (see fig. 147). Mother stated that two months ago she noticed he could not button his trousers or coat ; about the same time she noticed that he walked badly ; his arms and shoulders have been getting weaker, and he has difficulty in taking his coat off. On admission it was noted that the thenar and hypothenar eminences of the right hand were extremely wasted, indeed had almost entirely disappeared ; the interossei were much wasted. There was similar wasting in the left hand, but not so marked. The fingers of the right hand were extended at the metacarpo-phalangeal joints, thus giving the hand a 'claw-like' appearance. There was wasting of the right forearm and upper arm, both flexors and extensors. The deltoid was not much affected. There was wasting of the muscles of the sole of the foot of the right side, giving it a hollowed-out appearance, the right great toe was dorso-flexed at the metatarso-phalangeal joint, the calf and muscles of the legs were flabby, but not much wasted. The muscles of the left foot were wasted, but less than the right. There were no fibrillar twitchings in the muscles, the knee-jerks were

increased, no ankle-clonus, the elbow-jerk was present. The galvanic reactions of both hypothenar eminences showed A.C.C. > K.C.C. Interossei A.C.C. = K.C.C. on the right side, K.C.C. < A.C.C. on the left. No contractions with a strong faradic current could be got on the right hypothenar and thenar eminences ; a slight contraction on the interossei of right and muscles of the left hand. The muscles of the scapulæ and back are flabby, but there is no definite wasting or paresis. The face wears a more or less expressionless appearance, but there was no paresis or actual muscular wasting.

Neurologists usually distinguish between the 'hand-shoulder' type and the foot or 'peroneal' type of chronic spinal muscular atrophy. The first of these types is for the most part a disease of adult life, while the peroneal type of Tooth mostly commences before puberty. In the case related the wasting and the weakness of the hand and feet commenced about the same time. Both types have many symptoms in common ; there is gradual weakness, and marked wasting of certain groups of muscles, other groups of muscles becoming gradually affected. Usually, but not always, there are idiopathic fibrillations of the affected muscles, the faradic irritability dis-

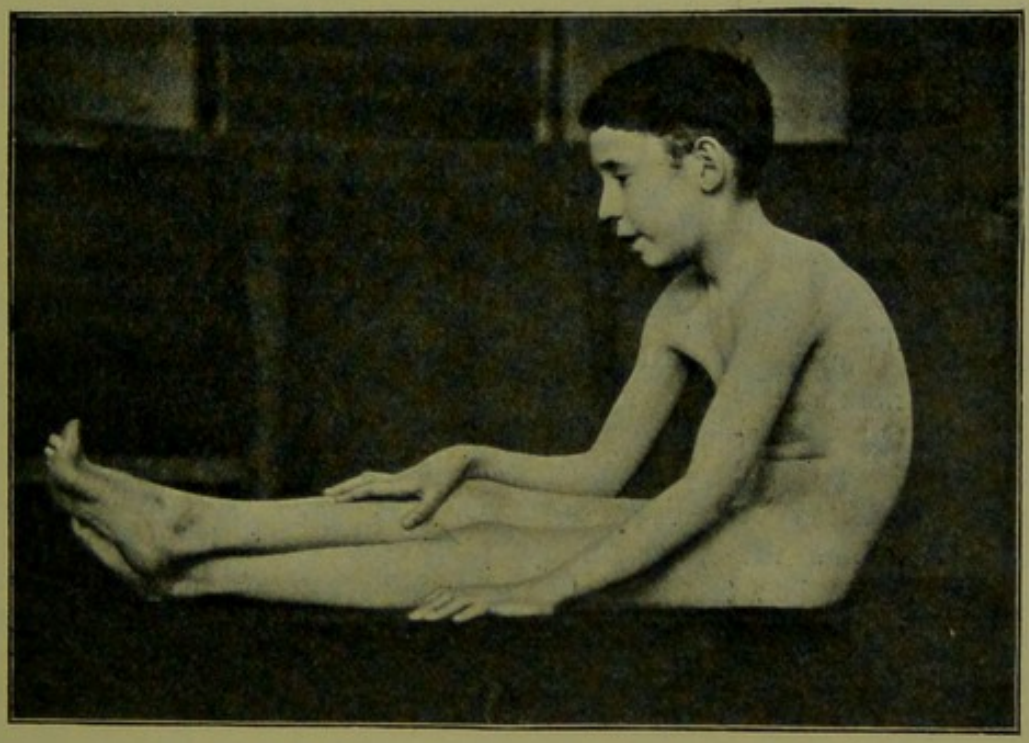

Fig. 147.—Peter L., aged 10 years. Acute Muscular Atrophy.

appears, the galvanic irritability is lessened and altered in quality (reaction of degeneration). In the hand-shoulder type usually the wasting commences in the thenar and hypothenar eminences of one hand, gradually involving the arm and shoulder and also the muscles of the hand of the opposite side. In the peroneal type, the wasting usually begins in the extensor of the great toe, the extensor of the toes, the peronei or small muscles of the soles of the feet. Gradually, 'club-foot,' talipes equino-varus, makes its appearance. The paresis and wasting may slowly spread to other muscles. We have known a slight degree of the peroneal type present in several members of the same family—namely, a hollowing out of the sole of the foot, a paresis of the peronei with a resulting over-action of the gastrocnemius, and a marked

dorsi-flexion of the great toe (see fig. 147). The 'family toe' is spoken of as a joke! This condition is by no means uncommon, and may remain stationary for years at least.

Peripheral Neuritis

We have already referred to the fact that a form of paresis or paralysis may accompany or follow an attack of diphtheria. The ptomaines present in the blood give rise to a degeneration or neuritis of the terminal nerve fibres. While it is far more common after diphtheria than any other disease, it occurs also after influenza and some other zymotic diseases. Occasionally peripheral neuritis accompanies rheumatism and chorea, and we have also noted it when no history could be obtained of any disease preceding the paralysis. That it occurs in connection with influenza we feel sure; in one case coming under our notice paresis of the ciliaris muscles occurred in a boy aged 7 years during convalescence from influenza, and where diphtheria could be excluded with certainty. In another case of ours of pneumonia which appeared to be due to influenza, paresis of the intercostals, diaphragm, and extremities supervened during convalescence, and ended fatally.

The Muscular Dystrophies

In this group the lesion is regarded as primarily muscular, there is a tendency to occur in the same family, and it is specially characterised by wasting of the muscular tissues. The pseudo-hypertrophic form is by far the most common.

1. **Pseudo-hypertrophic Paralysis.**—Very little is known about the etiology of this particular disease. It is apt to run in families, and, strange to say, while it affects boys far more frequently than girls, in some families it affects the boys only, and in others it affects the girls. In some cases there is a family history of the disease, and it appears it may be transmitted through the female side without the women themselves being affected (Gowers). In one of our own cases the patient's brother was an epileptic, but it rarely happens that any family tendency to nervous disease exists.

Symptoms.—In the majority of cases symptoms first make their appearance during the second or third year, the child being late in learning to walk, the parents attributing this to backwardness or weakness. In some cases the symptoms of weakness are noted after the child has been walking some time, perhaps as late as the six or seventh year. The early symptoms are those of weakness in the legs. As Gowers well put it, 'these children usually walk late, also walk clumsily, fall with ease, and rise with difficulty.' If placed upon the ground they either cannot get up without help, or, what is more likely in the early stages, they are obliged to use their hands in rising, pushing themselves off the ground and catching hold of chairs or table-legs to help themselves up. They walk clumsily, with a swaying gait, are quickly tired, and have to be wheeled about in a perambulator long after children of a corresponding age are running about.

In other cases the friends pay little heed to the backwardness in walking, but are struck with the size of the calves or perhaps apparent stoutness of the child. At 4 or 5 years of age, often earlier, the muscular hypertrophy is conspicuous. The muscles of the calf are strikingly enlarged, firm and hard; as are usually also the glutei and lumbar muscles —less often the hamstrings, extensors of the knee, and dorso-flexors of the foot. Of the other muscles, the infra-spinatus is, next to the calf, the most frequently enlarged, and, as Gowers points out, this enlargement of the infra-spinatus may be of diagnostic importance. The deltoid and supra-spinatus are often enlarged, the latissimus is mostly wasted, and the rule is that the other muscles of the upper extremity are wasted rather than hypertrophied. In rare cases the masseters and muscles of the tongue are enlarged.

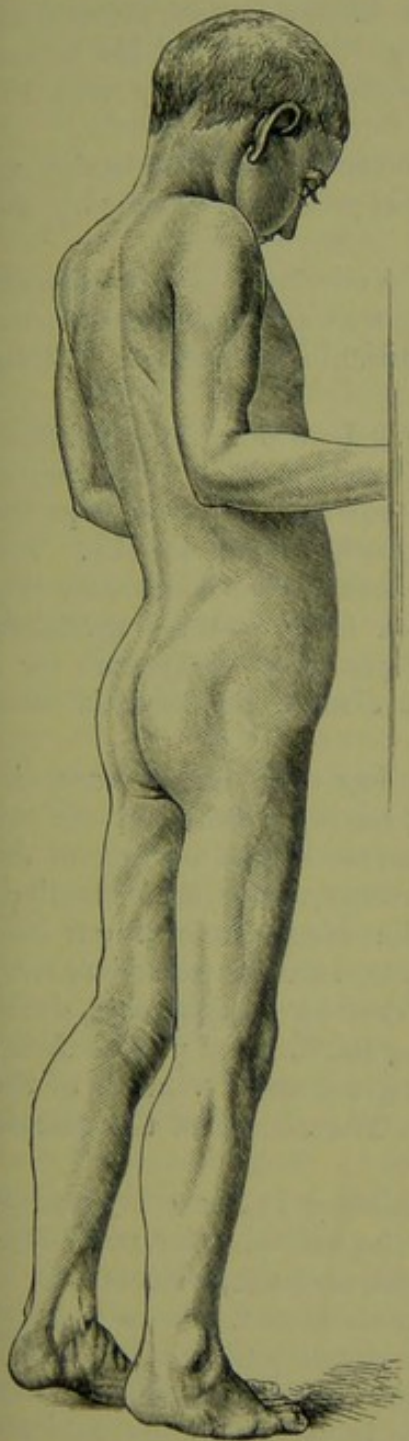

Fig. 148.—A case of Pseudo-hypertrophic Paralysis in a boy of 10 years; showing enlarged calves and slight talipes equinus.

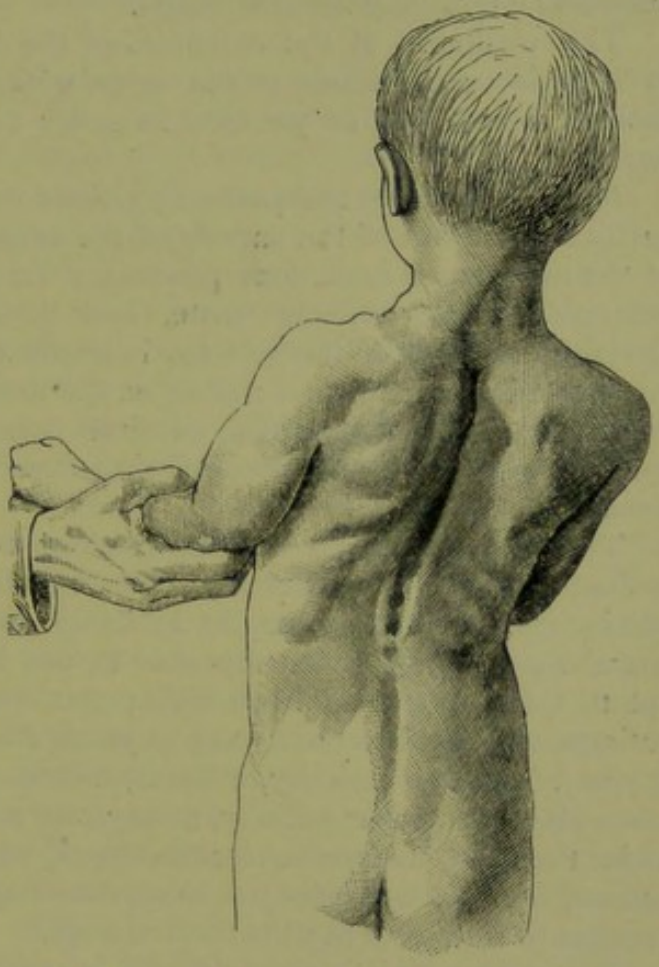

Fig. 149.—Same case as fig. 148; showing hypertrophied deltoid and infra-spinati.

The muscles, whether enlarged or wasted, are weak, and it is this weakness of certain muscles which gives rise to the characteristic movements

of the child. The waddling gait is the result of weakness of the gluteus medius and extensors of the hip generally. The difficulty in rising from the floor is due to the paresis of the extensors of the knees in the first part of the act, and the extensors of the hips in the second, the patient assisting the extension of the hips by placing his hands on his knees, and 'climbing up himself' by grasping his thighs alternatively with his hands.

Later in the disease the enlarged muscles contract, the earliest to shorten being the calf muscles, so that a talipes equinus is produced. Later on, the knee and elbow may become flexed.

The weakness of the extensors of the hip produces a certain amount of lordosis or curvature of the spine with the concavity backwards, the patient assuming this position in order to maintain his balance. (See figs. 148, 149.)

In the last stages the patient becomes entirely bedridden and helpless, partly on account of the paresis of the muscles, partly also in consequence of the muscular contractions producing talipes equinus. In this stage the enlarged muscles mostly waste, and consequently lessen in size. The electric irritability of the muscles is unaffected both to the continuous and interrupted current at first ; later, as the muscular fibre wastes, it gradually disappears. The knee-reflex, at first normal, gradually disappears for a similar reason. In children suffering from this disease the mind is often weak.

The progress of the disease is slow, extending over many years, the patient possibly being helpless and bedridden, having almost lost the use of his legs. He is even unable to sit up on account of the wasting of the spinal muscles, but is usually able to use his hands to the last. Death is apt to take place from bronchitis ; this was the case in one of our own patients who lived to the age of 12 years, the disease having existed at least 8 years. In the majority of cases, where the disease begins early, death takes place soon after puberty, at any rate among the hospital patient class ; under the most favourable circumstances, where great care is taken of the patient, life may be prolonged to a greater age. The course of the disease appears to be slower in girls than in boys.

Diagnosis.—This is most difficult in young children in the early stages, and in the absence of typical enlargement of the calf muscles and infra-spinati. A fat, yet weakly, child of 3 or 4 years of age, who is late in walking and more or less rickety, may somewhat simulate a case of pseudo-hypertrophic paralysis in its gait, and in the difficulty of getting up. Usually there is sufficient enlargement and hardness about the gastrocnemii to make the diagnosis tolerably clear, especially if there is corresponding enlargement of the infra-spinatus and wasting of the latissimus dorsi. In the absence of muscular enlargement, especially if there is wasting, the disease may be confounded with idiopathic muscular atrophy ; but the latter disease is rare before puberty, is apt to affect the face and hands, and to avoid the calf muscles. A fragment of muscle may be obtained, and muscular atrophy can be excluded if there is an excess of fibroid and fatty tissue present.

Prognosis.—The cases slowly, but surely, get worse ; the weakness year by year increases, though a certain amount of temporary improvement may take place. We have seen cases which we believe to have been examples of this disease in a mild form get entirely well.

Pathology.—The disease has been conclusively proved by the careful examination of Gowers and others to be primarily a disease of the muscles, and if changes take place in the spinal cord they are only secondary. There is an overgrowth of connective and fatty tissue ; it is the latter which forms the enlargement of the muscles, and it is the absence of muscular fibres which renders them weak. The shortening which takes place is due to the contraction of the fibrous tissue.

Treatment.—Medicines, except those which are likely to improve the general health, are of little use. The treatment which has proved itself of the greatest use in checking the progress of the muscular wasting is exercise of the affected muscles by well-arranged movements, which the patient is encouraged to perform, and friction, with passive movements, so as to prevent shortening of the muscles. We have certainly seen cases which have been admitted into hospital improve in no inconsiderable degree under this treatment. It is needless to say it must be systematic and carried out with the greatest patience, if it is to be successful.

2. **Juvenile Form of Muscle Atrophy** (Erb).—This form of muscle atrophy resembles in some respects pseudo-hypertrophy of muscles, and some cases occur in which it may be difficult to say to which class they belong. We note here also the tendency to run in families, as in pseudo-hypertrophic paralysis. There is weakness and wasting of certain groups of muscles ; the upper-arm muscles are usually first affected—namely, the biceps, triceps, and supinator longus ; the lower part of the pectoralis major and minor, and also the serratus, trapezius, latissimus and rhomboidei often also suffer more or less atrophy. The deltoids, infra- and supra-spinatus, usually escape ; in some cases they have been described as hypertrophic. The muscles of the forearm and hand for the most part are not affected. In the legs, the quadriceps, the flexors of the hip, the glutei, the peronei and tibialis anticus may be affected. The muscles of the spine, especially the sacro-lumbalis, may be wasted more or less. The electric irritability of the muscles is lessened in proportion to the wasting. There is no reaction of degeneration. The disease is essentially chronic.

3. **Infantile Muscle Atrophy of the Face** (Landouzy, Dejérine).—This form is closely related to (2), if not actually belonging to the same class. This disease appears to be almost entirely observed in children. There is wasting of the muscles of the face, especially the orbicularis oris, zygomatics, and frontalis. The expression of face is peculiar, and there is a curious alteration of expression if the child laughs or smiles, on account of the paralysis of the zygomatics which elevate the angles of the mouth. On account of the weakness of the orbicularis oris, the lips are separated and the lower lip protrudes. The tongue, eyeball muscles, and muscles of mastication escape. The course, like that of other diseases of this group, is chronic and progressive.

Myotonie. Thomsen's Disease

The first symptoms of this rare disease are observed during childhood, and apparently persist through life. The disease is apt to affect several members of the same family, and can be traced back through several generations. The characteristic symptom is that, whenever the patient attempts to move, the muscles assume a condition of cramp or tonic spasm.

After a few attempts to use his limbs the patient succeeds in gaining command of the muscles, and the spasm does not return till after a period of rest. No treatment appears to be of any use.

CHAPTER XXVII

DISEASES OF THE GENITO-URINARY SYSTEM

Abnormal Conditions of Urine

We have already referred to the fact (p. 7) that while infants and children pass a smaller quantity of urine per diem than adults, yet relatively—for their weight—they pass more, and this is also true of the urea excreted. The amount of urine passed is influenced by slighter causes, such as cold feet, chills, indigestion, &c., during early life than later. Speaking generally, the urine excreted by children is of a paler colour, lower specific gravity, and is less concentrated than the urine of adults. The amount passed is increased in such conditions as diabetes mellitus and insipidus, while it is diminished in acute nephritis and most febrile conditions.

Lithæmia. Uricacidæmia.—We have quoted the observations of Carrière and Monfit (p. 7) to the effect that both actually and relatively less uric acid is excreted by children as compared with adults ; but we must add that this is not in accordance with the observations of some other authors. Thus Haig says, 'for while in adults urea is formed in about the proportion of 3 or 4 grs. per lb. of body-weight per day, uric acid in its normal relation to urea of 1 to 35 would be about ·09 to ·11 gr. per lb. per day ; in a child 3 or 4 years old urea may be as much as 9 or 10 grs. per lb. and uric acid ·27 to ·3 gr. per lb. of body-weight.'

Unfortunately the estimation of uric acid in the urine is a complicated process and there is no clinical method of ascertaining with certainty if the uric acid in the urine is above or below the normal amount. Uric acid is only in evidence when it is deposited in fine reddish crystals, or as a bulky precipitate in the form of urates which separates from the urine on cooling ; the degree of acidity and concentration of the urine must be taken into account in judging whether there is an excessive quantity of uric acid being excreted or not. We find that a more or less copious deposit of uric acid is common in children convalescent from scarlet fever and other febrile diseases, and it is said to occur also in children who have inherited a gouty diathesis. This sandy deposit is seen not uncommonly in the urine of quite young children, and such may complain of soreness and redness around the meatus ; often as much as a teaspoonful of deposit may be seen in the chamber vessel in the morning. In one case we knew of, quite a tablespoonful could be seen at times, especially in urine which was passed with a stool, or after some rough movement as a pony ride. In such cases presumably the

uric acid has been deposited in the kidneys, pelvis, or bladder, and becomes dislodged by straining at stool or by rough movements.

It is very common to find urates deposited from urine on standing and cooling. There is not much significance in this, though if it occurs habitually we should naturally be suspicious that an excess of uric acid was being excreted. It usually occurs when the skin has been acting freely and the urine is concentrated.

Haig has collected evidence to show that an excessive quantity of uric acid in the blood or joints may give rise to headache, asthma, eczema, epilepsy, Bright's disease, rheumatism, &c., but it cannot be said that his views have been universally accepted in their entirety.

In those children who from time to time pass uric acid in their urine, t is well to give alkalies, as citrate of potash, effervescing phosphate of soda, or Carlsbad salts. The diet should consist for a time at least of vegetables, eggs, and milk ; butcher's meat, beef teas, and meat extracts being avoided.

Hæmaturia.—Blood is present in the urine in a variety of conditions, in general diseases as well as in local, and a difficulty may not infrequently be experienced in determining the source from which the bleeding takes place.

Hæmaturia or hæmoglobinuria occurs at times in infants a few days or weeks old, who are also jaundiced ; epidemics of such cases have been described by Winckel and Bigelow as occurring in lying-in hospitals (p. 31). Two fatal cases, in which hæmoglobinuria was present in infants 5 months and 8 months old respectively, have been described by Hirschsprung. In both cases the symptoms supervened suddenly ; there was cyanosis, dark albuminous urine and feverishness ; in one of the cases there was dyspnœa (uræmic) and tetany of the hands and feet. The *post-mortem* showed that all the organs were of a dirty brown colour, and the blood in the body had undergone a remarkable change. Similar cases have occurred from poisonous doses of chlorate of potash, but neither of these cases had been taking this salt.

Hæmaturia occurs in rare cases in wasted infants and young children from thrombosis of one of the renal veins, a consequent hæmorrhagic infiltration of the kidney taking place.

We should say the commonest cause of hæmaturia in infants and children under 2 years of age is infantile scurvy (p. 207). In some cases hæmaturia is the first symptom ; usually spongy gums are present, but periosteal tenderness may be absent. Hæmaturia may succeed the tenderness and immobility of the limbs. The infant is generally pallid and is more or less markedly rickety. The nurse probably notices that the urine stains the napkin, it may be a bright red, or in milder cases a yellowish-red colour. If the urine is passed into a vessel a red sediment of blood corpuscles settles to the bottom, leaving the fluid portion tolerably clear, but if much blood is present the supernatant liquid is bright red. We can call to mind several instances where infants suffering from hæmaturia from this cause were sounded for stone ; it is needless to say that no stone was found, and they quickly got well when their diet was changed. It is uncertain whether the blood oozes from the kidneys or bladder. In these cases there is no nephritis, only a passive oozing of blood.

Hæmaturia may be the first symptom of **hæmophilia,** and in any case where the diagnosis is doubtful the family history should be inquired into for similar cases. Hæmaturia is often associated with purpura, and may occur in acute cases of variola, diphtheria, or typhus, resulting from the rapid blood change which takes place in these diseases.

Hæmaturia may be present in acute nephritis; in this case the urine is usually of a smoky tint, or more the colour of porter, but in some cases the colour may be bright red from the large amount of blood which it contains. We have seen hæmorrhagic nephritis following scarlet fever, diphtheria, and pneumonia. A microscopical examination of the deposit which falls to the bottom of the glass after the urine has stood for a while will show blood and epithelial casts in cases of nephritis. Blood in the urine also occurs in cases of renal or vesical calculus, more rarely in tuberculous kidney, sarcoma of the kidney, and vascular growths in the urethra or bladder.

Poisoning by chlorate of potash, cantharides, or turpentine as a cause of hæmaturia must not be forgotten.

Intermittent Hæmoglobinuria occurs in children as in adults, but it is a comparatively rare disease.

Treatment.—The treatment necessarily depends upon the cause, and the history of the case, and other symptoms apart from hæmaturia, must be carefully considered. It is important to exclude stone in the bladder as the cause of hæmaturia, and in all cases where the cause of the blood in the urine is doubtful it is wise to explore the bladder with a sound. Hæmaturia may be the only symptom of the presence of a stone. In hæmaturia depending upon an impoverished condition of blood the most important part of the treatment consists in improving the condition of the general health. Meat juice, orange or lemon juice, with dialysed iron or the perchloride, may be given. Styptics may also be given, though we have frequently been disappointed with their action. Of these ex. hamamelis liq. (U.S.P.), in 5–15 minim doses, may be given every four hours, and continued for some days. Gallic acid ½–2 grs., with aromatic sulphuric acid, is sometimes efficacious where hamamelis fails. Spirits of turpentine ½–3 minims in mucilage, or liquid extract of ergot 2–10 minims, may be tried.

Pyuria.—Pus present in the urine may come from any part of the urinary tract or from an appendicular, perinephritic, or spinal abscess opening into the bladder or urinary tract. The most common causes are pyelitis, tuberculous kidney, calculus, and cystitis.

Cystinuria.—Occasionally cystin may be found in considerable quantities. The urine is opalescent when passed, and on examining the deposit with a low power after standing crystals of cystin will be seen. In a case of our own, a girl of 9 years, attacks of 'recurrent' vomiting were followed by the appearance of cystin in the urine.

Albuminuria in apparently Healthy Children.—Albumen in more or less quantity is found in the urine of a considerable number of children and young adults, who have no definite symptoms of renal disease and who are in good health, or at any rate are not considered ill by their friends. The frequency with which this albuminuria is found during early life has been differently estimated by various observers. Thus, Ward (quoted by Dr. S. West) found on examining the urine of 126 children attending Dr. Garrod's

out-patients at Great Ormond Street, that in one-fourth (24·6 per cent.) of the cases was more or less albumen ; but in only 7·5 per cent. was the amount appreciable. The test used was boiling and the addition of acetic acid. Dr. Clement Dukes, as the result of his experience, concludes that at least 22 per cent. of schoolboys (10–18 years) have albuminuria. Probably every physician who methodically examines the urine of his patients will have been struck with the frequency with which he gets a cloudiness on boiling which does not disappear on adding acetic acid ; and this in patients or proposers for insurance who have no symptoms of Bright's disease. This is especially true in boys and girls of school age. It is not necessary for us here to discuss the significance of mere traces of albumen, or to decide the somewhat difficult question as to whether the opalescence is due to serum albumen, nucleo-albumin, globulen, or some other proteid, though it is doubtless wise in those cases in which traces only are found to examine, if possible, other specimens passed at different times of the day and on different dates. The cases which are most perplexing and difficult are those in which considerable quantities of albumen are found in some specimens, and no albumen or only traces in others. Such cases have been described as 'cyclic' or 'intermittent' albuminuria. They occur by no means infrequently in boys and girls from 8–16 years, and are quite as common in our experience in girls as in boys. The urine passed on or before rising in the morning is free from albumen, or nearly so, while specimens passed after breakfast or midday give perhaps a thick cloud on boiling, or it may be sufficient to deposit on standing $\frac{1}{4}$ to $\frac{1}{3}$ of its volume of precipitated albumen. The amount varies during the day, and is again absent after a night's rest. The urine is usually of high specific gravity, 1025 to 1030, both when albuminous and also when free from albumen. No blood or casts are detected on microscopical examination. There is no puffiness nor œdema, and no cardiac hypertrophy. The patient appears quite well, and wonders why he is physicked, dieted, or put to bed. The albumen disappears when the patient is kept in bed on a fluid diet, but probably appears again when he gets up and about and goes back on ordinary diet. Dr. C. Dukes has described a similar class of case, but calling special attention to the fact that the intermittent albuminuria is very frequently associated with frontal headache, high tension pulse, and a tendency to faint. We can certainly confirm his observations from our experience.

In connection with these cases we must bear in mind that intermittent albuminuria is common in children recovering from scarlatinal nephritis and also diphtheria. We have often noticed in our fever ward that in children who have had œdema and albuminous urine and apparently recovered, the albumen has disappeared while they were kept in bed on a milk diet, but reappeared when they were allowed to get up and go about the ward. We have several times discovered 'intermittent' albuminuria in children in families where one or more members have died young of Bright's disease. In all forms of Bright's disease the urine is apt to contain less albumen when the patient remains in bed than when he is up.

What is the prognosis in these cases of albuminuria without definite symptoms of ill-health ? In the majority of instances they improve, and finally the albumen disappears in the course of months and years. In

another class, the patient remains for years *in statu quo* ; one of our cases has been more or less under observation for ten years, and is now 18 years of age, and still has albumen in his urine. In a third case, after a while definite symptoms of Bright's disease, such as puffiness of the face and œdema, develop. This has been so in one or two cases which we know of.

The prognosis, in any case, will be more serious in those patients who have at one time suffered from nephritis, and in those with a family history of Bright's disease.

The treatment of these cases presents the difficulty that the patients are not ill, that the course is chronic, and the friends are apt to think that an unnecessary fuss is being made. It is clear in such cases, however, that a guarded prognosis must be given, and every care taken, especially during the winter months, to guard against exposure to cold. Where there is evidence of the uric acid diathesis, alkalies, such as the effervescing citrate of potash, or phosphate of soda, should be given with an occasional dose of calomel. If there is any history of Bright's disease in the family, it is well, if possible, for the patient to winter abroad or in the south-west of England. Butcher's meat, in all its forms, should be interdicted, for a while at least.

Diseases of the Kidney

Congenital Anomalies of the Kidney.—The principal malformations of the kidneys found *post mortem* are : (1) absence, or only a trace, of one kidney, with hypertrophy of the other ; (2) 'horse-shoe' kidney, in which the two kidneys are united by a bridge of kidney tissue, giving the organs a horse-shoe shape. The kidney is placed with its convexity downwards, the ureters passing down behind the bridge. (3) The kidneys are frequently found *lobulated*, the surface being deeply fissured, or divided into 'lobules' as in the fœtal state. (4) *Movable* kidney.

These abnormalities, though of extreme importance in reference to operations on the kidneys and the diagnosis of abdominal tumours, need not be further referred to here. Obliteration of one ureter, partial or complete, may give rise to hydro-nephrosis and require operation, as in a case reported by Tuckwell and Symonds of Oxford.[1] Incontinence of urine from an abnormal opening of the ureter just in front of the meatus urinarius has also been met with.[2]

Displaced or Movable Kidney.—'Movable kidneys,' though quite common in adults, especially in women, are not often discovered in infants and children. We have known several instances, but have not seen a well-marked case *post mortem*. Comby reports eighteen cases coming under his notice ; sixteen were in girls and two in boys. It is probable that this condition in children is usually congenital, the attachment of the kidney is longer and looser than usual, and it is surrounded by peritoneum and attached by a mesentery.

The right kidney is affected in the vast majority of cases. In fourteen of Comby's cases the movable kidney was associated with dyspepsia and dilatation of the stomach ; this association of movable kidney and dyspepsia

[1] *Brit. Med. Journ.* November 17, 1883.
[2] *Archives of Pædiatrics*, November 1894.

is common at all ages, and probably depends upon the close connection between the renal and solar plexuses. The same author speaks of paroxysmal pains in some cases, apparently from the kidney becoming twisted and the ureter occluded. In the majority of cases no symptoms are apparently produced, and the movable kidney is discovered by accident. In palpating the kidney, the left hand should be placed in the lumbar region behind, while the right is pressed backwards from the front, an attempt being made to seize the kidney between the two hands ; its mobility can thus be tested. In some cases the kidney can be pushed upwards under the liver or downwards to the brim of the pelvis. A severe case might justify operation, otherwise the treatment is palliative.

Tumours of the Kidneys.—Swellings occurring in the region of one of the kidneys may be due to one of the following causes :

(1) New growth. (2) Tuberculous or other abscess in the kidney. (3) Hydro-nephrosis. (4) Perinephritic abscess.

(1) **Renal New Growths.**—Two forms of renal growth appear to be met with. The one is a primary growth in the adrenal body, the other is an adeno-sarcoma, taking origin in the Wolffian body, and lying at first in the hilum of the kidney. By its growth it presses into and spreads out or displaces the kidney rather than infiltrates it.

The structure of these growths consists of a series of tubes, with an epithelial lining and a connective-tissue stroma, which may also contain cartilage and muscle elements from inclusion in course of the tumour growth. Metastasis occasionally occurs, both by the blood and more rarely by the lymph stream. A few instances of symmetrical growth involving both kidneys are on record. The epithelial lining of the branched and convoluted tubules derived from the Wolffian body has been seen in section, and probably given rise to the belief that some of these growths are carcinomata. (*Vide* Strong, ' Archives of Pediatrics,' May 1903.)

In the minority of cases the new growth appears to begin in the kidney itself—at least no trace of the kidney can be found *post mortem*, but traces of kidney structure may be found scattered through the tumour on microscopical examination.

Renal sarcomata are usually soft in consistence, resembling brain substance, and frequently contain masses of blood clot and altered blood in consequence of hæmorrhages which take place into their substance. They often attain to great size, weighing many pounds, and by their enlargement displace the other organs of the abdominal cavity. The liver or spleen is pushed upwards, the small intestines are pushed on one side or backwards ; the large intestine, where it crosses the tumour, is compressed against the abdominal wall (see figs. 150, 151). The tumour may set up a certain amount of chronic peritonitis and contract adhesions to the intestines and other viscera.

Renal sarcomata occur most commonly in children under 3 years ; of fifty cases collected by Seibert, forty occurred during the first five years of life, twelve being in infants under a year old. In a case recorded by A. Jacobi a sarcoma was present in the kidney of a fœtus born dead, and other cases (Sir William Roberts and Lloyd Roberts) have been recorded in which the tumours were present at birth.

F. T. Paul,[1] of Liverpool, says, 'The chief characteristics of congenital renal sarcomata are these :

'(1) They show themselves during the first five years of life, and are probably invariably of congenital origin.

'(2) They are primarily extra-renal though usually intracapsular.'

He points out that they may be bilateral, that they cause death by exhaustion or pressure rather than by urinary lesions, that metastatic growths only occasionally occur, but all forms of growth tend to recur after removal. The tumours frequently contain striped muscle, embryonic renal tissue, and various forms of adult connective tissue. The complexity of the structure of these growths is to be explained by the inclusion within the capsule which forms round the embryonic kidney of elements of other neighbouring tissues. Mr. Paul describes growths of the 'simple connective tissue type,' of the 'complex connective tissue type,' and of the 'renal adenoma type.'

Kelynack ('Renal Growths') says over 52 per cent. of malignant growths occurring at all ages were met with below 10 years, and that most, if not all, of these were sarcomatous.

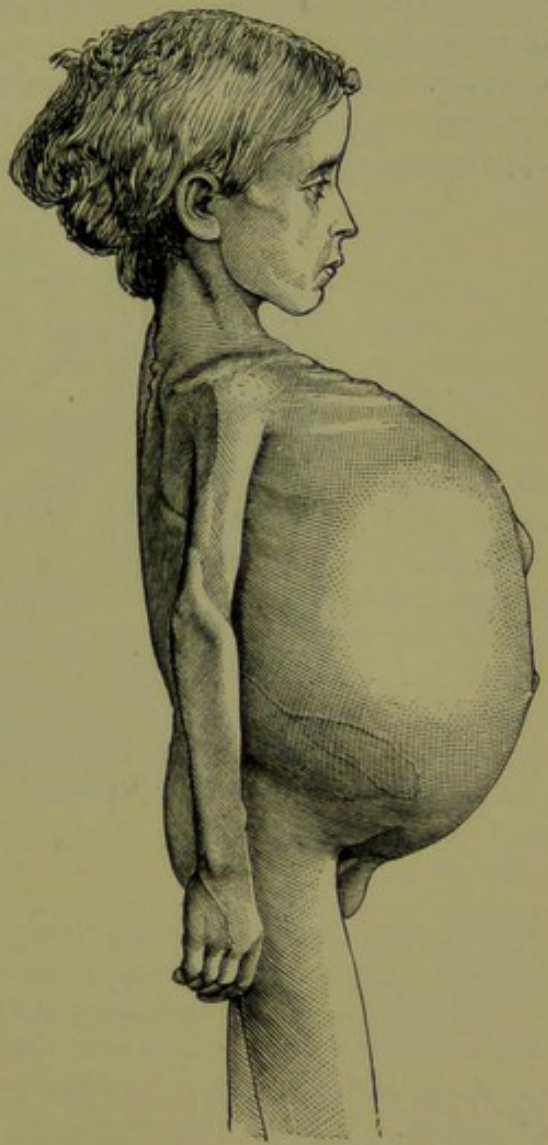

Fig. 150.—Malignant Tumour of Kidney in a girl of 9 years. (Dr. Hutton's case.)

Symptoms and Course.—In the majority of cases enlargement of the abdomen due to the new growth encroaching on the other abdominal organs is the first symptom to call the attention of the friends to the case. In the minority of cases (one-fifth, Seibert) hæmaturia is the first symptom, occurring at a variable period before the discovery of a tumour. The swelling is first noticed occupying the right or left lumbar region, between the ribs and the crest of the ilium ; it has a rounded outline, which can be traced downwards, but not into the pelvis, and upwards behind the liver or spleen. By palpation it can be separated from the liver or spleen. It moves less freely with respiratory movements than an hepatic or splenic tumour does. Percussion shows that the large bowel lies across superficially to it, but if the tumour is large the colon may be compressed and no tympanitic note will then be detected. The swelling has a soft semi-fluctuating feel, and on exploration with a subcutaneous

[1] *Liverpool Med.-Chir. Jour.* January 1894.

syringe pure blood is withdrawn. During the early stages the patient appears perfectly well, is well nourished, complains of no pain, and there is no tenderness on handling the tumour. Exceptionally pain is complained of; in some cases it is acute and due to accompanying peritonitis. In Seibert's collection of fifty cases hæmaturia was present in nineteen at some time or other during the course. Vomiting is an occasional symptom. As the tumour increases in size it distends the abdominal walls, the skin becomes smooth and shiny, and is marked with large dilated veins. The tumour pushes up the diaphragm, passes perhaps beyond the middle line in front, and extends backward to the spine behind, sometimes, as in the case fig. 150, forming an enormous abdominal tumour. The liver and spleen are frequently enlarged; the patient gradually emaciates and has a cachectic appearance; perhaps the lower limbs become œdematous from pressure

Fig. 151.—Congenital Renal Sarcoma; from a photograph. (F. T. Paul.)

on the vena cava, and death comes after many weeks of lingering misery. Constipation is often present from pressure on the colon.

Diagnosis.—A sarcomatous enlargement of the kidney may be possibly mistaken for a hydro-nephrosis, abscess of the kidney, perinephritic, or spinal or other abscess. It is less likely to be mistaken for a tumour of the liver or spleen. A renal tumour may be distinguished from an *hepatic* or *splenic tumour* by the fact that it moves less with respiration, and the colon traverses its anterior surface, and moreover the edge of the liver and spleen may usually be felt. A *congenital hydro-nephrosis*, in which the obstruction in the ureter is complete, may cause some difficulty in diagnosis; there would be, however, in a swelling of any size, fluctuation transmitted from the abdomen to the flank in a hydro-nephrosis. An abscess in, or tuberculous enlargement of, the kidney is rare without a history of pain and tenderness in the lumbar region, and without pus in the urine. It is, however, possible that these may be absent, and then the rapid growth in the case of a sarcomatous kidney would in time decide the diagnosis. But a difficulty could rarely occur.

Prognosis.—This is necessarily grave ; though such tumours are chronic in their course and the patient may live for many months or even a year after the discovery of the tumour.

Treatment.—As far as we know, no drug influences the progress of the growth. Removal of a sarcomatous kidney is usually followed so rapidly by recurrence that this, the only possible, treatment is, though justifiable when the tumour is recognised in an early stage, not very hopeful. Abbé and others have had a few successful cases.

Tuberculous Kidney.—Tuberculosis of the kidney is very commonly met with in children as part of a general tuberculosis. Thus of 110 fatal cases of tuberculosis in the Children's Hospital in the years 1881–1885 inclusive, in forty-six there was evidence of tubercle in the kidneys in larger or smaller amount. Most frequently the lesions are simply scattered grey tubercles in the substance or on the cortex of the organ : this was the case in thirty-nine instances.

Much more rarely large masses of tuberculous material are found, or occasionally extensive destruction of the papillæ and ulceration of the pelvis, and sometimes of the ureter. Occasionally calculi are found co-existing with tuberculous lesions.

It is rare in our experience to find children suffering from tuberculous kidney apart from a general tuberculosis ; less than half a dozen such cases were admitted to the hospital in the five years above mentioned, and genito-urinary tuberculosis—i.e. lesions affecting the kidneys, bladder, testes, prostate, vesiculæ seminales—is not nearly so common as in adult life, though the bladder is not rarely involved. When the tuberculous lesions of the kidney are only part of a general tuberculosis, life is usually destroyed before the kidney affection is very far advanced ; but where the disease is limited to the urinary tract the whole of one kidney may be destroyed and converted into a mere sac with hardly a trace of secreting structure left. Very commonly both kidneys are affected together, but in a considerable proportion of cases one organ alone is attacked, and under such circumstances life may be prolonged, or even recovery may take place, the damaged kidney shrinking and ceasing to cause irritation ; the whole of the work then devolves upon its fellow. All stages of disease, from the presence of a few tubercles to that of cheesy masses, and on to complete disorganisation, may be found. Perinephritic abscesses develop in some cases.

Symptoms.—When the kidneys are the seat of miliary tuberculosis there are usually no symptoms whatever pointing to disease of those organs : thus of thirty-nine cases of this form of disease, in only one was there even albuminuria, and that to a very slight degree. When, however, tuberculous ulcers or abscesses exist, pus, mucus, and large quantities of albumen may be found ; but the only instance in which hæmaturia existed in the forty-six cases of tuberculous kidney we have examined was one in which calculi co-existed with the tubercle, and undoubtedly the presence of blood in the urine points to calculi rather than to renal tuberculosis.

Pain and tenderness are only prominent symptoms when there is extensive disease and the pelvis becomes distended with pus and tuberculous material, and the same statement holds good of enlargement ; it is only in the later stages of the disease that any palpable enlargement of the kidney takes place.

Frequent micturition is rather a symptom of tuberculous cystitis than of renal disease, and where it exists with evidence of tuberculosis of the kidney, especially if there are tenderness of the bladder and much pain on sounding or passing a catheter, it is tolerably certain that the bladder is affected as well as the kidney.

The presence of tubercle bacilli in the urine would, of course, indicate urinary tuberculosis, though without other evidence it would not show whether the disease was renal or not ; unfortunately in most cases of renal tuberculosis the bacilli are not to be found until the disease is far advanced.

When one kidney alone is affected and the ureter becomes blocked with caseous material or granulations, pyo-nephrosis may develop and form a large abdominal tumour in which fluctuation may be detected : in such cases more or less fever will also be present and the diagnosis will be easy. It is in the early stages that a doubt arises. If there is a tuberculous history or evidence of tubercle elsewhere, if the trouble is of only a few months' duration and there is pus, but little or no blood in the urine, and if there is a gradual failure of health, the disease is probably renal tuberculosis.

Treatment.—In cases of miliary tubercle nothing, of course, can be done for the renal affection. Where pyelitis exists medicine can do something : the urine should be kept unirritating by the use of diluents and boric acid (two- or three-grain doses in half an ounce of peppermint water) ; alkalies such as carbonate of potash or liquor potassæ, or the citrate of potash with hyoscyamus, will also be found useful. If there are lumbar pain and tenderness, with palpable enlargement of the kidney, and the symptoms do not subside under medicinal treatment, nephrotomy by the lumbar incision should be performed and the kidney drained. If on exploration the kidney is found entirely disorganised, and there is evidence from the amount and quality of the urine that the other kidney is sound and efficient, a trial should be given to simple drainage ; but, should the discharge not decrease, and should the health be failing, removal of the affected kidney is called for. This, however, clearly can only be justifiable if the other organ is working well, and if the bladder and viscera are affected nephrectomy would be probably useless. If removal of the kidney is decided upon, it should be done before the health is too much broken down, and the lumbar operation should be the one selected. We have only once met with a case *in a child* calling for either nephrotomy or nephrectomy, so that we do not think suitable cases can be common.

Hydro-nephrosis is not very rarely met with in children, and may be congenital or the result of partial blocking of the ureter by a calculus or cicatrix. Complete obstruction of the ureter appears to lead usually to atrophy of the kidney rather than to hydro-nephrosis.

The dilated kidney forms a tumour which has characters like those of the solid renal growths, except that fluctuation may be felt in it. The history is, however, often of longer duration than is the case in solid tumours, which usually prove fatal in less than eighteen months. Occasionally the fluid of a hydro-nephrosis is discharged by the ureter, in which case the swelling will, of course, vary in size.

Treatment.—Hydro-nephrosis should be treated by incision, which is best performed in the lumbar region. The fluid which escapes has usually the

characters of clear dilute urine. The kidney should be drained for some time, and only after failure of this treatment should nephrectomy be thought of.

Renal Calculus.—Stone in the kidney is, like stone in the bladder, a disease much more commonly met with in some localities than in others ; it is, however, apparently relatively rare in children, and when it does occur it is seldom that the symptoms are as severe or characteristic as they are in the case of adults. It appears that the majority of calculi formed in the kidney in children pass down to the bladder without giving rise to any severe symptoms of renal colic. Should, however, a stone form in the kidney and be retained there, it may give rise to pain, local and radiating, pyuria, frequent micturition, tenderness on pressure over the kidney, with rigidity of the lumbar muscles, retraction of the testis, vomiting, and above all to hæmaturia : this last is the most characteristic symptom of calculus, and in the absence of nephritis renal hæmaturia is probably due to calculus, though occasionally intermittent hæmaturia is met with without there being any proof of the presence of a stone. We have only on two or three occasions had to perform nephro-lithotomy in children. They recovered satisfactorily from the operation.

In a few cases, if the disease goes on, pyo-nephrosis may be set up, and the kidney will then form a tumour perceptible to the touch.

Treatment.—Should medicinal treatment, which is the same as that for tuberculous nephritis, fail to give relief, the kidney should be exposed by the lumbar incision and explored by puncture with a needle ; if the calculus is struck, a director is passed along the needle, and the kidney opened along its convex surface and the calculus removed. If the needle fails to find the stone, the kidney should be carefully explored with the finger, both by palpation upon the surface and subsequently by opening the pelvis and examination with the finger and with sounds. Any calculus found should be removed and a drainage tube passed up to the surface of the kidney. The wound is then treated on ordinary principles, the tube being gradually shortened. If the kidney is healthy and the ureter patent, the wound will probably speedily close entirely ; if, however, the ureter is blocked, or there is much destruction of the kidney, discharge may go on indefinitely, and it may be necessary to remove the organ in order to obtain healing of the wound. Before nephrectomy is thought of, however, care must be taken to ascertain that the other kidney is capable of doing sufficient work. For further particulars we must refer to the works of Morris, Bruce Clarke, and Newman ; also to papers by one of the present writers in the 'Medical Chronicle' for 1886-7-9-94.

Acute Pyelitis is not a common disease in infants or children. We have, however, seen several cases of acute illness in infants or young children accompanied by a high temperature of an intermittent type, and after the attack has lasted several days it has been noted that the urine contains excessive quantities of mucus or muco-pus ; the nurse having called attention to the fact that there was something unusual in the way in which the urine stained the diapers. Dr. S. J. Gee has recorded a similar case in an infant of 9 months. Dr. Emmett Holt records three such cases in infants of 8 months, 9 months, and 14 months respectively. The temperature in one of his cases ran high, and there were distinct 'chills' in which the infant became blue.

In these cases we must bear in mind that the temperature may run high for some days before any marked change is noted in the urine. It is important in all cases of unexplained fever in infants to procure and examine the urine.

In two of our cases the infants had been taking artificial foods for some months, and we were inclined to think this was a factor in the case.

In all cases of acute pyelitis, we should give a whey-milk mixture, citrate of potash, and orange juice freely.

Acute Nephritis.—Acute inflammation of the kidneys occurs much less frequently as a primary than as a secondary disease. The kidneys are fortunately not so prone to take on inflammation as the lungs, possibly because they are less exposed to cold, and they are out of reach of the micro-organisms present in the air.

Acute nephritis does, however, occur as a primary disease, or at any rate in patients who, as far as can be ascertained, have not suffered from any antecedent disease, and who were in perfect health up to the time of the attack. Thus we find a schoolboy, who never had scarlet fever and has been in good health, have a shivering fit, an evening rise of temperature, followed by the passage of albuminous and perhaps dark urine, and pass through the stages of a typical attack of acute nephritis. In other cases the onset is more insidious, and the first thing noticed is a pale and puffy face. But in all cases in which the urine contains blood as well as albumen and casts, we should be suspicious of antecedent scarlet fever, though possibly a very mild attack. In rare cases acute nephritis occurs during infancy apparently as a primary disease; and it is needless to say that it may be readily overlooked, as the urine of infants is not often examined unless special attention is called to it on account of its staining the napkin. If there is associated broncho-pneumonia or gastro-intestinal disturbance, it is still more likely to be overlooked. The difficulty of diagnosis in such cases is not always overcome by a *post-mortem* examination, inasmuch as we may find pale kidneys with more or less marked parenchymatous changes in infants who have died of enteritis, septic pneumonia, and other acute diseases. It is by no means easy always to say, when sections of kidney are examined microscopically, whether such changes as desquamation of the epithelium are pathological or accidental, or whether there is slight proliferation of the epithelium or not.

Reference has already been made to acute nephritis (p. 277) when speaking of scarlet fever, as acute nephritis occurs more frequently during convalescence from this fever than after any other disease. It is well to bear in mind, however, that nephritis may occur after some other febrile states, such as diphtheria, croupous pneumonia, varicella, typhoid fever, vaccinia, and eczema. These febrile conditions appear to give rise to an irritable state of the kidneys and render them liable to take on an acute inflammatory state. It must not be forgotten that nephritis may follow mild attacks of scarlet fever; the primary fever may have been overlooked by the friends, especially if the latter are unobservant or ignorant; and in any patient coming under notice for the first time, suffering from acute nephritis, the history of the case should be carefully inquired into and the child's skin examined for any traces of desquamation.

In rare cases infants are born with an acute nephritis (see Case of Nephritis in a Newly-born Infant. 'Reports of the Society for the Study of Disease in Children,' vol. i.)

In the following case acute nephritis supervened during an attack of croupous pneumonia.

Croupous Pneumonia, Acute Nephritis.—George H., aged 4 years. March 18 was sick and feverish; admitted March 20. There was well-marked dulness and bronchial breathing at the left apex, both in front and behind. P. 100; R. 60; T. 103°; urine $\frac{1}{12}$th albumen. March 21.—T. 104°, much dyspnœa; only 8 oz. of urine passed, which contained much blood and albumen. Vomiting. T. 104°. After this date he improved; the temperature fell April 4, and recovery ensued.

Acute nephritis occurring during convalescence from scarlet fever, or as a primary disease, is usually an inflammatory lesion of the croupous pneumonia type. There is an inflammatory engorgement of the blood vessels with fever of an intermittent type, and, as a result, a choking of the tubules by the exudation of liquor sanguinis, and usually of blood corpuscles. As a consequence of this the urine is scanty and contains fibrinous casts, blood corpuscles, albumen, and much epithelial *débris*. In the less acute cases there is not sufficient blood present to discolour the urine. If the inflammatory condition fails to be relieved, secondary changes occur, the most important of which consists in a glomerular or periglomerular nephritis. The glomeruli become enlarged in consequence of a hyperplasia of their endothelial nuclei (Friedländer), or in other cases a fibro-cellular growth takes place between the glomerulus and the capsule of Bowman; in either case the result is the same—namely, an obstruction to the flow of blood through the glomerulus. Changes in the epithelium also take place. As these changes progress the urine becomes more and more scanty, and death takes place from either cardiac failure, uræmia, or some inflammation of a serous membrane.

The symptoms and treatment have already been discussed (pp. 277 and 284), and little need be added here. It is well to bear in mind that cases of very different severity may be met with: in some cases the engorgement of the kidney is extreme, and variable quantities of urine are passed, containing large quantities of blood and albumen. In other cases there may be marked anæmia, much general œdema, scanty urine, with no albumen or only a trace, and we may be left in doubt if the case is really one of nephritis or whether the œdema is simply due to a watery state of the blood. This class of case is not uncommon in young children under 3 years who have recently suffered from some acute disease, such as acute diarrhœa or pneumonia; the pallor and œdema present suggest acute nephritis, but an examination of the urine possibly gives negative results as far as albumen is concerned. In some of these cases we have failed to find any evidence of nephritis on a microscopical examination of the kidneys. Acute or subacute attacks of nephritis do, however, occur in young children. The first symptom is mostly œdema of the face, the œdema becoming general. It is often associated with broncho-pneumonia, and tends to a fatal issue.

Septic Nephritis has been also referred to under the complications of scarlet fever (p. 277). It is well, however, to bear in mind that such cases occur after other febrile states. We have seen a condition of the kidneys answering this description occurring apparently primarily, but we have always had our suspicions that some cause must have been overlooked.

Acute Toxic Nephritis, Parenchymatous Nephritis.—In diphtheria, malignant endocarditis, zymotic diarrhœa, and any disease in which there is

ptomaine poisoning, there is albuminuria, and certain changes in the kidney are found after death. This is specially so in diphtheria. We have already referred to the albuminuria which so frequently occurs in the course of this disease, and also to the fact that in some cases, especially the malignant ones, the urine becomes more and more loaded with albumen while becoming more scanty, and complete anuria may take place twenty-four hours or forty-eight hours before death. Unlike scarlatinal nephritis, there is rarely œdema, muscular twitchings, or uræmic convulsions, but coma usually precedes death. On making a *post-mortem* examination of those dying from diphtheria, in most cases the kidneys will be found to be hyperæmic and slightly enlarged, the cortex being pale, the medullary portions congested. The principal microscopical changes occur in the epithelial cells, which are swollen and granular. A few fibrin cylinders and blood cylinders are sometimes present. No very marked changes sufficient to account for complete anuria have been found in the kidneys of those dying with total suppression of urine. It is possible, as has been suggested, that the anuria is due to a peripheral neuritis of the abdominal sympathetic, or that portion of the system which regulates the local tension of blood in the capillaries of the kidneys.

Chronic Nephritis.—We cannot too strongly emphasise the necessity of examining the urine from time to time of children who have recently had scarlet fever, especially if they have suffered from scarlatinal nephritis. It is not enough to find that on one or two occasions the urine is free from albumen in order to declare them well. Nephritis, however mild, renders the kidneys liable to attacks, and these subsequent attacks may readily pass into a chronic nephritis in which organic changes take place and irretrievable damage is done. There may be an albuminuria which is intermittent, and in consequence a slight kidney affection is liable to be overlooked. We have already referred to cases in children who have suffered from nephritis and were apparently quite well, who passed urine free from albumen during the night or when they were kept in bed, but albumen at once appeared in the urine when they got up, and especially if they went out of doors. In such cases an acute attack is readily set up, with attendant anæmia and dropsy. The history of a chronic nephritis is the history of a series of acute or subacute attacks, followed by a period of apparent health, perhaps extending over many years. No doubt in a certain proportion of cases recovery eventually takes place, but in others the kidneys become hopelessly damaged by fatty and fibroid changes, and they eventually succumb. In many of these cases the progress is exceedingly insidious ; it is only when the friends have their attention called to the puffy face or œdema of the feet that medical advice is obtained.

In some instances we have known schoolboys who had apparently been in good health noticed by their house master to look 'puffy' in the face, and on medical examination large quantities of albumen were found in the urine. There has been no history of scarlet fever and no marked symptoms till the œdema has been noticed. In these insidious cases of subacute nephritis the prognosis is mostly bad ; there is a course perhaps of three months to two years, but rarely complete restoration to health.

In a typical case of subacute or chronic nephritis the appearance of the patient at once establishes the diagnosis—the bloated, puffy, pallid face is

characteristic. The abdomen is distended, being tympanitic over the air-containing intestines and stomach, dull and fluctuating in the flanks from the presence of fluid. The scrotum is œdematous, the skin everywhere pits on pressure, especially on the dorsum of the feet. There is frequently headache and vomiting or nausea. The pulse is usually slow and of high tension, but in children the high-tension pulse of Bright's disease is less marked than in adults. The heart cavities become dilated, the apex beat is diffused and tends to become displaced outwards beyond the left nipple line. Possibly the urine is scanty, contains many casts, and is loaded with albumen. Gradual improvement takes place till the patient is fairly well again, and the urine free, or nearly free, from albumen. Other cases remain for months in practically the same condition, the amount of albumen and dropsy varying from time to time. Gradually perhaps there is increasing dropsy, so that the patient becomes waterlogged. The face, lower extremities, and scrotum are extremely œdematous, and the peritoneal cavity distended with fluid, while the sickness is very distressing. Dyspnœa is usually a marked symptom, and the patient has to be propped up in bed. Finally the patient lapses into coma, which marks the beginning of the end. The urine is often reduced in amount to 1 or 2 oz. in twenty-four hours. Uræmic convulsions are common at the last.

In such cases a **'large white kidney'** is found *post mortem*; sometimes the kidneys are enormously enlarged. In one of our cases (a girl of 12 years) the two kidneys weighed together 22¾ oz., and one measured 6 in. in length. Such kidneys show the epithelium infiltrated with fatty drops, and various fibroid changes, especially around the glomeruli, many of the glomeruli having been strangulated by a surrounding fibroid growth. The heart is hypertrophied.

The **'granular contracted kidney'** is rare in children; we have seen at least five cases—three occurred in girls, aged 11½ years, 10½ years, and 7 years respectively—and two in boys, aged 12 years and 4 years 11 months. In the first case there was only a history of two or three weeks' illness before admission to hospital, but the history was imperfect; she had never had scarlet fever; when admitted there was much œdema and dyspnœa; the urine was of sp. gr. 1015, containing half albumen—she passed 800–1000 c.c. daily. At the *post-mortem* the right kidney weighed 2¼ oz. and the left ¾ oz. The left was a mere vestige of a kidney; the capsule of the right was adherent, the surface granular, the cortex was narrow, and, in short, the kidney was an extreme example of a granular contracted one. The ureters were dilated. The heart weighed 8 oz., the walls of the left ventricle were much hypertrophied.

A second case (girl 10½ years) was admitted to a surgical ward for rickety deformity of the tibia. There was a history for two years before of thirst, headaches, and frequent passage of urine, especially at night. On admission there was urgent dyspnœa, for which no cause could be found; she gradually passed into an unconscious state, and died twenty-four hours after admission. No urine was obtained, it having been passed into bed. At the *post-mortem* the kidneys were typically granular and contracted; they together weighed 1½ oz. only, and measured 2 in. in length; the capsules were adherent, the surface granular, and the cortex surface wasted; the heart weighed 8¾ oz. and the left ventricular walls were thickened.

In a third case, that of a boy aged 12 years, it was uncertain if he had had scarlet fever; he had measles at 3 years of age, which had left him deaf in one ear. For three months before death he had suffered from frontal headaches and had been thirsty. A month before death he had uræmic convulsions, which continued at intervals. Only one or two specimens of urine were obtained; the excretion was free, s.g. 1010, much albumen. Coma supervened twenty-four hours before death. There never was any œdema. *Post-mortem*: typical granular kidneys weighing 1¼ oz. each; heart 8 oz.; hypertrophy of the left ventricle, thickening of the mitral valves, atheroma of the aorta and thickening of the aortic valves.

A fourth case, a boy aged 4 years 11 months, was admitted to hospital for genu valgum. No albumen was found in the urine. He was operated on, and a day or two after the operation he became drowsy. There was no fever, convulsion, or twitching; he died comatose eight days after operation. There was albumen in his urine shortly before death. At the *post-mortem* made by Mr. Woodhouse, the kidneys were found small and shrivelled, weighing together 2 oz., the capsule was adherent, the surface irregular, not granular, and pale. On section, the cortex was pale and much wasted, the calyces of the pelvis much dilated. The kidneys were undoubtedly wasted and shrivelled, but not typically granular.

Another case (patient of Drs. Fawsitt and Godson), a girl 7 years old; was never strong from her birth and had more or less incontinence of urine all her life. For a year before death she was anæmic and easily out of breath on exertion. When seen some months before her death there was $\frac{1}{12}$ albumen (by volume), the cardiac area was enlarged towards the left, but the apex beat was just inside the nipple line. There was a bruit heard at apex and base. The spleen was enlarged. The anæmia increased and œdema supervened. At the autopsy small white granular kidneys were found; the larger of the two, which Dr. Godson kindly forwarded to us, weighed ¾ oz.; the left ventricular wall was hypertrophied, the cavity not dilated.

We have once or twice seen young children who passed large quantities of urine containing small amounts of albumen, and who suffered from constant thirst. Such cases are apt to be labelled diabetes insipidus. In one case, a child of 2 years became suddenly drowsy and passed into a condition of anæmic convulsion. At the autopsy small contracted cystic kidneys were found.

Treatment.—In chronic albuminuria the patient must be rigidly protected from cold, as the least chill is liable to lead to an acute attack. Bed is the best place as long as albumen is present in the urine. A simple unstimulating diet is necessary, milk forming the staple food, with arrowroot, ground rice, or other light puddings. Meat is best avoided as long as the urine is albuminous. When œdema is present and the urine scanty, hot air or vapour baths should be given daily, while the kidneys are acted on by salines, such as tartrate of potash, or by diuretics, such as digitalis or squills. During convalescence tr. ferri acetatis may be given with digitalis. Vomiting is best treated by saline purgatives and peptonised milk gruel in small quantities. Nitro-pilocarpine in $\frac{1}{10}$ gr. doses by the mouth seems often to relieve. In anæmic convulsions injections of morphia, $\frac{1}{10}$–$\frac{1}{8}$ gr., are useful and may be given without risk. (See also F. 91, 92, 93, and 94.)

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Addison's Disease. Tuberculosis of the Adrenals.—Addison's disease occurs occasionally in children after puberty : it is very rare before this epoch. Dr. Pye Smith has recorded a case in a boy of 14 years, and Monti has collected eleven cases in children from 3 to 14 years of age. Tubercules, both caseous and grey, are frequently present in the suprarenal capsules of children dying from general tuberculosis, without any symptoms occurring during life.

Dr. J. S. Bury has recorded a well-marked case in a girl of 13 years of age. The early symptoms were those of gastric disturbance and vomiting, which continued throughout her illness, which lasted twelve months. Her skin gradually became discoloured, all the parts of the body being of a brown colour. She gradually wasted and died of exhaustion. The adrenals were found adherent to the fatty tissue which surrounds them and to the diaphragm ; on section they showed caseous and fibroid changes. There was no tuberculosis elsewhere.

CHAPTER XXVIII

DISEASES OF THE GENITO-URINARY SYSTEM—*continued*

Stone in the Bladder in children is, as in adults, a much more common disease in some localities than in others. It may occur at any age, and a congenital case even has been recorded. The symptoms vary much in severity ; sometimes but little pain or trouble is caused by the stone, at other times the distress is constant and severe. The causation of calculus need not be discussed : there is little evidence that any particular diet has any active share in producing it.

Symptoms.—There is usually pain referred to the end of the penis, or to the hypogastrium or perinæum ; the pain is most severe towards the end of micturition, but when there is cystitis it is nearly constant. Passage of blood in the urine, usually at the end of micturition, is a very frequent though not absolutely constant sign ; frequent micturition and inability to retain the urine are almost always present. The straining efforts to empty the bladder often give rise to prolapse of the rectum and hernia. An elongated, excoriated prepuce, the joint result of the irritating quality of the urine, of frequent micturition, and of pulling at the penis to relieve the irritation felt at the end of the organ, is usually seen. The urine is muddy, containing pus and phosphates in varying quantity ; if no cystitis is present, it may, however, be quite clear. On sounding, the stone is usually felt at once ; it is rare to find a stone in children that is not struck by the instrument as it enters the bladder ; but, as this is not always so, if the other signs of stone are present, repeated soundings should be made if the calculus is not found at once.

A few cases of ureteral calculus are recorded by H. Morris and others as having occurred in childhood.

The most common variety of calculus in children is the uric acid ; next, perhaps, comes the form consisting of urates ; if the stone has caused cystitis, there may of course be a phosphatic coating, or the whole calculus may be phosphatic. Ebstein believes that the uric-acid infarcts of newly-born children form the first stage in calculus production, and that the large quantity of uric acid present in fœtal and early life explains the frequency of calculi of this substance ('Centralblatt f. Chirurg.' No. 14, 1885). The abnormal elimination of uric acid leads to degeneration of epithelium, which forms the animal basis of the calculus.

Calculi in children vary much in size : that is to say, that as different calculi give rise to varying degrees of distress, some of them are allowed to reach a larger size before the child is brought for treatment than are others.

In shape the calculi are usually oval and flattened (uric acid), but spindle-shaped stones are often met with: such are those which, while small, so frequently pass into the urethra, and, becoming impacted, give rise to retention of urine. Thus one of these small oat-shaped calculi some day comes to lie with one end projecting into the urethra, violent straining to pass urine takes place, and the calculus is washed along the urethra and usually becomes fixed just within the meatus at the fossa navicularis, since the meatus is the narrowest part of the urethra. In other cases the stone is arrested at the bulb or in the penile portion of the tube. The symptoms of such an occurrence are pain, œdema of the part, retention of urine, and tenesmus; on examination the stone can usually be felt through the urethral wall, or is readily struck on passing a sound or probe into the urethra. If the case is neglected, ulceration may take place and extravasation of urine; this sometimes occurs very rapidly. We have seen fatal extravasation come on in a few hours. When this occurs the symptoms are the same as in an adult: pain, swelling of the perinæum, scrotum, and penis, constitutional disturbance, and, failing relief, rapid sloughing of the tissues. In all cases of retention of urine in a child, if phimosis will not account for the inability to empty the bladder, impacted calculus should be suspected. The secondary effects of calculus are cystitis, pyelitis, and suppurative nephritis. The ureters may become dilated and inflamed by extension of mischief from the bladder; and obstruction to the outflow of urine, suppurative pyelitis, and subsequent extension of suppuration along the renal tubes and in the peritubular tissue may result. This is probably, but not always fatal, and on removal of the stone the kidney mischief may subside: nevertheless the injury so done to the kidneys may be one of the reasons why children, the subjects of stone, seldom seem to grow up, though the mortality from lithotomy is so small in childhood; it is, as Mr. Erichsen said, very rare to see an adult who has been cut for stone in childhood.

Diagnosis.—One or more of the symptoms of stone may be caused by many other conditions: worms, phimosis, a contracted meatus urinarius, simple or tuberculous cystitis, the so-called irritable bladder,[1] vesical tumours, and renal calculus, all may simulate stone in the bladder to a certain extent; the diagnosis is only to be certainly made by sounding. Stones can often be felt by bimanual palpation, one finger being passed into the rectum and the other hand pressed down above the pubes.

Treatment.—Until recent times lateral lithotomy has been practically always the mode adopted for removal of a vesical calculus in boys, and its success is so great that but little attempt has until lately been made to find any other treatment. Median lithotomy is little applicable, on account of the small size of the parts. Of late the operations of litholapaxy and suprapubic lithotomy have both been employed in children. Keegan, in the 'Indian Medical Gazette,' May 1884 (*vide* also 'Lancet,' vol. ii. 1886 and 1890),[2] collected over one hundred cases of lithotrity in children between the ages of 1½ and 11 years; among these there were three deaths; in six cases the stone was allowed to escape with the urine after crushing,

[1] Thus, for instance, hæmaturia may result from phimosis and consequent irritable bladder (Bryant), and also may be due to tuberculous cystitis. See also p. 207.

[2] Also Southam, *Med. Chron.* vol. xii. 1890.

in the rest it was evacuated ; the size of the calculi varied from five grains to four drachms. The operation has since been largely used.

It is now well established, chiefly by the work of Keegan and Freyer in India, that the urethra of a child of 3 or 4 years will readily admit a No. 8 lithotrite after slitting the meatus, and we have found no difficulty whatever, as far as this goes, in the cases in which we have tried it ; such an instrument is abundantly powerful for the vast majority of stones we find in children, and there seems no valid reason against lithotrity on this ground. In one of our cases, however, the lithotrite broke in the child's bladder, and was removed, together with the stone, by suprapubic lithotomy. This child died of bronchitis shortly after. The death was clearly the result of the somewhat prolonged operation and exposure. Freyer even says that a No. 6 catheter may be readily passed into a child under 1 year old, though this is not always the case. In our own cases there was some difficulty in seizing the stone, but this was got over in one child by passing a finger into the rectum and lifting the stone between the blades of the lithotrite. The operation, in this instance, was followed by pyæmia, and the child died ; after pyæmia had developed it was found that a second stone existed, and this, being lodged in the neck of the bladder, was removed by median lithotomy, but the pyæmia was in no way improved. We do not, however, look upon this case as any argument against lithotrity, though it must be remembered that the natives of India bear surgical operations far better than Europeans, provided no bone lesion is present. In our case kidneys and ureters were both diseased, and probably this condition largely contributed to the fatal result. Though the cases we have mentioned show that lithotrity in children is not without its difficulties and dangers, we have no doubt from our own experience that it is the proper operation to perform in cases where the stone is small or of moderate size, and the child is not too weakly to bear an often necessarily prolonged manipulation. In any case a well-fenestrated lithotrite is essential, as detritus is apt to become jammed in the blades, and thus to prevent the withdrawal of the instrument without difficulty. We have had to open the urethra and protrude and clear the lithotrite before it could be withdrawn through the front part of the passage.

As to the suprapubic operation, there is much to be said both for and against it. Against it is the risk of wounding the peritoneum, the risk of urinary infiltration, and the fact of the good results following the lateral operation. In favour of it is the fact that the operation is done, as it were, in the open : there is no cutting in the dark, no risk of wounding important structures such as the rectum, pelvic fascia, and seminal ducts,[1] while injury to the peritoneum is only likely to occur exceptionally, and is less likely in children than in adults, from the fact that in children the bladder is an abdominal, in adults a pelvic organ.

Suprapubic lithotomy in children has, as shown by Sir Wm. MacCormac and others, a very small mortality ; it is an easy operation, and requires no skilled assistance. In performing the operation no rectal bag should be used ; the bladder should be injected with from 3 to 4 oz. of boric lotion

[1] Sir Wm. MacCormac quotes Haemstadt, to the effect that of eighteen males who had been lithotomised in childhood, and had grown up and married, only one had children.—*Lancet*, March 19, 1887.

and a gradual dissection made down to the organ, not using the knife after the peri-vesical fat is exposed. A staff should be kept in the bladder during the operation, and its end used as a guide upon which to open the bladder ; by pushing the bladder up gently with the staff, and opening the viscus lower down, all risk of injury to the peritoneum is entirely avoided. As soon as the bladder is laid bare, two sutures are passed through it, and the organ is opened between them, the stone is extracted with forceps or the finger, and the wound either left altogether open or the bladder stitched up, the superficial structures being left quite open. Any stitches passed through the bladder walls should not include the mucous membrane. It is well to keep the child on its side or face after the operation, to allow free drainage away of any urine that may collect in the wound. By suturing, the wound has been made to unite by first intention, but, on the whole, we think it better to leave the rest of the wound open while the bladder wound is sutured, or perhaps better still to use no sutures at all. The operation has largely replaced lateral lithotomy. We have not done lateral lithotomy for several years, all cases of stone having been dealt with either by lithotrity or the suprapubic operation.

It is unnecessary here to describe the operation of lateral lithotomy ; it will be sufficient to point out that the operation in children differs from that in adults chiefly in that in childhood the field of operation is smaller, not only on account of the size of the patient, but because the genital organs are undeveloped and the prostate exists only in a very rudimentary condition. It is usually said that in children the difficulty of the operation is in getting into the bladder, in adults it is in getting the stone out. This arises partly from the small size of the parts already mentioned, partly from the fact that the bladder in children is more an abdominal than a pelvic organ, and partly because the tissues of the child are more easily lacerated than those of the adult, and very gentle manipulation is therefore required. In lateral lithotomy in a child the incision is usually carried through the whole depth of the prostate, instead of only through a part of the gland, and unless the opening into the bladder is fairly free there is a risk of pushing the bladder before the finger and stripping it up from its attachments, or even of tearing across the urethra. The only other point requiring remark is that in children it is often easy by passing a finger into the rectum to bring the stone within the grasp of the forceps, or even to extrude it from the perineal opening ; and this is still further facilitated in some instances by pressure with the hand on the abdomen. In one case we could easily grasp the stones (there were two) with the hand through the soft, flaccid abdominal walls.

Vesical calculus is occasionally found in female children : in such cases the urethra should be rapidly dilated with a three-bladed dilator or a pair of dressing forceps, and the stone extracted. If the calculus is large, it should be crushed before extraction and the bladder well washed out. Rapid dilatation is not, as a rule, followed by incontinence, even temporarily ; in a case of our own the urethra of a child 3 years old was dilated sufficiently to admit the little finger, and there was no incontinence, even immediately after the operation.

The mortality after lithotomy in children is about 5 per cent. Death when it occurs is due either to exhaustion of the child by distress and

pain before the operation, to kidney disease, or in some cases to peritonitis, cellulitis, septicæmia, or hæmorrhage.

Cystitis.—Though cystitis in children is very commonly due to stone, it is by no means rare to find other causes for it; thus retention from phimosis, or a contracted meatus, or possibly a growth, may give rise to it: tuberculosis of the bladder often is a cause of severe cystitis with much pain and hæmaturia, while frequent micturition with phosphatic deposit often occurs in children from such causes as errors of diet, or from no obvious reason. Rectal irritation may give rise to frequent micturition and even to hæmaturia.

The so-called 'irritable rugous bladder' is a condition often described as a disease; there is no doubt that certain children are brought with symptoms pointing to stone, and on sounding them no stone is found, but the bladder feels rough and traversed by ridges. We are, however, inclined to think that this is not a pathological condition in itself, but simply the result of some passing irritation such as hyperacid or phosphatic urine, since these cases seldom require prolonged treatment and usually rapidly lose their symptoms after a course of salines followed by tonics. In Mr. Holmes's view it is simply a contracted bladder resulting from some irritation. Renal calculus and phimosis sometimes are the cause of this condition.

Tumours of the bladder are rare in children; one case of prostatic tumour has been already mentioned, and Owen records a case of his own, and mentions Giraldès' and Birkett's cases. Shattock has also recorded a case of mucous polypus in the 'British Medical Journal,' 1883, p. 15, and several cases of sarcoma have also been met with (*vide* Southam); indeed sarcoma of the bladder occurs more frequently in childhood than any other form of growth.

Tuberculous cystitis may be recognised, in the absence of stone or other obvious cause, by pain in urination, itching at the end of the penis, pain in the hypogastrium and perinæum, frequent micturition, and sometimes incontinence. The presence of tubercle bacilli in the urine would be, of course, conclusive, but they are by no means always to be found. The pain may be greatly lessened by passing urine as soon as the least inclination to do so is felt; the urine is alkaline, with a deposit of pus and stringy mucus and epithelium; sometimes there is hæmaturia, and the bladder usually very readily bleeds—for instance, after gentle sounding. We have found a chain of enlarged lymphatics on rectal examination in a case of this sort, and also swelling, probably glandular, in the iliac fossa. Pressure over the bladder sometimes relieves pain. We have not found tuberculous cystitis in children associated with genito-urinary tuberculosis, as is so commonly the case in adults, but the disease is not common enough to speak with authority. Terrillon says the deposit is less gelatinous and more flocculent, and the pain more constant, in tuberculous than in simple cystitis, while bleeding is an early symptom. Where the bladder alone is involved no casts will be found in the urine; their presence would of course point to renal mischief. Ulceration takes place after a time, and the ulcers may be single and small, or numerous and large; they are usually at the trigone.

Treatment.—Alkalies, citrate of potash, and boric acid are the most useful internal remedies, opium and henbane being added where much pain is present. Salol, urotropin, and perhaps helmitol are also valuable

drugs. Washing out the bladder with boric acid (gr. x to ʒi) is of much value in simple, but sometimes too painful in tuberculous cystitis. Powdered iodoform washed into the bladder forms a coating upon its surface, and gives much relief in some cases; it appears, however, to be somewhat specially prone to cause iodoform poisoning: this method was, we believe, first used by Mr. Whitehead for malignant disease. Suprapubic cystotomy with subsequent scraping of the ulcers and prolonged drainage is probably the best treatment in intractable cases.

Incontinence of Urine.—During the first few months of life the infant has no voluntary control over the sphincters of the bladder; urination at this time is a reflex act, like the respiratory movements or deglutition. During the last few months of the first year, a good nurse will have trained the infant to retain its urine till held over the chamber vessel, so that by the end of the first year the napkin can be dispensed with during the daytime. Before the end of the second year accidents either by night or day ought to be infrequent. Unduly frequent micturition may be due to mere habit, to a too often occurring desire to pass urine, or to an absolute inability to retain it. In the first two cases the apparatus is perfect, but is by some cause or other too often excited; in the last there is either paralysis or a malformation. Nocturnal incontinence belongs to the former group; diurnal or continuous incontinence may be due to either condition. Thus a child may have a frequent desire to pass water because a larger amount is secreted, as in diabetes insipidus; because it has a congenitally small bladder; because it has a stone or hyperacid urine, or cystitis, or a feeling of irritation about the penis from an adherent or tight prepuce or a contracted meatus; or because worms or other rectal irritations are present.

On the other hand, there may be continuous dribbling of urine from the bladder, as a result of distension and overflow from obstruction; or in case of entire absence of the bladder, or extroversion, or imperfect development of the neck of the bladder, or of the urethral muscles; or, again, from deficient innervation, as in paraplegia, or from imperfection of the micturition centre in the spinal cord, as seen in some cases of spina bifida. Mention must also be made of certain rare conditions, such as an abnormal communication between the bladder or ureters and the exterior. Obviously a child that can hold its water during the day can have none of these conditions; hence, when a child is brought and said to be unable to hold its water, the first question is whether the condition is nocturnal only or constant. Dribbling from over-distension due to obstruction is nearly always the result of either an impacted urethral calculus or of phimosis, less often of a contracted meatus, though, of course, in these there is, as a rule, complete, or almost complete, retention rather than overflow.

Inability to retain the urine is occasionally seen associated with hypospadias and incontinence of fæces: in such cases the condition is no doubt due to actual malformation of the sphincters.

Dribbling from paraplegia will be recognised by the associated paralyses; so too with the case of spina bifida; hence examination of the spine should be made in all cases, and the child's cerebral condition should also be inquired into. A careful examination as to the condition of the bladder and urethra should be made, to see if there is any deficiency or abnormal

arrangements of these parts ; the urine should be examined for excess of uric acid, also for albumen and sugar.

Diurnal incontinence is much less common than nocturnal, though frequent micturition without any actual inability to retain urine is common enough ; in such cases the sources of irritation already mentioned should be sought for and removed. Sometimes a child, the subject of nocturnal incontinence, passes urine frequently by day, but is able to retain it.

Ordinary nocturnal incontinence (or enuresis, as it is sometimes called) is more common in boys than in girls ; it may occur at any age before puberty, but very rarely persists beyond that time ; if it does so it is usually incurable, and this rare condition is said to be most often met with in girls.

The discharge of urine may take place once or several times during the night ; perhaps most often during the first sound sleep, and again in the early morning.

In cases of nocturnal incontinence those conditions which have been mentioned as giving rise to a frequent desire to pass urine during the day should be looked for, since, when the child is awake, he may be able to control the flow, or pass his urine in a suitable place ; while during sleep no such power is exerted. Other causes, such as unduly deep sleep, due in some cases to the semiasphyxiated condition caused by enlarged tonsils or post-nasal adenoids,[1] dreams in which the child imagines that it is properly passing its water, gastric disturbance from late or unwholesome meals, temporary polyuria from free drinking of fluids at night, and perhaps masturbation, may be added to the list. We have also reason to think that mere delicacy of health, often conjoined with a somewhat unstable and easily excited mind, such as is sometimes seen in children born or brought up in hot climates, may give rise to enuresis. Possibly in some cases renal calculus or pyelitis of tuberculous origin may be an exciting cause.

In the majority of cases of nocturnal incontinence, the trouble is really a neurosis, the result of a developmental failure or an infantile condition of nerve centres which control the bladder.

Treatment.—Setting aside the irremediable malformations and the cases due to paraplegia, the first thing is to look for and remove any of the sources of irritation. If there is phimosis, circumcision or the breaking down of adhesions, if there is a small meatus, enlargement by incision will be required. The bladder should, of course, also be sounded in any case of doubt, or if the condition does not speedily yield to medicinal treatment. If the urine is hyperacid or contains crystals of uric acid, or there is evidence of cystitis, citrate of potash or liquor potassæ should be given ; the child should be carefully dieted and its allowance of meat curtailed, while any irritating vegetable food, such as rhubarb, should be forbidden. Late meals should not be allowed, nor should the child take any fluid for an hour or two before going to bed. Too great a weight of bed-clothes and the habit of

[1] Dr. L. Freyberger found on inquiry that in 350 cases of enlarged tonsils, there was enuresis in 104 ; 193 of the cases were complicated with other troubles, such as phimosis, worms, indigestion, &c. Of the uncomplicated cases (157), only 26 had enuresis ; while in the other class (193), 78 had enuresis. He comes to the conclusion that in uncomplicated cases of enlarged tonsils only some 16 per cent. will have nocturnal incontinence ; in the complicated cases about 40 per cent. It is obvious that the inquiry is a difficult one.

sleeping upon the back should be avoided; in the latter, the immediate impact of the urine upon the trigone is believed to excite the effort to empty the viscus.

For nocturnal incontinence alone the most successful drug is undoubtedly belladonna, or, still better in some cases, atropia. Belladonna should be given in full and increasing doses: for a child 2 years old it is well to begin with five or ten drops of tincture three times daily, and increase the dose by five drops every twelve hours till the physiological effects are produced, bearing in mind that children are not readily susceptible to the action of the drug; as soon as this point is reached the dose should be continued for several days. If the treatment is successful, it should be continued for a week, and then the dose be gradually diminished, increasing it again if there is any relapse. We have seen liquor atropiæ given at night in 2-minim doses, reached gradually, cure a child 2 years old in which belladonna had failed. The drug probably acts both by stimulating the contraction of the sphincter muscles and by acting as a sedative. Bromide of potassium, alone or with belladonna, ergot, cantharides, nitrate of potash, camphor, and other drugs, has been employed. Strychnine is chiefly of use in diurnal incontinence, though sometimes it succeeds in the nocturnal form; it is said by Bouchut to be a dangerous drug for children. Such treatment as blistering, or painting over the orifice of the urethra with nitrate of silver, or the use of a perineal truss, is not to be recommended. The child should be made to pass water just before going to bed, and should be taken up again in an hour's time, and if possible once again during the night; he should be encouraged to try to control the inclination and to exert his will, but on no account should he be threatened or punished, except possibly in the exceptional cases when, as sometimes happens, the presence of one child with incontinence in a school induces an epidemic, as it were, among the others; in such instances probably the affection is in the acquired cases simply a trick, and may be controlled by fear of punishment. The disastrous results of frightening such children into tying strings round the penis, as well as the misery inflicted by the shame of believing that what is really a disease is a fault, are sufficient arguments against such cruelty. Cold sponging to the perinæum is sometimes useful, and we have known the use of the constant current, one pole being applied above the pubes and the other in the perinæum or over the sacrum, to succeed where other means have failed; the interrupted current also sometimes answers. The application of nitrate of silver to the neck of the bladder is advocated by Holmes. In weakly children and in cases of diurnal incontinence, where no organic cause can be found, tonics, iron, strychnine, good food, and sea air will often prove successful, and we have known sea air cure enuresis. The possible existence of chronic renal disease or diabetes must be borne in mind.

In inveterate cases in girls dilatation of the urethra and exploration of the bladder may, as pointed out by Owen, cure the affection even if no organic disease is found.

Retention of Urine.—The causes leading to retention of urine are mentioned under their several headings, but it may be convenient here to group them together. They are congenital malformations, impacted calculus, phimosis, ruptured or strictured urethra, including stricture of the meatus,

pressure on the urethra by abscess or a new growth, blocking of the orifice of the urethra by a vesical or prostatic tumour, or, lastly, the tying of a string round the penis. It must be remembered that retention of urine may be voluntary, or imaginary on the part of the friends : it is voluntary where the passage of the water causes pain, as is often seen after circumcision, when the urine flowing over the surface causes discomfort. We have never seen any harm other than alarm to the friends result from this voluntary retention, though it is well in such cases, if a warm bath does not relieve the retention, to pass a catheter into the bladder. Lastly, retention must not be confounded with suppression of urine from any cause. Of course, retention of urine if unrelieved will lead to extravasation, the treatment of which is free incision deeply into all the infiltrated tissues, so that a free outlet for the urine already extravasated is provided, as well as any further mischief prevented.

Malformation of the Genito-urinary Organs. Extroversion of the Bladder.—Deficient closure of the ventral laminæ, giving rise to hiatus of the abdominal wall, has already been mentioned in connection with umbilical hernia (p. 165). In certain, not rare, instances, however, the lower part of the abdominal wall, from the umbilicus or its neighbourhood downwards, may fail to close, and coupled with this there may be deficiency of the anterior wall of the bladder, constituting the condition known as extroversion or exstrophy of the bladder, ectopia vesicæ, or hiatus of the bladder. A patent urachus or even a protrusion of the bladder wall through such a passage may also be found (*vide* Tanner, 'Diseases of Childhood'). Wood-Jones's researches, already mentioned (Imperforate Rectum, &c.), appear to confirm the view that ectopia vesicæ may be really a result of distension of the fœtal bladder from obstruction of the outlet (urethra) and the condition rather due to a bursting-open process than to a failure of closure of the ventral laminæ. For the arguments in support of this view we must refer to the original interesting paper in the 'British Medical Journal,' December 17, 1904. Tillmann mentions this view as being one of the several possible explanations. In this condition the lower part of the abdomen presents a red rugous area covered with mucous membrane, which is usually excoriated from friction and irritation, often more or less coated with mucus and phosphates. From this surface, or rather from the orifices of the ureters exposed upon it, the urine continuously dribbles, keeping the child always wet, and leading to irritation of the neighbouring skin. This red mucous surface is the posterior wall of the bladder, which is usually flush with the abdominal wall ; hence in most cases there is no bladder cavity, though occasionally there is a slight depression. More often the surface is corrugated and somewhat protuberant, and on drawing down the penis, which is always distorted and ill developed (*vide* Epispadias), the orifices of the ureters can be seen, and drops of urine may be watched flowing from them, and often escaping in a little jet when the child cries or strains. The malformation is most common in males.

On further examining such a child, it will usually be found that the symphysis pubis is deficient, the two bones failing to meet in the middle line, and being only connected by fibrous tissue. The umbilicus may be absent altogether, or may be more or less well formed. The scrotum is always imperfectly developed, and the testes do not fully descend, usually lying in,

or just outside, the inguinal canals. Very commonly there are inguinal herniæ developed, and these may even become strangulated. We have had occasion to operate in such a case.[1]

This deformity, which is quite unmistakable, gives rise to much trouble, both from the constant wetting and excoriations as well as from the incapacities associated with it. It is impossible in most cases to fit any apparatus satisfactorily to receive the urine. Hence the treatment is solely operative ; and even this, it must be confessed, is not always satisfactory. Attempts have been made to divert the ureters into the intestine, and successful results, at any rate for a time, have been recorded. Holmes, Ayres, Wood, Greig Smith, and others have devised operations for covering in the exposed bladder ; these consist of dissecting up a flap from the abdominal wall or scrotum, and turning it over the bladder surface, subsequently covering over the raw side of the flap with other superimposed flaps from the groins. For details of the operation works on operative surgery must be referred to. Several successive attempts are often required before a good result is obtained, and there is sometimes a tendency for the flaps to retract and leave the lower part of the bladder exposed ; this difficulty is met by subsequent attachment of the flaps to the scrotum or labium below, a plan suggested by Mayo Robson, and one we have found of value. On the whole, the result of our experience is that the operation should certainly be done in all cases where the child is in a condition to bear a somewhat severe and prolonged manipulation, and that a great improvement may be expected as a final result (fig. 152). The child should not be operated on until it is

[1] According to Dr. Champneys, *St. Bartholomew's Hospital Reports*, 1877, extroversion may be associated with talipes and other deformities ; the sex may be doubtful from external appearances ; there may be rectal prolapse, with a long, loose rectal mesentery. All grades of deformities, from mere separation of the symphysis pubis, with perhaps a hernial pouch, but no deficiency of the bladder, may be met with ; in the second degree of deformity there may be prolapse of the bladder, though it is itself perfect ; the prolapse may take place through the urethra or urachus (Vrolik, Froriep) : the third degree is the ordinary form ; while in the fourth and most severe degree there is extroversion and division of the bladder into two halves by the opening of the intestine between them. The condition really arises from the fact that the allantois is developed by two lateral portions which afterwards meet in the middle line, and thus the various degrees of deformity of the bladder, epispadias, &c. are explained (*vide* Baly in Müller's *Physiology*). Union between the halves of the allantois takes place at the third week of fœtal life, so the deformity must exist at that time ; but see chapter on Rectal Deformities.

The condition of the umbilical vessels is inconstant : they may run separately to the placenta (Dietrich). The umbilicus is lower than usual, and the anus is generally more anterior than usual. Herniæ are inconstant. The external genitals may be deficient altogether or developed in varying degrees ; the testes may be retained, or may descend into the scrotum and be well developed. The symphysis is not always ununited ; when it is so it causes awkwardness of gait.

As Tenon pointed out, the malformation is not a cleft of the bladder merely, since there is a deficiency of all excepting the trigone and neighbouring parts. The pelvis of the kidney and the ureters are usually dilated, and may open into the rectum, vagina, or urethra.

The intestine is variously malformed or deficient, and there may be an imperforate or misplaced rectum.

For further details and references Dr. Champneys' able paper should be looked at ; from it much of the above is taken.

3 or 4 years old. It has been proposed to scrape or cut away the mucous surface of the bladder except at the orifices of the ureters, and thus avoid irritation of an exposed mucous membrane. Excision of the bladder, with or without transplantation of the ureters, direct suture of the vesical margins, with or without section of the sacro-iliac joints, to allow approximation of the rami of the pubes, have also been suggested. A good summary of the various operations will be found in 'Ann. des Mal. des Organes Génito-urinaires,' March 1888, by Pousson, and in Tillmann's

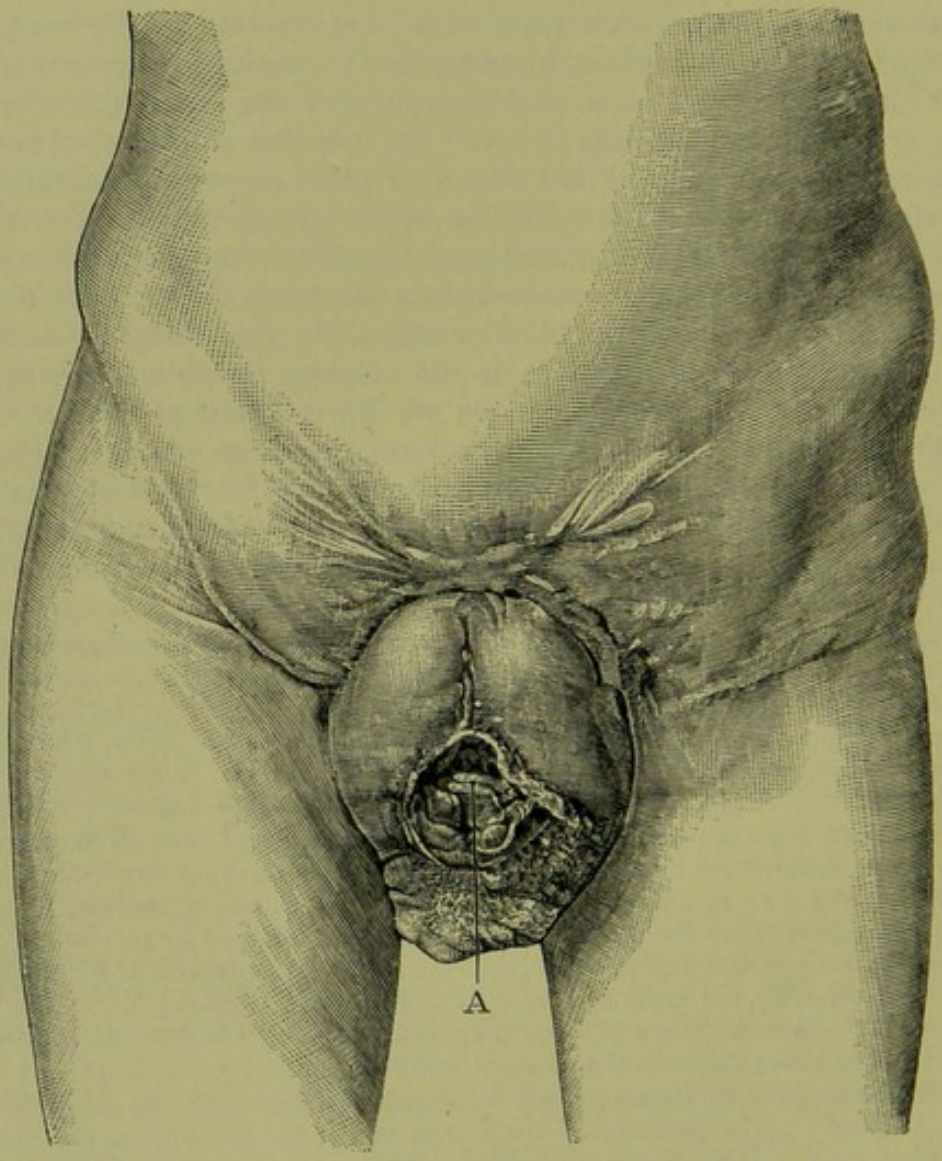

Fig. 152.—Shows the result of a plastic operation for Extroversion of the Bladder in a boy. A urinal can be worn over the orifice now remaining. A points to the glans penis.

'Surgery,' 1899. After operation one of the troubles is the constant formation of phosphatic deposit about the parts; careful cleansing and daily syringing with a dilute acid solution are required. We have found dilute hydrochloric acid ♏xx, glycerine ʒi, water ℥i, a useful form of wash. If, however, as is sometimes the case, the deposit persists in spite of these measures, we have found that scraping it away from time to time with a sharp spoon is the most effectual means of getting rid of it. When the bladder surface

has been covered in as shown in the figure, an appliance is readily adapted to receive the urine.

In extroversion of the bladder in the male the penis is nearly always deformed, the corpora cavernosa are deficient to a greater or less degree, and the corpus spongiosum is ununited on its upper surface, so that the floor of the urethra is exposed on the dorsum of the penis. The whole organ is stunted and turned up against the abdomen ; the prepuce is usually redundant below, and the glans is generally better developed than the rest of the penis.

Epispadias.—The condition of penis above described may occur without extroversion, constituting epispadias.[1] In such cases there is usually imperfect power of retention of urine from deficient muscular development at the neck of the bladder, and for sexual functions the organ is useless. In such cases an apparatus is readily applied to prevent the discomfort of constant wetting ; but to improve the power of urination, and perhaps the sexual function, operations may be performed, consisting in either turning down a hood-like flap from the front of the abdominal wall over the urethral groove, or in dissecting up flaps of skin and bringing them over the dorsum—or lastly, in taking a flap from the scrotum and turning it upwards over the penis, which is passed through a slit in the centre of the flap. Any small fistulous openings left after union of the main flaps are closed by subsequent operation or by repeated application of the actual cautery. In all such operations it has been recommended, as a preliminary step, to open the urethra or bladder through the perinæum, so as to allow the urine to drain away freely, without flowing over the wound. This is, however, not a necessary procedure.

Hypospadias.—When the floor of the urethra, together with the corpus spongiosum, is deficient to a greater or less degree, the deformity known as hypospadias is present. In the slighter cases the deformity is merely one of the urethral orifice, which opens on the under surface of the glans penis instead of upon its apex, though even in these cases the corpus spongiosum is always thinner and less developed than it should be. A dimple usually represents the opening of the urethra, or a groove may run on from the existing opening to the end of the glans. All degrees of malformation are met with from this to cases where the urethra opens in the perinæum, behind the scrotum. In severe cases, the corpus spongiosum being entirely deficient below, the penis is bent downwards and held down by fibrous bands representing the aborted spongy body ; it is also bound down by the deficiency of the prepuce below, though a redundant, hood-like fold overlies the glans above. In the severest cases the scrotum is cleft and ill developed, and the testes are retained or imperfectly descended, and the arrest of development may be such as to give rise to doubts as to the sex of the individual ; such are the majority of the so-called hermaphrodites. Sometimes the urethra is continued on to the glans, but there is a congenital urethral fistula further back, even within the rectum, and urine escapes by both orifices.

The slighter degrees of deformity, where the urethra opens at the base of the glans, need no treatment, and do not interfere with either the urinary or

[1] A case of epispadias in a girl is recorded by Smith in *Brit. Med. Jour.* September 20, 1884, and we have one now under our care (1905).

sexual functions as a rule, though we have met with a case where this condition was associated with incontinence of urine and fæces, probably due to deficient development of the sphincters of both outlets. In all cases of hypospadias a probe passed into the urethra will show how thin the lower wall is, and the meatus is often contracted and insufficient. Sometimes the opening is sufficiently far forwards to serve all purposes, but the penis is tightly bound down to the front of the scrotum. In such cases the organ may be liberated by careful dissection, but unless great caution is observed the thin floor of the urethra will be cut through, and a urinary fistula result. Where the opening is further back than half the length of the penis an operation may be performed to lengthen the channel; with or without a preliminary cystotomy or urethrotomy, flaps should be dissected up from the sides of the penis and turned over one another (method of superimposed flaps). This is a successful plan, but even it often fails from non-union, or breaking down again after partial adhesions. We more often perforate the prepuce, and bring up the glans through it, and then, after refreshing the edges of the preputial fold and of the urethral furrow, unite them, completing the new floor of the urethra by subsequent operations. A flap may also be turned forward from the scrotum and posterior part of the penis. We have found the plan advantageous and it is less likely to leave a fistula behind.

Congenital Contraction of the Meatus Urinarius and **Congenital Stricture of the Urethra** have already been mentioned. We have met with two instances of the latter; one, seen in adult life, was remedied by catheterism in the ordinary way; in the other, an infant, there was retention of urine, with overflow. On passing a catheter two distinct obstructions were found, one at the front of the scrotum, and the other in the prostatic region; they appeared to be definite bars of thickened tissue, the latter closely simulating prostatic enlargement, which, if it existed, only affected the middle lobe.[1]

Congenital contraction of the meatus may become an important affection, giving rise to incontinence, to retention and consequent cystitis, and indeed to all the secondary troubles associated with obstruction to the urinary outflow. In one instance a boy of 5 years old was brought to us, who was said to have had gonorrhœa for three years, and was believed to have been tampered with; there was a distinct gleety discharge, and the meatus was very small. All the symptoms disappeared after slitting the meatus and passing a catheter a short distance down the urethra at frequent intervals for a few weeks; the child was subsequently neglected, and recontraction took place. The following case further illustrates the evils of a narrow meatus:

Contracted Meatus Urinarius; Retention.—Jas. F., age 4 years; admitted December 7, 1882. Well till five weeks before admission, when he was unable to pass urine without pain: subsequently had pain in hypogastrium and became ill in himself; never passed blood: was catheterised at the out-patient room twice, and once passed urine voluntarily. On admission was found to have a contracted meatus, and was catheterised, a small instrument (size not recorded) being passed; urine clear, sp. gr. 1028, faintly acid, slight

[1] Dr. Mudd, *St. Louis Med. and Surg. Jour.* November 1883, mentions a case of enlargement of the middle lobe in a child of 13 months; the swelling proved to be a myoma.

sediment of mucus and phosphates on standing, no albumen; the edges of the meatus were found to become glued together, and he was unable, even by violent straining, to pass urine himself; the bladder contracted tightly round the catheter. December 11, the meatus was incised to enlarge the orifice, and a No. 8 silver catheter passed daily through the meatus, but not into the bladder. He was discharged on the 17th with all his symptoms relieved. It is usually said that retention in children is always due either to impacted calculus or extreme phimosis. Here probably some balanitis led to ulceration and cicatricial contraction of the meatus, the edges of which were probably acting as valves, which shut by the pressure of the urine.

Complete obliteration of the urethra may also be met with, as in a case recorded by Partridge and Watson.[1] Mr. Gray and others have recorded cases of double urethra, one on the dorsum and the other in the normal position, both communicating with the bladder, though not with each other.[2]

The male urethra in its prostatic portion represents the cloaca, the anterior part is formed by closure of the genital folds and is like the other canals of the hind end of the embryo, solid at one stage of development (*vide* Wood-Jones, *antea cit.*). Failure in the absorptive process by which the urethra is opened up explains the rare congenital strictures and obliterations, and failure of closure of the genital folds explains the various degrees of hypospadias.

Possible explanations of the other rarer deformities will suggest themselves on a study of Wood-Jones's paper, but cannot be discussed here.

Prolapse of the mucous membrane of the urethra in girls may be caused by straining; it gives rise to pain, bleeding, and irritability of the bladder. Day, who describes the condition in the 'Medical News,' Dec. 1883, advises astringents in mild cases, and removal by ligature of the prolapsed part in more severe instances. Dr. Coley removed the prolapse by radial incisions and obtained a good result (*vide* 'Brit. Med. Jour.' November 1, 1890, also April 12, 1890). We have met with a case of this condition in which the prolapsed mucous membrane was strangulated and black. It was excised, and no trouble ensued. Vascular growth of the meatus urinarius is occasionally met with in children (*vide* Eve, 'Lancet,' November 1889).

We have seen one case of complete absence of the penis, the urethra opening just at the margin of the anus, outside the external sphincter; the scrotum and testes were well developed. The child was under the care of our colleague, Mr. Collier. For an account of other malformations of the penis, such as torsion, adhesion of the penis to the scrotum, double penis, penile fistula, &c., we must refer to Mr. Jacobson's work on 'Diseases of the Male Organs.'

In 1901 we operated on a boy of 14 in whom the scrotum and prepuce were adherent nearly as far as the corona. He was seen three years after the operation and there was then little trace of anything wrong.

Phimosis, or the condition where a long prepuce exists which cannot without difficulty be drawn back over the glans on account either of the

[1] *Path. Soc. Trans.* vol. xiv. The ureters were enormously dilated; one kidney was atrophied, and the colon ended in the bladder; other deformities also existed. Another case treated successfully by a sort of forced catheterism is recorded by Forster, of Darlington, *Brit. Med. Jour.* January 3, 1885; also Shattock, *Lancet*, February 11, 1888.

[2] *Path. Soc. Trans.* vol. xiv.

small size of its orifice or because of adhesions, is an affection which may be congenital or acquired. Further, it varies much in degree: the prepuce may be very long and end in a puckered, tapering point, in which there is but a pin-hole orifice. Tanner has found it absolutely imperforate. Where the opening is very small, when urine is passed it collects between the glans and prepuce, and 'balloons' out the latter, or the prepuce may be tightly stretched over the glans and universally adherent to it.

In most children at birth the prepuce entirely covers the glans, and on withdrawing it adhesions are very often found between the two, while the coronal groove is filled up with retained smegma in round lumps; if these adhesions are not broken down and the glans kept clean, secondary inflammation is apt to occur (balanitis) and gives rise to still further adhesions, with perhaps increased contraction of the prepuce. In most cases, with a little trouble, the foreskin can be drawn back, the adhesions being torn down by the finger and thumb or a probe; the adhesions are frequently non-vascular, at other times a few drops of blood escape. Daily retraction and cleanliness for a week or two get rid of all further trouble, occasional drawing back and washing being all that is afterwards required.

If phimosis is neglected many ill results may follow. Retention of urine from obstruction at the preputial outlet or at the meatus with consequent extravasation of urine, or incontinence from irritation may ensue. Prolapse of the rectum and hernia may result from the straining required to empty the bladder or from irritation; while cystitis, balanitis, formation of preputial calculi, masturbation, and in later life sterility and increased liability to venereal diseases and epithelioma are also possible consequences of neglected phimosis. Other troubles, such as paraphimosis if a tight prepuce is drawn back, and, according to Mr. Barwell's view, possibly joint lesions from reflex irritation, may occur. Sayre also records cases of various contractions and deformities of the lower limbs resulting from phimosis.

If the obstacle to retraction is simply the adhesions, the breaking down of these, already mentioned, is sufficient; if, however, the preputial orifice is tight, circumcision should be performed in infancy. Dilatation of the prepuce answers in some cases; but we are strongly opposed to it, since we have seen not only rapid recontraction but also much inflammation set up, necessitating circumcision and a long delay in healing; it is not a good plan.

In any doubtful case it is wiser to circumcise, as the operation is as harmless as any operation can be if done properly.

In every male infant the condition of the prepuce should be attended to during the first few weeks of life; much subsequent trouble may be thereby avoided.

There are many ways of circumcising, of which we will only describe the two we prefer. Slitting up the prepuce should never be done in children: it is much better to circumcise properly.

The child should be anæsthetised, and then, with a pair of dressing forceps, the prepuce should be seized just in front of the glans; but it is not to be drawn forwards so as to put it on the stretch, or too much skin will be removed. The forceps should be held vertically, and the skin in front of them shaved off with a scalpel; but at the lower part of the section the

knife should be turned forwards so as to make a little triangular tongue of skin projecting from the cut edge of the prepuce; the dressing forceps are now removed and the skin retracts; the mucous membrane is next slit up along the upper surface of the glans with a pair of scissors, and clipped away all round as far as the frænum, leaving only enough rim of mucous membrane to readily hold the sutures; the frænum should not be clipped close. Interrupted catgut sutures are used to stitch together skin and mucous membrane; generally one on the dorsum and one on each side are sufficient; the little tongue flap is then stitched to the frænum and made to cover in its raw surface; by this means, which was shown us by Mr. Davies Colley, of Guy's, many years ago, rapid healing is usually obtained and there is no raw surface to granulate. The patient should be kept lying down for a few days. We often slit up the prepuce with scissors, and then clip away the required amount of skin; by this means it is easier to estimate the length of foreskin to be left. It is better to do without any dressing, simply keeping the clothes away from the part by a cradle. If there is any troublesome oozing, a strip of lint may be wrapped round the penis, leaving the meatus exposed. Bleeding should be carefully arrested before putting in the sutures. Covering over the penis with a thick pad of cotton wool in the hollow of which a large mass of vaseline has been put is a good plan (Banks).

In a perfect circumcision the edge of the prepuce will well cover the corona; if too much is removed the corona is apt to remain tender and irritable for a long time. A really good result is one that leaves no appearance of the operation having ever been performed. If catgut sutures are used they do not require removal. The Jewish mode of circumcision does not, we think, give such good results as that above described. Martin alleges that circumcision may produce contraction of the meatus, as a result of exposure and friction, and various secondary reflex irritations, which he has relieved by slitting the meatus; but we doubt the occurrence of any bad result from circumcision properly performed, and think any such troubles are more likely the result of the condition for which circumcision is done.

Woodyatt, of Halifax, 'Lancet,' Aug. 15, 1903, makes a suggestion that instead of circumcision it is only necessary to divide the tight mucous membrane inside laterally and suture the incision transversely so as to relax the mucous membrane. His operation is based upon the fact that the constriction is of the mucous membrane and not of the skin. The plan is well worth trying in the slighter cases, but is clearly not applicable to the more severe cases with a mere pin-hole orifice.

Balanitis is often met with in children, and is usually the result of neglected phimosis; the prepuce may be much swollen, and large quantities of pus are sometimes discharged from within it; there is much scalding pain on micturition. Mild cases are readily cured by syringing out the cavity beneath the prepuce with warm water or lead lotion. As soon as the acute inflammation has subsided circumcision should be performed; it is sometimes necessary to circumcise at once, but in such cases the wound is apt to be slow in healing.

The trick of tying a string or tape round the penis, for mischief, or to prevent the need of passing urine, is to be thought of in cases where a child is brought with swelling and inflammation of the penis; the string may be

completely buried in the soft parts, and may give rise to ulceration or even sloughing, urinary fistula, &c.

Congenital paraphimosis is the condition where the glans is congenitally uncovered by prepuce ; it is not a very common condition, but is always found in hypospadias, even in the slighter degrees.

Acquired paraphimosis is produced by retraction of a tight prepuce, so that the glans is exposed ; it is usually the result of mischievous meddling with the penis. If the prepuce is not speedily drawn forward again, the tight foreskin constricts the penis behind the corona and interferes with the venous circulation both in the prepuce and the glans : the result of this is swelling and pain, the swelling being chiefly of the prepuce, since its tissue is more lax than that of the glans. If the condition is neglected the appearance becomes somewhat alarming : there is much œdema, often redness, and some ulceration, with distortion of the organ. Since the constriction is tightest on the dorsum of the penis, there is little or no risk of ulceration into the urethra, and still less of complete gangrene, as has been sometimes stated, but much trouble and no little alarm are often caused by this condition, and we have known it give rise to suspicions of erysipelas ; it might also possibly be mistaken for extravasation of urine or cellulitis. The treatment of the affection consists in drawing forward the prepuce again ; to do this, the swollen foreskin should be punctured with a needle and all the serum squeezed out ; by then drawing forward the prepuce with the fore and middle fingers of both hands, at the same time pressing back the glans with the thumbs, reduction can be accomplished, unless the constriction is very tight or of long standing. Another method consists in winding a piece of tape or narrow elastic round the penis, from the glans backwards, and so, by reducing the size of the glans, the foreskin can be brought over it. Where the paraphimosis has existed for more than a few days it may be irreducible ; or, if the constriction is very tight, it may be necessary to divide the contracted prepuce behind the corona, but this is rarely required. Under such circumstances the swelling is to be reduced by puncture and a lead lotion dressing applied ; in time the parts will model down, and, though permanent paraphimosis usually results, no serious harm occurs. After reduction of a paraphimosis, if the foreskin is long and tight, circumcision should be performed, or in any case measures taken to prevent a repetition of the retraction.

Masturbation.—Masturbation in children is usually the result of a long prepuce, or retained secretion, or of some other source of irritation about the pelvic organs in either sex, such as worms, balanitis, vaginitis, stone, &c. The treatment obviously in such cases is to remove the source of irritation ; circumcision is in obstinate cases desirable, both as a means of removing irritation and as a deterrent ; while in older children, who are able to understand the matter, and in whom the habit is a bad practice and not the result of any obvious physical cause, judicious speaking, pointing out the uncleanness and the debasing effect of the act, is the best line of treatment. Coupled with these plans should be care in avoiding opportunities and, if necessary, punishment should the vice be persisted in. In all cases onanism should be treated first as a disease, and only as a vice when it is clear that no cause for it exists.

Œdema of the Scrotum in children is sometimes met with apart from any obvious inflammatory condition : it may be part of a general œdema due to cardiac or renal disease ; in other instances it is the result of intertrigo, such as is met with in fat and dirty children ; occasionally it occurs without obvious cause, and in such cases some source of obstruction to the lymphatic or venous circulation should be looked for. Erysipelas, or diffuse cellulitis of the scrotum, penis, &c., is also occasionally seen. In all these conditions attention to the general health and the use of lead lotion are usually all that is required.

Diseases of the External Genitals in Females.—The congenital malformations of the external genitals of female children, apart from so-called hermaphroditism, are rare, with the exception of the simple adhesion between the labia minora of the two sides, which, as Mr. Holmes has pointed out, if neglected, may produce retention of menses in later life, and probably forms the majority of the cases of so-called imperforate hymen. (*Vide* Wood-Jones, *loc. cit.*) The treatment of adherent labia is very simple ; the adhesions are broken down readily with a probe, and a little oiled lint kept between the labia for a few days, together with ordinary cleanliness, is all that is required.

Hypertrophy of the labia or clitoris in children, though common among the natives of some hot climates, is very rare in this country. We have, however, occasionally seen it, though rarely to an extent that required treatment. In a young adult, however, we have had occasion to remove hypertrophic labia, the condition having lasted some years, but whether it was congenital or not we cannot say. Nothing short of operation is likely to be of any service. We have seen a case in which the clitoris of a little child was much enlarged and caused irritation ; examination showed that there was adhesion of the prepuce of the clitoris to the glans, with retained smegma, just as in the case of phimosis in the male.

Nævus of the labia is seen every now and then, and is best treated by puncture with the actual cautery.

Of acquired affections, simple **Vaginitis,** or, as it more commonly is called, **Vulvitis,** is frequently met with ; it is usually caused by neglect and dirt, and often by the irritation of thread-worms, but is sometimes the result of inoculation with the discharges from other cases of vulvitis, or from older people by the use of dirty sponges for washing, &c. Very rarely indeed is it the result of attempted rape, and such charges are often brought against innocent persons simply because the mothers conclude that all discharges from the genital organs in children must be venereal ; and it should be remembered that some children are led to invent stories or to confirm suggestions made by ignorant or dishonest mothers. Even the presence of organisms indistinguishable from gonococci would not be conclusive.

This simple vulvitis is very contagious in many cases and readily spreads from one child to another ; hence isolation, perfect cleanliness, the removal of sources of irritation, and the free use of antiseptic lotions such as perchloride of mercury or boric acid, should be employed. In some cases astringent lotions, such as sulphate of zinc or alum, are useful, and iodoform should be well dusted into the vulva. In one instance we found

prominent masses of granulations in the vagina in a case that had long resisted ordinary treatment ; in this case nitrate of silver proved the best application.

The so-called **aphthous vulvitis** is a superficial ulceration occurring not rarely about the labia in ill-nourished, neglected, and unhealthy children, especially common as a sequel or complication of one of the exanthems. It occurs also in some cases of nephritis, and may simulate the severer disease, noma, from the presence of dried blood on the surface, giving the appearance of sloughing, as in the following case :

Acute Nephritis ; Ulceration of Labia.—Mabel C., age 2 years. Admitted October 27, 1885. Two months ago an eruption appeared on the face and head, which has lasted since ; for the past fortnight the labia have been swollen and sore, small spots appearing first ; has had epistaxis for the last few days ; is said not to have passed urine since the 24th ; bowels open this morning, motion quite black. On admission, pale, pasty, bloated child ; labia both much swollen and superficially ulcerated ; no vaginal discharge ; some superficial ulceration around the right ear ; eczematous patches on the head, covered with blood-stained scabs. 28th, seems very feeble ; no urine passed until this morning, and then into the bed ; vulva as yesterday, some thread-worms seen about it ; eyes puffy ; does not take food well ; found dead in bed at 9 P.M. The vulva was dressed with carbolic lotion and boric lint ; and carbonate of ammonia and bark, with strong beef tea and wine, given. Temperature, 28th, M. 98·2°, E. 96·6°.

Post-mortem.—Both lungs rather congested and œdematous ; no pneumonia ; heart normal ; kidneys swollen ; weighed together 3 oz. ; not very congested ; in one, cortex finely granular (like scarlatinal nephritis) with red points ; the ulceration on the vulva and head was quite superficial ; there was no sloughing ; it extended all over the vulva to the vaginal orifice.

The treatment consists in cleanliness, free stimulation, and abundant nourishment, together with such measures as the disease with which it is associated demands.

According to Savarin, aphthous vulvitis occurs most commonly in children of from 2 to 5 years, and usually is a sequel of measles ; the patches begin as blisters and then ulcerate ; they may finally become gangrenous. There is some fever and the parts around are swollen, but there is very rarely lymphatic enlargement. The labia majora are most often affected, but the process may spread to the perinæum, groin, &c. The disease has a certain resemblance to diphtheria and syphilis, but is distinguished from the former by the imperfect membrane formation, and from both by the multiplicity of the ulcers, the absence of lymphatic enlargement, and the history. The prognosis is favourable unless gangrene occurs, and the best applications are boric acid and iodoform. Tuberculous ulceration may be met with about the vulva as in other parts.

Noma Pudendi.—Noma pudendi or noma vulvæ is a gangrenous affection of the external genitals, of precisely the same character as cancrum oris ; it runs a similar course, occurs under the same conditions, and requires the same treatment. It is quite as fatal as cancrum oris, if not more so ; it is, however, much rarer : many of the cases of so-called noma are merely aphthous vulvitis. We have very rarely seen well-marked cases. Morse found an organism in noma that he regarded as pathogenic.

Warty and cystic growths are mentioned by Mr. Holmes and others as having been met with about the vulva and vagina in children, and would require treatment on general principles.

Hæmorrhage from the vulva or vagina is occasionally met with in infants, but is of trivial importance and requires no treatment (Holmes). (*Vide* chapter on DISEASES INCIDENTAL TO BIRTH).

Irritable Mamma.—Irritable or painful mammæ are not uncommon in girls of from 10 to 15 years. There is slight enlargement of the glands, which are tender; the pain is variable; usually one breast is affected first and the other is attacked later. This condition is usually met with before menstruation has occurred, but is probably associated with the physiological growth of the organs. A similar condition is met with to a less marked degree in boys about puberty. Occasionally the condition is simply hysterical. Treatment seems to be of little use, but all the cases we have seen have got well. Belladonna and strapping locally, with tonics and arsenic internally, should be tried.

In infants the breasts occasionally suppurate; this is usually the result of rough handling on the part of superstitious nurses,[1] and may result in permanently stunted or retracted nipples. A milky secretion may also now and then be seen escaping from the nipples of babies.

Abnormalities in the Descent of the Testicles.—In the fully-developed child the testes should be in the scrotum at birth, or rather shortly before birth;[2] it is not, however, rare for their descent to be delayed for varying periods—they may even pass into the scrotum as late as the time of puberty. Most commonly descent takes place between the second and tenth years (Hunter, quoted by Jacobson); if the testicle does not come down by the end of the first year, Curling says it is usually accompanied by a hernia. In some instances the organs are permanently retained within the abdomen (cryptorchism); sometimes one testicle descends, the other being retained (monorchism). When the testes have not reached their proper situation they may be found in the abdomen, at the internal ring, in the inguinal canal, in the upper part of the scrotum, in the perinæum, or even in the thigh;[3] and instances of descent of the testes through the femoral canal are on record. Usually the glands are movable, and, though they may generally occupy one particular position, they may often be drawn down or pushed up beyond that spot, just as their situation alters according to the contraction or relaxation of the cremaster and dartos under ordinary circumstances.

The cause of failure of natural descent of the testicles is still somewhat obscure. Possibly failure in the action of the gubernaculum, possibly simply a lack of development; certainly sometimes adhesions to surrounding parts, to the funicular process, the intestine, or the mesentery, prevent the descent. Premature closure of the funicular process, contraction of the inguinal rings, or a deficient development of the scrotum in some cases, perhaps accounts for the failure; other less frequent causes, such as shortness of the vas deferens, a long mesorchium allowing the testis to float freely in the

[1] The breasts are pulled at to 'break the nipple strings,' with the idea of preventing retraction of the nipples in later life.

[2] Camper found the testes in the scrotum at birth in sixty-three cases out of seventy.

[3] Displacement of the testes into the thigh has been accounted for by the fact that some fibres of the gubernaculum testis pass downwards into the upper part of the thigh.

abdomen, fusion of the two testes, or an enlarged epididymis, are mentioned by Jacobson.[1]

The condition of the glands when they are in an abnormal position is a question of importance: they are often imperfectly developed. In other cases, however, they are in no way defective, and cryptorchism does not necessarily imply sterility, while monorchism is, of course, functionally still less important.

Apart from functional imperfection, various evils may attend imperfectly descended testes. From their abnormal position and diminished mobility they are in many cases more exposed to injury, as, for instance, when they are lodged in the perinæum or in the canal. If a testis becomes inflamed from injury or other cause, the symptoms are likely to be much more serious if the gland is retained within the abdomen or in the canal, while retained testes are said to be frequently the seat of new growths.[2] Most important, perhaps, of all is the effect of an imperfect descent of the testicle upon the formation and persistence of hernia. By keeping the inguinal canal and rings open, the misplaced organ directly encourages the descent of a hernia. Where the gland acquires adhesions to the bowel and then descends into the canal, or even where the adhesions result from descent of a hernia after the testis, the matter is still further complicated, and great difficulty in the management of such cases may arise.[3] It is quite common for a child to be brought with the statement that it is ruptured, and that it has perhaps been wearing a truss—but this is said to have been always painful, and the child screams all the while it is on. Examination shows an undescended testis lying in the canal, which has been pressed upon by the truss, and, of course, the child could not bear it. In such cases the undescended testis is often the supposed hernia, though frequently enough the two conditions co-exist, and a reducible hernia is found to descend above the testicle. It appears, however, that there is little real proof that there is any special tendency to the formation of tumour in undescended testes. We have met with a case in which both testis and hernia were strangulated; we removed the testis, closed the canal, and the patient made a good recovery.

The diagnosis of undescended testis is not often a matter of difficulty; an examination of both sides of the scrotum will generally clear up the case. But we would suggest a word of caution not to be satisfied with too cursory an investigation: sometimes one testis may be down, and, unless both are felt for at the same time, may slip about so as to feel as if it belonged to either side; sometimes, too, an empty scrotum may be felt, but a little examination and manipulation of the canal, or the application of heat, may bring down the testicle, and the case may turn out to be merely one of retracted, not retained, testis.

[1] *Diseases of the Male Organs of Generation*, 1893. *Vide* also Lockwood, *Brit. Med. Jour.* 1887, and McAdam Eccles, *The Imperfectly-descended Testis*, 1905.

[2] Especially, according to Virchow, when they are retained in the inguinal canal; he points out that obscure abdominal tumours, in the absence of any more obvious connections, should induce examination for an undescended testis.

[3] The cæcum may descend with the testis in consequence, possibly, of unusual strength or abnormal arrangement of that portion of the mesorchium called the 'plica vascularis' (*vide* Lockwood, *Med. Chir. Trans.* 1886).

Occasionally a hernia, if it contains thickened omentum or glands, may be taken for a testicle or a hydrocele of the cord, or a fibrous or fatty tumour may simulate a testis in the canal. There is considerable variation in the size and firmness of the testes of young children, and we have frequently seen mistakes made about these conditions.

The treatment of undescended testicle is an important and difficult matter. Where in an infant or child 3 or 4 years old there is an undescended or imperfectly descended testicle, with no hernia, nothing should be done except gentle attempts to bring the glands further down by pressure from above with the fingers ; this manipulation should be repeated frequently during the day. In an older child, up to the age of puberty, the same line of treatment should be adopted as a rule ; if, however, the testicle gives rise to pain or trouble, an attempt may be made by operation to bring it down and fix it to the bottom of the scrotum. We have performed the operation in a good many cases, but though it is sometimes successful we have found that there is a great tendency for the testes to become again retracted. The scrotum in such cases is often small and ill developed. The operation consists in exposing the testis as in an operation for hernia, passing a silk or catgut stitch through its outer tunic, or between the gland and the epididymis, and then bringing the suture out at the bottom of the scrotum and fixing it there. Testis in perinæo is probably best treated by replacing it in the scrotum—by operation, if possible ; if not, and its presence gives rise to trouble, it should be removed. Mr. Jacobson advises that all such operations should be postponed till after the first or second year. It is essential to separate the testis freely from all the adhesions which usually exist, so that it lies quite readily in its new position, even before it is stitched there. The adhesions may be remains of that part of the gubernaculum which is attached to the tuberosity of the ischium, and this may explain the abnormal position of the testis.[1]

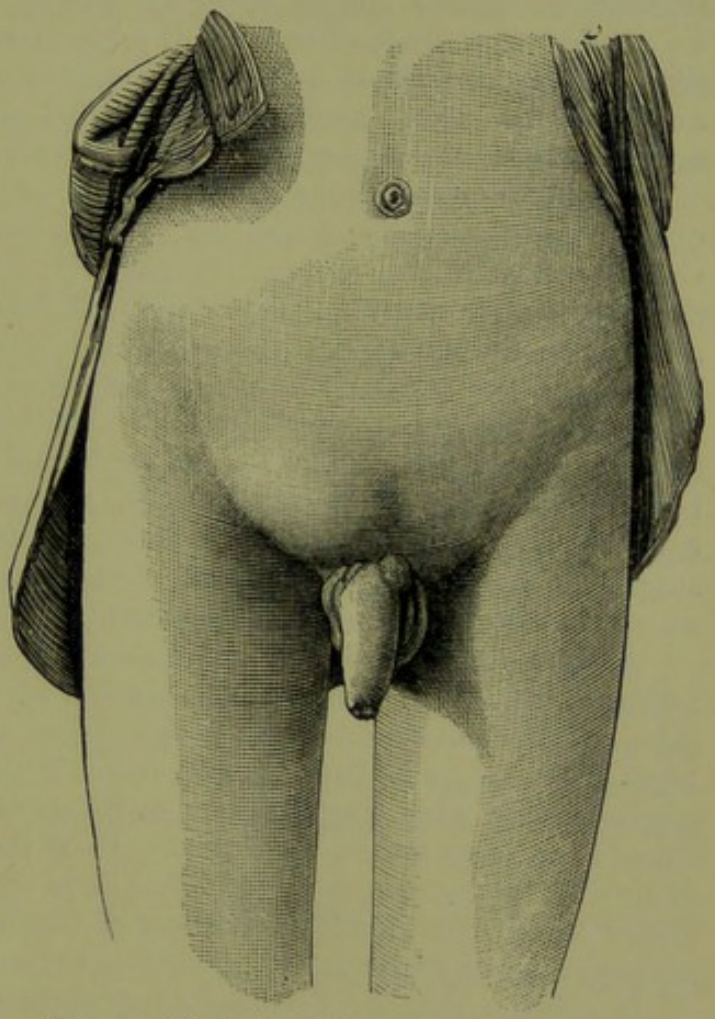

Fig. 153.—The right testis is undescended, and is seen forming a swelling in the inguinal canal.

[1] *Vide* Lockwood, *Med. Chir. Trans.* 1886.

Displacement of the testicle into the perinæum is sometimes the result of dislocation, and is not congenital: under such circumstances it has been successfully replaced.[1]

We must strongly protest against the use of a truss for undescended testis in young children with a view of keeping it out of the way, or preventing the descent of a hernia where no rupture already exists; we cannot but consider the plan unnecessary and unscientific except in the cases where the testicle is inseparably adherent to the bowel, and, as this can only be ascertained by operation, we think it is wiser to operate in doubtful cases, separate the testis, bring it down, and close the canal above it if possible. If this cannot be done, the testicle should either be removed—which should be only done, as a rule, when the testicle is small and wasted, and can be separated from the gut without risk of injury to the bowel—or, after reducing it into the abdomen, the canal should be closed; hence it is only in such cases that any obstacle to the descent of the testicle should be interposed.

Should an undescended testis become inflamed from injury, from torsion or from pressure while in the canal, the symptoms may be severe, and may simulate those of strangulated hernia—the absence of the gland from the scrotum usually clearing up the doubt; if, however, there is any uncertainty about it, or the symptoms do not speedily subside, the parts should be explored, and the inflamed or gangrenous testis is generally better removed. Fatal peritonitis has resulted from this condition.

Jacobson, in his well-known article in Holmes' 'System of Surgery' and book on 'Diseases of the Male Organs,' advises the use of Dover's powder, hydrarg. c. cretâ, and hot poppy fomentations in these cases in the early stage; to this work we must refer for further details on this subject: to it we are indebted for many of the points in the present chapter.

Where a hernia co-exists with an undescended testis, but the two are not adherent, the best treatment is to apply a truss of special size and shape for the particular case, made so as to fit between the testis and the canal, and so, while the rupture is kept up, the testis is pressed downwards. We have employed this plan usefully, and by its means both defects may be cured. Should the truss fail to procure closure of the canal, the hernia should be dealt with by the operation described in p. 169; the funicular process being closed above the gland, the descent of the testis will be favoured, and an attempt may be made at the same time to fix it in the scrotum.

It appears that the retained or imperfectly descended testis is usually defective as regards spermatogenic functions, but may be useful from the point of view of producing or preserving the secondary sexual functions, such as growth of hair, the male voice and appearance, and so on. The 'internal secretion' may still be of some value.

Recent researches seem to show (1) that an imperfectly descended testis usually undergoes sclerosis, and is not of functional reproductive value, except possibly for a short time. (2) That operations for such condition are often unsuccessful and do not result in further development of the organ. (3) That in cases of difficulty in getting the testis down into the scrotum which have been dealt with by free division of vessels, &c., atrophy follows.

[1] Victor Horsley, *Med. Times and Gazette*, December 1883.

(4) That pain or discomfort and torsion of the testis are apt to occur in imperfectly descended organs. Hence orchidopexy or operations for replacing the testis in the scrotum are of doubtful value, and with this we agree, except for cosmetic reasons.

Two alternatives remain unless the condition is to be left alone: one is to reduce the testis into the abdominal cavity, a course which is strongly advocated by some surgeons, but is not free from objections. The other is to remove the gland. This is undesirable in children, but may be done in adults in cases of unilateral defect. It may also be the wisest course where a hernia is present and the defect is unilateral; in such cases the cure of the hernia is made more certain and easy by complete closure of the canal after removal of the testis.

There seems, as has been stated already, very little evidence that an abdominal position of the testis makes it more likely to become the seat of new growth (Eccles). If any operation is done it is said to be more likely to promote the development of the gland if it is done early; at the same time it must not be forgotten that the testes may and do sometimes, as already stated, descend even as late as puberty.

We must refer to Mr. Eccles' work, and to a paper by Mr. Corner in 'Brit. Med. Jour.,' June 4, 1904, for further discussion of the question.

Supernumerary Testicles hardly ever occur. Most of the supposed instances have turned out to be either hydroceles of the cord, herniæ, or solid tumours. Lane has, however, recorded a recent case. Congenital absence of the testes as distinguished from mere cryptorchism is an exceedingly rare condition and usually associated with other malformations. Langton records two instances of unilateral deficiency, the vas deferens ending in blind coils ('Brit. Med. Jour.,' December 1, 1900).

Deficiency or closure of the vas deferens is occasionally met with: in such cases the testis is well developed, but, of course, functionless sexually. Inverted testicle, where the epididymis lies in front of the gland, is sometimes a congenital, sometimes an acquired condition; it may be of importance in case of the appearance of a hydrocele or hernia, or as a predisposing cause of torsion of the testicle.

Mr. Jacobson's table of the complications of misplaced testis, in so far as it relates to children, is here summarised:

1. The testis may be retained (*a*) in the abdomen, (*b*) in the iliac fossa, (*c*) in the inguinal canal, (*d*) just outside the external ring.

2. The testis may take an abnormal course into (*a*) the perinæum, (*b*) the crural canal.

3. Retained testis may become inflamed or gangrenous, may give rise to peritonitis, may simulate a strangulated hernia, or may become the seat of tuberculous disease, or of malignant growth, or may atrophy.

4. Misplaced testis may be complicated with hernia, (*a*) from adhesion of intestine to the undescended testicle, or (*b*) from co-existing patency of the funicular process.

5. Hydrocele may be a complication, as (*a*) an acute condition from inflammatory effusion into some unobliterated portion of the processus vaginalis, or (*b*) as a chronic effusion; in either case there may be a communication with the cavity of the peritoneum above, or extension into the scrotum below.

Congenital displacement or **Hernia of the Ovary** sometimes occurs, one or both organs protruding into the inguinal or even into the femoral

canals, and occasionally in later childhood a similar malposition occurs. We have seen both ovaries prolapsed into the inguinal canals in a case of tuberculous ascites, the ovaries returning to the abdomen on the subsidence of the fluid. If irreducible, the ovaries may give rise to trouble in later life from their enlargement at the menstrual periods, as well as from their presence keeping the inguinal canals patent: hence, where possible, they should be returned to the abdomen and kept back by a truss; occasionally an operation as for hernia is required. Torsion of an ovary prolapsed through the inguinal canal has been recorded.

Diseases of the Testicle in Childhood.—Simple **acute orchitis** in children occurs as a result of injury—undue pressure of a truss—or the result of an operation such as that for the radical cure of hernia or lithotomy; sometimes without assignable cause, or under circumstances mentioned in the case of hydrocele. The inflammation often results in the development of hydrocele, and there is often œdema of the scrotum; but the affection is seldom severe, and subsides readily under the use of lead lotion, rest, and elevation. We have never seen any immediate bad result, though it is possible that the subsequent growth of the gland may be interfered with. Orchitis from mumps is very rare in childhood; we have never seen it. Acute inflammation of the testis going on to gangrene may be a result of 'torsion' of the testis, an accident occasionally met with, usually occurring in cases in which there is some abnormality of the organ, and very apt to be mistaken either for an acute orchitis from some other cause, or for strangulated hernia, especially if, as is often the case, the testis has imperfectly descended. Chronic orchitis may result from the acute form.

Syphilitic Testitis is, in our experience, very rare; Mr. Holmes mentions having seen hard knots in the testicle which were apparently gummatous; they readily yield to the use of hydrarg. c. cretâ. Other cases have also been recorded, and sometimes a diffuse orchitis is found. We have met with cases of induration of the testes in young children for which we have been unable to account.

Tuberculous disease of the testicle is met with in two forms: as a part merely of a general tuberculosis, and as a localised condition limited to the testes alone or the genito-urinary tract. Genito-urinary tuberculosis is much rarer in children than in adults, but it is common to find both testes tuberculous. In the former case the tubercles may be only miliary and disseminated, and hence not recognisable during life, or they may form definite, hard, circumscribed masses in the epididymis, just as in adults. While the disease is limited to the testicle, it takes the form just described, giving often a sensation as of a 'dumb-bell' or double testicle; it is usually not painful, and often of slow growth. If nothing cuts short the child's life, the testicle usually at last breaks down, and a suppurating 'strumous testis' develops, with its characteristic adherent or undermined skin, livid colour, and intractable course; the cord is usually thickened.

Where the tubercle is generalised, no treatment of the testicular affection is, of course, of any use; when, however, no obvious lesion exists elsewhere, the usual management, medicinal and dietary, of these cases should be carried out (cod-liver oil, phosphate of iron, &c.). For the testicle itself, pressure, with occasional inunction of mercurial or iodide of lead ointment,

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may be used, but as soon as suppuration occurs it is probably better to remove the gland; it is in such cases most likely functionally destroyed from blockage of the efferent ducts, and is a source of general infection. The operation is sometimes advised as a precautionary measure as soon as a diagnosis can be made, but the propriety of this we think open to doubt; we have had occasion to perform the operation only once or twice, and in one case the child was seen two or three years later in good health, his brother being affected by 'general surgical tuberculosis.' In this instance the disease began at 7 weeks old, and the gland was removed at 18 months; testicle and epididymis were involved. Our colleague, Professor Dreschfeld, has recorded a case of congenital tuberculosis of the testis in which tubercle bacilli were found.[1] Hernia testis occurs only in those cases where the body of the testis is involved, and when present castration is probably the wisest course. Occasionally the tuberculous deposit gives rise to acute inflammation.

Tumours of the Testis.—Tumours of the testis in children may be congenital or acquired; the congenital are rare and usually teratomata or 'dermoid,' consisting of cysts which contain hair, teeth, &c., as in the corresponding tumours of the ovary.[2] Striped and unstriped myomata, however, have also been found,[3] as well as congenital adeno-sarcomata,[4] and, according to Silcock,[5] carcinoma—though Butlin disbelieves in the occurrence of carcinoma testis in children.

Acquired tumours are usually sarcomata (round-celled), very rapidly growing, very malignant, and tending to involve the lumbar glands very early. The large size, rate of growth, solidity, dilated veins, opacity, and bossy surface, sometimes with cysts, make the diagnosis usually easy. These growths generally occur in the first few years of life, but according to Butlin are common from the time of birth to the tenth year.

Non-sarcomatous cystic disease may be met with; the cysts usually arise as dilatations of the seminal tubules, and may be lined by cylindrical or ciliated epithelium. Immediate removal is the only treatment to be adopted in a case of malignant disease of the testis, though recurrence within a year is to be expected in most cases; in simple cystic disease the same treatment is required, since a diagnosis between it and sarcoma is impossible. In the case of dermoid cysts it is sometimes possible to dissect away the cysts without injury to the testis.[6]

Hydrocele.—Hydrocele is a very common affection in childhood, most frequently met with in quite early infancy; it may result from simple irritation, intertrigo, &c., especially when, as is often the case in that condition, the testes hang loose and pendulous. It is sometimes caused by injury, the testis being squeezed by the child while keeping its legs crossed, or by other

[1] *Brit. Med. Jour.* 1884, p. 860.

[2] Teratomatous tumours of the testis are explained by Saint-Hilaire as instances of 'fœtal inclusion'; by Owen as instances of parthenogenesis; and by Lebert as the result of 'hétérotopie plastique.'

[3] Rindfleisch and Rokitansky. [4] R. W. Parker, *Path. Soc. Trans.* 1885.

[5] *Path. Soc. Trans.* 1885.

[6] Verneuil, *Brit. Med. Jour.* April 4, 1885. For a full account of testicular growths see Jacobson, *op. cit.*

accidents. Hydrocele may be congenital where the whole processus vaginalis remains patent; in this case if the communication with the peritoneal cavity remains free, the fluid will flow in and out according to the position of the child. We must say this condition is not often found: either the opening is a small one and readily occluded by flexion, or this form of hydrocele is rarer than is commonly supposed.

Infantile hydrocele, so called, is the condition where the tunica vaginalis and funicular process are distended with fluid, the processus being closed at the internal ring; this is a common condition. Again, the funicular part of the processus may remain open, but be shut off from the tunica vaginalis; in such a case a congenital funicular hydrocele would result. Or, finally, there may be an encysted hydrocele of the cord from distension of an unclosed segment of the funicular process.

Diffused hydrocele of the cord, described as a sort of œdema of the cellular tissue of the cord, is believed to be very rare; we met with a case while operating for hydrocele of the cord, in which there was some gelatinous material lying in the tissue of the cord, superficial to the funicular process, which contained ordinary clear fluid. Hydrocele (encysted) of the testis and epididymis from dilatation of the hydatid of Morgagni, or organ of

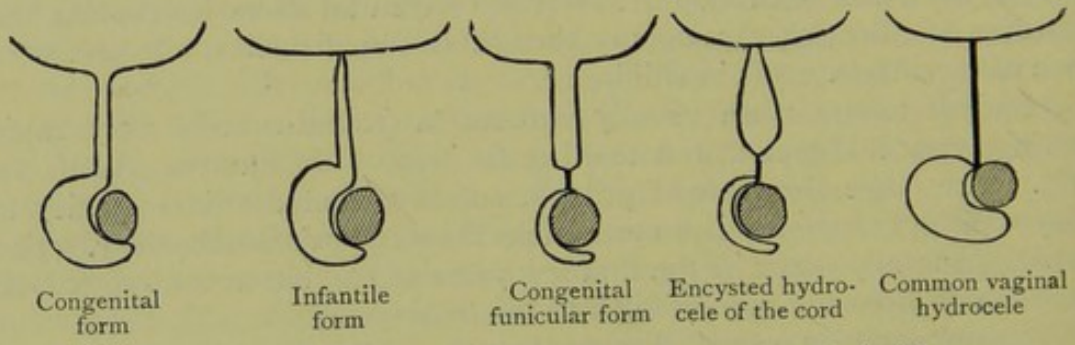

Fig. 154.—Diagram of the commoner forms of Hydrocele of the Vaginal Process. Altered from Lane.

Giraldès, may possibly occur; it is, however, usually a disease of later life, and no case appears to have been recorded in childhood (Gosselin).

Diagnosis.—The diagnosis of hydrocele in children is made by first examining the cord, and excluding the presence of a hernia by finding that there is no increased thickness of the cord above; next, a soft, elastic, fluctuating feeling points to hydrocele; and, finally, translucency, or the possibility of reduction gradually by pressure or elevation, without any gurgling sensation, clears up the case. It is, however, certain that herniæ in infants, when the bowel contains only flatus and is much distended, are sometimes quite translucent. Sir H. Howse was, we believe, the first to point out this fact, and we have many times seen the same thing.

When there is an encysted hydrocele of the cord it is usually possible to bring it down by traction, and feel the absence of thickening above, or the tense swelling may be made to slip backwards and forwards between the fingers, quite unlike a hernia. The mode of reduction serves to distinguish a funicular hernia from a funicular hydrocele, and the absence of distinct impulse gives corroborative evidence. Hydrocele of a retained testis sometimes occurs and may give rise to difficulty; the possibility of isolating it,

its irreducibility, and its consistence, together with the absence of the testis from the scrotum, will give the clue.

Combinations of two forms of hydrocele, e.g. of vaginal hydrocele with encysted hydrocele of the cord, may be met with, and a funicular process may contain fluid at one time and a hernia at another. Or there may be infantile hernia with infantile hydrocele. A collection of fluid may form in the sac of a congenital hernia, but is usually masked by the presence of bowel.

Engel and Camper are quoted by Jacobson as having found the processus vaginalis closed at birth in about 10 per cent. only of children examined ; this supports the view that some abnormal condition of secretion in the abdominal cavity must exist to produce a congenital hydrocele, for it is certainly not as common as these figures would imply.

Hydrocele in Girls.—The funicular process in girls (canal of Nuck) is occasionally the seat of hydrocele ; the diagnostic points and treatment are practically those of hydrocele of the cord in boys.

Treatment.—Many cases of hydrocele get well without treatment ; those due to local irritation subside on removal of the cause. The congenital form may disappear by spontaneous closure of the funicular process ; other cases subside under the use of evaporating lotions, lead lotion, or mild counter-irritation such as painting with tincture of iodine. The congenital and funicular varieties are usually cured by a truss, and it is seldom that hydroceles give much trouble. When, however, these plans fail, the methods of treatment we prefer are: (1) injection with solution of pure carbolic acid in glycerine (1 part in 3) without emptying the sac of its fluid, so that the injection is still further diluted ; (2) simple antiseptic incision : the sac is laid open and drained for four or five days without any stitching of the edges of the sac to the skin, as in the so-called 'schnitt operation,' or part of the parietal layer of the tunica may be excised, and so the sac may be obliterated. Tapping, subcutaneous puncture, letting the fluid escape into the loose scrotal tissue, setons, injection with iodine or spirit, &c., all have their advocates, and are no doubt often successful ; but the plans mentioned are in our opinion the safest,[1] surest, and quickest, though relapses occasionally occur, whatever method is adopted. We have seen a hydrocele develop some time after an operation for the radical cure of hernia in an infant in whom the bowel was strangulated.

Œdema of the scrotum is often met with as a result of intertrigo in children, and should be distinguished from hydrocele, anasarca, erysipelas, and extravasation of urine—also from the 'inflammatory' or 'malignant œdema,' so-called.

Varicocele has been met with in childhood by Bryant, Pearce Gould, and Landouzy, but we have never seen a case earlier than about the tenth year, though we have seen a boy of 13 with a large varicocele which was said to have existed for five years.

Ovarian Tumours in children are nearly always sarcomata, teratomata, or dermoid cysts ;[2] they may appear at any age : thus Chiene has operated

[1] Poland has recorded a case of fatal peritonitis after tapping a congenital hydrocele of the cord.—*Lancet*, December 1884.

[2] Evers, *St. Louis Courier of Medicine*, August 1884, has met with a case of sarcoma in a girl of 2½ years.

successfully at three months, and Roemer[1] of Berlin at twenty months. The only treatment is abdominal section in the ordinary way. In the case of large tumours it may be impossible to make an accurate diagnosis between ovarian and renal or other congenital tumours until the abdomen is opened. Precocious puberty has in some instances been found associated with ovarian tumours. We have seen considerable development of the external genitals, with growth of hair and discharge of blood from the vagina, in a child 3 years old, who was the subject of a tumour which apparently involved the liver and the right kidney. Tuberculous pyosalpinx has once been met with by Chaffey, and once by Quarry Silcock.[2]

[1] *Jahrbuch f. Kinderheilk.* Bd. xxi. H. 4. Eight out of eleven cases collected by Roemer recovered.

[2] *Path. Soc. Trans.* 1885. See also *Tumours of the Ovary &c.* by Doran.

CHAPTER XXIX

DISEASES OF THE BONES

Diseases of the Bones.—A full description of the subject of inflammation in bone would be out of place in the present work, but a few of the more important points may be summarised here.

(For tumours of bone *vide* Chapter XXXVII.)

The process of inflammation as occurring in bone differs from that in the soft parts only in that the inflamed tissue is more rigid and unyielding; hence, on the one hand, the progress of inflammation may be slower, and on the other, as tension is greater, its effects may be more destructive.

As elsewhere, inflammation in bone leads to rarefaction, i.e. absorption of healthy tissue (rarefying ostitis), and this may go on slowly, and without any sufficient outpouring of material to develop pus or any obvious external signs of the changes going on. The bone slowly becomes thinner and weaker, and its tissue may entirely disappear; such a change we see in the caries sicca, or non-suppurative caries, of the vertebræ or of the articular ends of the long bones. It is in some cases accompanied by a deposit of new periosteal bone, while rarefaction is going on in the interior; such a condition occurs in some instances of chronic osteomyelitis of the shaft of the femur after excision in hip disease. In these cases fractures may occur almost spontaneously, or at least from very slight violence.

Again, in other instances, the inflammatory material may be in sufficient quantity, and so incapable of becoming organised that pus is formed, and this may infiltrate the adjacent bone, and so give rise to further extension of the process, without the formation of any definite abscess; such a condition we see in some of the cases of chronic osteomyelitis of the long bones, epiphysitis, certain forms of necrosis of the jaw, &c. Under these circumstances necrosis usually results, or if there is more abundant pus formation an abscess in bone is found.

Where, in consequence perhaps (Cornil and Ranvier) of primary fatty degeneration of bone corpuscles, the bone tissue slowly dies, the dying part, acting as an irritant, gives rise to inflammation around, and the bone is slowly disintegrated, with more or less abundant formation of pus; such a process is seen in ordinary caries of a rib or of the pelvis, or of the articular end of a bone. When small islets of bone are marked out and, as it were, cut off from the rest by the surrounding inflammation, minute sequestra become detached (caries necrotica), while, if larger masses are so separated by a line of demarcation, common necrosis results. The last-named may, of course, be an acute or chronic process, a slow diminution in blood supply

causing gradual starvation, or an immediate strangulation causing rapid gangrene of the part (acute necrosis).

So-called 'condensing ostitis' or 'sclerosis' is in its results an hypertrophy, making the bone denser and stronger ; the new material has sufficient vitality to stand, and sufficient blood supply to support it as well as the original tissue ; such a process we see in chronic periostitis, the results of which may be compared with the sclerosed bone of repaired rickets.

Should, however, this deposit of new bone go on beyond a certain point, the blood channels become themselves so narrowed that the surrounding bone is starved, and so necrosis results.

It should be noticed that while some of these processes of destruction and growth and repair are constantly seen going on side by side, as where chronic osteomyelitis causes central necrosis and at the same time the periosteum forms a new peripheral layer of bone, in others we do not see any repair so long as the disease is spreading : thus, in caries of a flat bone or an articular surface, until the destructive process ceases, no new bone is, as a rule, laid down.

Inflammation in bone may occur primarily either as a periostitis or as an osteomyelitis, the latter, often called osteitis, attacking the endosteum and marrow in the medullary cavity or in the cancellous tissue. Compact bone can hardly be supposed ever to be the seat of a primary lesion, though constantly involved by direct extension along the Haversian canals from either periosteum or medulla, it being remembered that a thin layer of medullary tissue lies in each Haversian canal. Inflammation beginning in the epiphysial line may be considered as an osteomyelitis.

Periostitis.—Acute periostitis, phlegmonous periostitis, or 'acute necrosis,' is a disease essentially of childhood and youth, rare in infancy,[1] and still rarer in adult life, though we have seen it in a man of over 50 and in a young man of about 25. These are facts of importance, since they show that the disease does not necessarily begin in or near the epiphysial line. The disease is seen in two distinct forms, corresponding to the anatomical structure of the periosteum ; in the one there is an acute inflammation, with pouring out of the inflammatory products between the surface of the bone and the deep fibrous layer of the periosteum (true deep sub-periosteal abscess) ; in the other the exudation takes place superficially to the deep fibrous layer, in the looser cellular zone which connects the periosteum with the surrounding cellular tissue (parosteal abscess). The difference in texture of these two layers is of the utmost importance, and is marked by striking differences in the course and results of the inflammation. While the sub-periosteal effusion, whether serous or purulent, lifts up the periosteum from the bone, presses upon and detaches the vessels passing to the Haversian canals, and thus cuts off the blood supply to the affected part, and further, by the extreme tension under which it is pent in, gives rise to all those evil results due to pressure of confined fluid, on the other hand, the supraperiosteal exudation lies in loose tissue, interferes comparatively little with the blood supply to the bone, and is not bound down, so that there is but little tension.

1 We have only twice seen it under 2 years of age. Watson Cheyne mentions a case of Rosenbach's in which it occurred *in utero*, but this was considered to be an osteomyelitis (? epiphysitis).—*Brit. Med. Jour.* March 3, 1888.

Either form of acute periostitis may be met with as a result of injury, exposure to cold and wet, as a sequel of one of the exanthems,[1] or as a pyæmic condition. It will nearly always be found that one of these causes has produced, or at least preceded, the attack; often two or more may be combined. The disease is an infective one, and in some cases pure cultures of staphylococci may be obtained from the pus.

The onset of acute periostitis is marked by fever with its general constitutional disturbance, rigors, pain in the affected limb, with swelling coming on rapidly, and usually involving the whole length of the affected bone, and often the adjacent joints. Mr. Clinton Dent has pointed out that extension of suppuration to the joint is commoner in supra- than in sub-periosteal abscess; it certainly does, however, occur in both forms. The skin soon becomes swollen, red, and shining, and there is extreme tenderness. The temperature commonly, in the sub-periosteal variety, reaches 103°–105°, and there is much prostration. Soon the swelling increases, and, if proper treatment is not adopted, in a few days pus finds its way to the surface and is discharged, with much relief to the symptoms. Usually, however, fresh foci of suppuration arise, and, if the child is neglected, in a large number of instances pyæmia occurs, and the patient dies; in others, after much destruction of periosteum and the formation of many abscesses, the limb is left riddled with sinuses leading down to the bare dead shaft.

Sometimes, but not commonly, the neighbouring joints suppurate by direct extension from periosteum to capsule, and thence to synovial membrane; most often, however, there is merely a serous effusion, the result of interference with circulation, or a slight degree of inflammation.

Suppuration of a joint by direct extension might be expected to be most common in the case of the hip, where the epiphysial line lies within the joint, and this complication does sometimes occur; it is not, however, common in our experience. Of twenty-three cases of acute periostitis under our care, the femur was affected alone in eight instances, the tibia was attacked in six cases (in two of these there was extension upwards to the femur), the humerus alone in two cases, the humerus and ulna in one, the radius in one, the ulna alone in one, the fibula in one, a rib in one, the ilium in one, and a metatarsal bone in one instance was inflamed. Five of these cases were supra-periosteal (parosteal), and in them no necrosis followed. There were five deaths, all from pyæmia, and all in sub-periosteal cases; one child had non-purulent pericarditis (proved by aspiration) and recovered.

Usually the inflammation is limited by the attachment of the periosteum to the epiphysial line, and does not reach beyond this; sometimes it spreads in along this line and loosens the shaft from its epiphysis, or sets up an osteomyelitis. The same endosteal lesions may, of course, result from extension inwards along the Haversian canals, but we think it is not the rule to find suppuration within the medulla, either epiphysial or diaphysial, as the result of acute periostitis. Quite apart from osteomyelitis, the whole shaft may necrose, probably because not only is the blood supply from the

[1] Periostitis and necrosis after typhoid do not occur till the patient is well of his fever (Paget, *Path. Soc. Trans.* 1884). Macnamara, however, quotes Affleck's cases of periostitis in the third week of typhoid. We have seen a case of acute periostitis of the fibula following exposure to cold after influenza.

numerous small vessels entering the bone throughout its length cut off, but also because the nutrient artery itself, as well as the supply from the epiphysial zone, is lost.[1]

Mr. Macnamara, Mr. Tubby,[2] and others believe that all these cases really begin as an inflammation of the epiphysial line, and that the mischief spreads downwards and upwards, both beneath the periosteum and in the medulla. That such a condition does occur their specimens prove, and we readily admit from our own experience, but that it is by any means the universal condition we cannot agree.

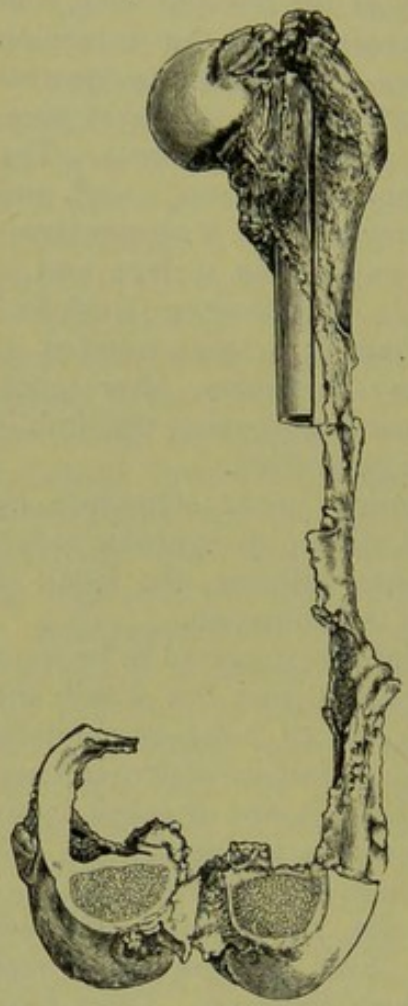

Fig. 155.—Acute Periostitis of the Femur, showing stripping off of periosteum and separation of the epiphysial junction. The lower part of the shaft has been removed *post mortem*.

If left to itself, then, and the patient survives, acute periostitis results in necrosis of a part or the whole of the shaft of the long bone attacked ; subsequently new bone is thrown out by the surviving periosteum and surrounding tissues, and the sequestra are inclosed in the sheath of this new bone, in which are cloacæ leading down to the dead part.

Probably because the disease is a somewhat uncommon one, it is often mistaken, when it does occur, for erysipelas or rheumatism ; most of the cases of necrosis resulting from it are said to have followed one or other of these diseases. From erysipelas it is distinguished by the much greater pain in periostitis, by the absence of any defined line of redness, by the limitation of the disease and its evident relation to the shaft of a long bone, and, as soon as an incision is made, by the exposure of the bone shaft.

There is, of course, no real resemblance to rheumatism of joints, inasmuch as the joints are only involved in very minor degree, so that this is a less excusable mistake. The disease most closely resembling it, especially the supra-periosteal form, is diffuse cellulitis ; this, however, is usually more superficial and more widespread, not ceasing at the joints. In one case which we saw with Mr. Coates, of Manchester, the mischief spread from tibia to knee, and beyond this upwards to the lower end of the femur—but this is very exceptional ; there was no suppuration in the femur. We have had another very similar case.

There is but one treatment of acute periostitis at all worthy of consideration, and this is free incisions down to the bone through the periosteum, as soon as the disease is diagnosed : each incision should be about one inch to

[1] *Vide* Dent's able paper, *Med. Chir. Trans.* 1881. Mr. Dent believes that the medulla may disintegrate without being inflamed at all. *Vide* also Makins and Abbott, *St. Thomas's Hospital Reports*, 1889.

[2] *Brit. Med. Jour.* May 9, 1891.

two inches in length, and made in the long axis of the bone, care being taken, where practicable, to make the incisions not all on one side of the limb, though, of course, important vessels, &c. must be avoided. Several shorter incisions are better than one the whole length of the limb, as Mr. Holmes long ago pointed out.

Bleeding is usually very free, and it may be necessary to plug the wounds for a few hours to arrest it ; the plugs should then be removed, drainage tubes inserted, and the wounds dressed every day or two, or oftener if there is much discharge. Should no pus be found at the time of incision, provided that it is certain that the bone has been laid bare, it may be taken as a proof that the disease is in its early stage, and the prospect is therefore better. In all cases, however, serum and flakes of lymph will be found, even if there is no pus, and there will usually be free suppuration in a short time. Too free exploration of the bone with the finger or probe, and too frequent or forcible syringing, are to be avoided, as tending to separate any still adhering periosteum, or to prevent adhesion after separation has occurred. The limb should be kept slightly raised, and stimulants, opium, and abundant nourishment given to the child. Should the fever not subside in a few hours, it is probable that some abscess has not been relieved, and a director should be passed round the bone, or a fresh incision made at any painful spot. In the tibia, for instance, where incisions can hardly be made at the back, pus may be lying beneath the periosteum at the back of the bone, bound down by muscular attachments. In spite of the authority by which it is supported (Billroth), we cannot regard applications of nitrate of silver or iodine, or anything except free incision, as good treatment.

Since such extensive necrosis and so much suppuration with liability to pyæmia often follow in these cases, it has been proposed to resect the affected bone at the time of incision, and this has been done by various surgeons. Since the periosteum is preserved, a new bone is developed, and, it is said, without shortening in cases where a second bone exists, as in the leg and forearm.[1] We cannot say we see any great advantage in this method, and it is impossible in any case to be sure how much of the bare bone will die—usually it is only a very small portion compared with the part exposed ; and, though we have at a later stage removed nearly the whole of the shaft of some of the long bones as sequestra, it is common to see quite small portions of dead bone as the result of most extensive stripping off of periosteum. We believe that much harm is often done by the practice, already alluded to, of passing in the finger, sweeping it all over the bone, and then remarking that the whole bone is bare ; of course it is, for the operator has just stripped off the remaining periosteal attachments. We think, therefore, that primary resection of the diaphysis is not to be recommended unless it is absolutely detached at each epiphysial junction and bare of periosteum throughout— a very rare condition. Neighbouring joints should not be incised unless they are pretty clearly suppurating, i.e. a slight degree of effusion does not mean suppuration. If the joint is full of fluid, and the skin over it is hot and its veins turgid, or if the swelling does not subside

[1] Much shortening has, however, followed in some cases (*vide* Neve, *Indian Med. Gaz.* April 1884, who records a case of an inch and a half shortening after removal of the upper half of the tibia ; also Holmes, *Surg. Dis. of Children*).

rapidly after incision of the periosteum, the joint should be opened or, if in doubt, aspirated ; if pus is found, a free incision and the insertion of a drainage tube are required.

It must be very rarely that immediate amputation is demanded, even if joints are involved ; if there is no pyæmia, a large proportion of the cases do well, and if pyæmia exists already amputation will not usually succeed. If after free incisions the symptoms do not subside, and especially if pus escapes from the epiphysial line, there is probably suppurative osteomyelitis ; the bone should then be exposed and trephined to give vent to the matter.

Those surgeons who only admit the osteomyelitic origin of the disease advocate trephining the shaft of the bone close to the epiphysial junction as a routine measure in all cases. It should certainly be done when there is mischief in the interior of the bone, and though it is certainly not always necessary it is better in these cases to do too much rather than too little.

The time at which sequestra may be expected to be loose after the onset of the disease varies with the size of the bone and the extent of destruction ; if the whole shaft dies the bone will probably be loose in a month or six weeks ; if only a part is necrosed it will vary from the time mentioned to many months, or, in the case of the femur, the bone, especially if the lower end is affected, may remain for years without being detached, and yet is so far devitalised that it acts as a foreign body and keeps up suppuration. This especially applies to periostitis attacking the popliteal surface of the femur, and holds good of chronic inflammation as well as acute.

No absolute rule, then, can be laid down as to the time at which sequestra can be removed ; the sinuses should be explored with a probe from time to time, and if the dead part can be felt to be movable it should be cut down upon and taken away. If no loose bone can be felt, but the probe passes down through cloacæ in new bone to a sequestrum, the patient should be anæsthetised, the limb rendered bloodless, the sinuses laid open, the cloacæ enlarged, and the sequestra examined : any that are loose should be taken away, and any distinctly dead but not loose bone may be cut away, but no doubtful bone should be disturbed—it may recover. The wounds are then plugged with iodoform gauze or lint, and daily dressed until they fill up or the sequestra become loose. It is very seldom that all the dead bone is removed at one operation ; usually small fragments either come away of themselves or have to be removed by later operations. In cleaning out the cavities in which sequestra lie great care should be taken not to break into joints or remove more new bone than is necessary. The delay in waiting for the separation of sequestra is not wasted time, for the new bone is meanwhile consolidating, and the limb getting stronger. In subsequent dressings care must be taken to keep all the cavities well drained and syringed out, otherwise retention of discharges and detritus will give trouble. Unnecessary probing of sinuses is useless and harmful : it is useless to be constantly feeling bone to see whether it is loose, for the process of separation is a slow one ; it is harmful, because broken granulations readily absorb septic material, while sound ones are proof against it—moreover, it needlessly frightens a child. Where repair is very slow, and profuse discharge is wearing out the patient, it may be necessary to sacrifice doubtful bone

for the sake of rapid healing, or in extreme cases, chiefly where there is destruction of a neighbouring joint and great prostration, even amputation may be required.

CASE.—T. B., aged 6½ years, was admitted April 22, 1881. Three weeks previously the boy fell down some steps and hurt his forehead and his shin, but seemed to get quite well. Two days before admission he complained of pain in the left thigh, but ran about as usual. On the following morning he could not get up, had pain in the knee, and could not move the leg; he was delirious during the night, with profuse sweating. On admission he was pale, dull, and heavy-looking; respiration 48, temperature 106°, pulse 156, with low, muttering delirium. He was ordered four grains of quinine and brandy-and-egg mixture. The left thigh was swollen to nearly double its normal size from the top to the knee, and intensely painful. A short time after he came in, three free incisions were made through the periosteum down to the bone; much sanious sero-pus and lymph escaped. The bone was quite bare. After the operation the temperature was 104°, falling to 102·4°. There was great prostration. The temperature again rose to 106·6° at 11 P.M., when he died.

Post-mortem.—There were recent pyæmic abscesses in the lungs and the whole femur was bare from the neck to the lower epiphysis. No other disease was found. *Vide* fig. 155.

Supra-periosteal abscess has the same general symptoms as the more serious conditions, but it is much less severe, for the reasons already mentioned; the pain and fever are less, though the swelling is often as great. On cutting into the abscess, and passing the finger in, the bone will be found still covered with the dense fibrous layer, and is consequently not bare. Necrosis seldom follows, or if it does it is limited both in extent and depth; usually only a small scale of bone comes away. If this form of periostitis is, however, neglected, the deeper layer may slough, or the mischief spread through it, and more extensive necrosis may ensue. The diagnosis between the two conditions can generally be made by the less severity of the symptoms in the superficial variety.

The immediate and later treatment is the same as that of the sub-periosteal form, i.e. free incisions at first and subsequent removal of sequestra, should any necrosis occur.

CASE.—*Supra-Periosteal Abscess of Thigh.*—Mary Ann D., aged 13 years 2 months; admitted December 24, 1882. Three weeks before admission she had pain about the lower part of the leg and walked lame; the symptoms increased latterly, and the left thigh was noticed to be swollen and shining; she had been getting thin and pale for two or three months previously; no injury. On admission a large fluctuating swelling occupied the anterior and upper half of the left thigh, large veins ramified over the surface, there was a blush of redness over it, and some tenderness and pain; an incision was made into the swelling, and a large quantity of pus escaped, which was in close contact with the bone, though the latter was doubtfully bare; considerable bleeding took place into the abscess cavity, which stopped after a free counter-opening and more perfect drainage were employed; she then steadily improved, and was discharged well on August 4, 1883. This case did not come under our care at first, and it was only at the second examination that we had an opportunity of exploring the bone; at this time it was certainly not bare, a thin layer (deeper layer of periosteum) covering it. The constitutional disturbance, as usually occurs in the superficial periosteal abscess, was much less than in the sub-periosteal form, and no necrosis followed.

A careful watch should be kept for the onset of pyæmia in all cases of acute periostitis; it appears sometimes exceedingly rapidly. We have just

mentioned a case of acute periostitis of the femur, which died with infarcts in the lungs and ecchymoses on the pleuræ after an illness of altogether only two days, and another child died in the same way six days after an injury giving rise to periostitis of the fifth metatarsal bone.

In some instances the periostitis is multiple at the first: these cases are no doubt pyæmic, and sometimes occur after a primary joint lesion; thus we have seen acute suppuration in the ankle followed shortly by an abscess in the wrist, and a few days later by periostitis of the humerus and ulna, and by pneumonia. After death no other lesions than these were found. In another case, that of an infant 6 months old, periostitis of the tibia followed a suppurating nævus of the scalp; the bone necrosed and gave way, a fracture resulting; the child died of pyæmia, sinking, as they so often do, quite suddenly.

We have seen a case of pyæmic necrosis of the radius in which the lesion was close above the lower epiphysial line, but there was no shortening of the bone four or five years after. The patient was under the care of our friend Dr. Pooley, of Rochdale.

The disease very rarely attacks any bones except the long bones of the limbs; the tibia, femur, humerus, and ulna we have seen most commonly affected—sometimes the whole shaft, in other instances only a part, being laid bare. Occasionally the short and flat bones are attacked (*vide* T. Jones, 'Diseases of Bones,' p. 90). Owen has recorded a case of the os calcis being the seat of the disease; we have seen the ilium and a metatarsal bone attacked, and acute periostitis of the skull has been met with.

A case of acute periostitis of a vertebra is mentioned by Macnamara: Makins and Abbott have collected twenty-one cases of vertebral 'osteomyelitis,' as they prefer to call it ('Annals of Surgery,' May 1896), and their article shows that any of the vertebræ may be attacked, and that either body or laminæ or a transverse process may become inflamed. There is the greatest danger of extension to the spinal meninges, and pyæmia is very common (sixteen of the twenty-one cases died). The depth of the lesion and the obscurity of the symptoms have prevented the recognition of the condition in many instances. Free incision and perhaps removal of a lamina to set free pus within the spinal cord may be required. The lumbar spine is most commonly attacked (Chipault, 'La Gazette des Hôpitaux,' December 1896. Abstract in 'Medical Chronicle,' June 1887). Coutts also records a series of cases.

Case.—*Necrosis of Rib (traumatic); Empyema.*—Wm. G., aged 10 years 7 months; admitted November 20, 1881. Nineteen days before admission fell with his side against the kerbstone; two days later had much pain in the side, and swelling appeared next day; had rigors, and was feverish and vomited on November 28. On admission, pale; some dyspnœa, but not urgent; anxious expression; a soft fluctuating swelling over the lower part of the left side of the chest, rather larger than the palm of the hand; the heart's impulse was two or three inches to the right of the sternum, and the whole of the left side of the chest was dull, and the respiratory sounds were distant, though audible; a cyrtometer tracing showed distinct bulging of the left side; the abscess was opened the same day, and a small quantity of thin pus escaped; the pleural cavity was then opened and a pair of dressing forceps pushed into it between the ribs; a large quantity of slightly turbid yellowish fluid was evacuated; the abscess cavity was clearly quite distinct from the pleura, and at that time the pleuritic fluid was not purulent; the rib was bare, but not

fractured; a tracheotomy tube was tied into the chest and the wound dressed antiseptically. All went well, and on December 3 a vulcanite tube was substituted for the silver tracheotomy tube. On the following day it was seen that for the first time the discharge was distinctly purulent, and it was considerable in amount; the lower half of the left chest behind was still dull and tender to percussion, though in front the resonance was good. Up to this time there was still partial orthopnœa; a week later another abscess behind and above the first opening appeared, and, on incising it, bare bone was felt; the dulness &c. was clearing up. By the end of January 1882 the discharge from the chest had lessened and the dulness nearly disappeared. On February 2 an incision was made over the diseased rib, and about a third of it removed; there was a good deal of new bone around the sequestrum; the cavity left was plugged with a piece of sponge, which remained in place till March 6, when some of it was cut away; several bleeding points in it then appeared, due to granulations which had sprouted into it and held it firmly in position; at this time the left base was normal, except slight dulness. On March 13 antiseptics were discontinued; on the 20th more of the sponge was cut away, and at the end of the month the rest was removed; it was found that it was impeding healing and causing eversion of the edges; the sponge was filled with granulation tissue, which microscopically was seen to penetrate the unaltered sponge framework. The wound rapidly closed, and on May 5 patient was discharged almost well; there was little if any retraction of the side, and the lung had apparently fully expanded. Here traumatic periostitis of the rib led to abscess externally and serous effusion into the pleural cavity; after the opening was made probably the suppuration in the chest cavity resulted from the communication with the external abscess.

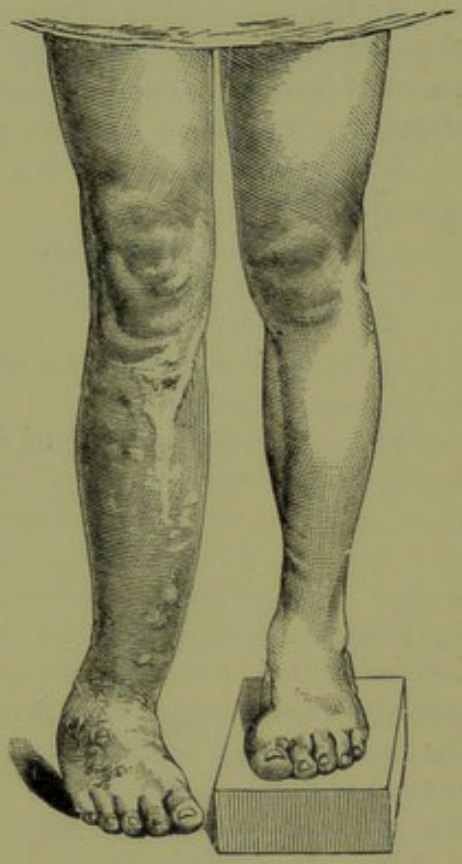

Fig. 156.—Shows Overgrowth of the Bones of the Right Leg, especially the Tibia, after necrosis. (Dr. Massiah's case.)

It is usually only in cases which are so severe as to be fatal that joint invasion or multiple bone lesions are found, but we have met with an instance in which the tibia was first attacked, then the knee joint by direct extension, the humerus, lower jaw, and opposite femur all were involved, and yet the child completely recovered.

Arrest of growth from destruction or synostosis of the epiphysial line may result;[1] or, on the other hand, there may be overgrowth from persistent hyperæmia of the limb, as the result of the subsequent irritation caused by sequestra (fig. 156). This overgrowth may, as seen in the figure, cause distortion from one bone of the limb outgrowing the other.[2] Occasionally relapses occur many years after the original disease has subsided, and abscesses form and sequestra

[1] J. H. Morgan has detailed a case in the *Brit. Med. Jour.* September 1, 1883. The humerus was the bone affected. *Vide* also Tubby, *Lancet*, June 6, 1891.

[2] Birkett has recorded a case of overgrowth of a limb after injury to the patella in a boy of 8 years (*Path. Soc. Trans.* vol. xviii.); *vide* also Edmunds, *Path. Soc. Trans.* 1885. A case of B. Pollard's, described as hypertrophied callus, is perhaps of the same nature.

are separated in middle life. We have several times met with these cases of 'relapsed necrosis,' perhaps most often in typhoid cases.

Where the periosteum has extensively sloughed, or where the bone has been fractured, a short, weak limb may result from deficient development of new bone; these fractures sometimes remain ununited, and may require resection and wiring.

CASE.—*Non-union of Tibia after Fracture as Result of Necrosis.*—Female, age 4 years 5 months; five months ago left hospital, after sequestrotomy, in a plaster bandage; no union occurred, and limb was useless and quite movable, though not flail-like; incision made down upon ends of bone, which were much atrophied; surfaces refreshed and wired together by one silver suture, which was fixed to buttons on surface of wound; ultimately firm union occurred, and child could bear her weight upon her leg and walk well.

As the accounts of different writers on the subject of acute bone inflammation are somewhat conflicting, and give rise to confusion, the following statement of how the different lesions may arise will perhaps be of service to those less familiar with bone diseases.

Acute inflammation of bone may begin as:

A. Periostitis.
   1. Sub-periosteal.
   2. Supra-periosteal or Parosteal.

B. Osteomyelitis.
   1. Epiphysitis, i.e. disease beginning in the cancellous tissue of the epiphysis.
   2. Inflammation of the medulla of the shaft (diaphysitis).
   3. Inflammation beginning in the epiphysial line, often called epiphysitis also.
   4. 'Juxta epiphysary diaphysitis,' or inflammation of the end of the diaphysis close to the epiphysial cartilage.

Inflammation arising in any of these ways may give rise to the other forms of lesion; e.g. sub-periosteal abscess may spread along the epiphysial line and cause suppuration in the medulla of the shaft, or inflammation of the medulla may spread outwards and cause periostitis. As a rule, however, careful clinical observation will enable an accurate opinion to be given of the primary seat of the mischief. We are becoming strongly of opinion that it is common for tuberculosis to be grafted on to cases of acute inflammation of bone, i.e. we believe that many of these cases which after the acute symptoms have subsided run a chronic course, are really tuberculous, and it is possible that in some at least the process may have been acute tuberculosis, or at least a mixed infection, from the first.

Acute Osteomyelitis.—Acute diffuse infective osteomyelitis occurs as a result of amputations or resections, but this is a rare condition; it is said to be more common in hot climates. The disease is, however, here most often met with as a result of extension to the medulla of inflammation beginning in the epiphysis or epiphysial line or end of the diaphysis, or of acute periostitis, and occasionally occurs as a primary condition. Some surgeons, as already mentioned, believe that the affection described as acute periostitis is really acute osteomyelitis; this, however, is not always the case, since, if it were so, complete recovery in these cases without extensive necrosis would

not be nearly so common as it is. Moreover, in cases of acute periostitis dying of pyæmia, sections of the bone have shown an entire absence of osteomyelitis in some instances.

The characteristic symptoms, in a case where acute osteomyelitis follows amputation, are swelling and subsequent suppuration of the medulla, retraction of the periosteum and soft parts, so that the bone is left bare, and diffuse swelling of the limb. Pyæmia usually rapidly ensues, and in many cases death speedily results. Amputation at the joint above has been usually said to be the only successful method of treatment, but the plan introduced of scraping out the entire contents of the medullary canal, as advocated by Mr. Keetley and others, is well worthy of adoption, and has proved successful in several instances ; our late colleague, Mr. T. Jones, among others, had good results from this method.

Where acute diffuse osteomyelitis occurs as a sequel in epiphysitis or periostitis, or is the primary lesion, the shaft of the affected bone should be freely opened with trephine or chisel, and a similar treatment adopted. The existence of this disease may be suspected, as already pointed out, when the severe constitutional symptoms and pain do not subside after freely incising the periosteum or opening up an epiphysial abscess ; swelling and tenderness at one or more points in the shaft, or diffuse bony swelling without any collection of fluid beneath the periosteum, will indicate the presence of pus in the medulla.

Acute Epiphysitis.—Acute circumscribed osteomyelitis or acute epiphysitis is a more common condition ; it consists in a localised inflammation attacking the cancellous tissue of an epiphysis or the immediate neighbourhood of the epiphysial line. The disease nearly always goes on to suppuration, and on examination a cavity will be found containing pus, or in some cases sequestra. Acute epiphysitis may occur in children of any age : for instance, most cases of 'acute suppurative arthritis of infants' are typical examples of this disease ; in other, though much rarer, instances older children are attacked.[1]

If left to itself, the pus finds its way either into the adjacent joint or along the epiphysial line to the surface (the epiphysis may in this way become detached from the shaft), or down the medulla of the shaft, giving rise to acute diffuse osteomyelitis. The disease may follow an injury or exposure, or one of the exanthems, or, according to the late Mr. Greig Smith, may arise from lymphatic infection of the bone marrow. It most commonly attacks the head of the femur, the upper end of the tibia, or the lower end of the femur, less often the extremities of other long bones. Some of the cases of acute disease of the hip, elbow, shoulder, and ankle, apart from 'acute suppurative arthritis of infants,' are really also of this nature.

The lesion is marked by early fever and much pain,[2] of gnawing, toothache-like character, followed, after a longer or shorter time, according to the age of the patient and the amount of resistance to the exit of the pus, by swelling of the bone coverings and effusion into the adjacent joint, which is usually kept fixed in the position of least tension. We have, however,

[1] Vide *Abstracts of Cases treated at Children's Hospital, Pendlebury*, 1882.

[2] In the infantile cases we have, of course, no means of knowing the kind of pain, but usually it is evidently severe.

seen the knee strained to its utmost degree of flexion, far beyond the point of least tension ; thus showing at once that the lesion could not be intra-articular.

The pain is usually agonising, and the failure of health very rapid. Deep pressure in the earlier stages, and any touch of the limb when the pus is approaching the surface, is exceedingly painful. Local heat is usually only appreciable in the later stages ; increased pulsation in the main artery of the limb may be found. In infantile arthritis (acute suppurative arthritis) the symptoms are sometimes subacute. The diagnosis is made by careful exclusion of joint lesions (by lack of marked effusion, &c.), where the joint is still free, and attention to the history of the pain and swelling, so as to distinguish the case from periostitis, though, of course, as pointed out by Macnamara and others, and as already described, epiphysitis may give rise to sub-periosteal abscess and necrosis as well as to intra-articular abscess : pain on deep pressure in the absence of joint disease is a characteristic feature. Rheumatism and rickety pain are readily distinguished by the strict localisation of the suffering. In the infantile cases the joint is usually involved by the time the child is brought.

CASE.—*Abscess in the Head of the Tibia.*—Wm. Hy. D., age 9 years ; admitted December 30, 1881. Had pain in the leg for two months ; worse for five days ; no further history. On admission he was pale, ill, and anxious. Temperature 103·8° ; there was intense pain in the right knee, which was flexed to its fullest extent ; there was no effusion in the joint, and the outlines of the condyles were distinct through the tightly stretched skin. Over the head of the tibia and the upper third of the leg there was considerable swelling, most marked over the inner tuberosity of the tibia, where also the tenderness was greatest ; no fluctuation ; under chloroform an incision was made over the inner tuberosity, and the soft parts found infiltrated with inflammatory products, but no pus ; a chink indicating the line of union of epiphysis and diaphysis was seen, and on gouging away some bone about ℥ss. of thick sanious pus escaped ; no distinct cavity was found ; operation antiseptic ; a tube was put into the opening in the bone ; one hour after the temperature was 102·6°. He had pain on several evenings subsequently, and there was but little non-purulent discharge for two days, when several drachms of pus were discharged. On January 5, as the joint was swollen, it was aspirated, and a small quantity of turbid sanious fluid withdrawn and an ice bag applied ; he had no pain afterwards, but on the 12th the joint began again to swell, and on the 15th was distended, and incisions were made into it, discharging fluid, at first flaky, but serous, and subsequently more nearly purulent. On February 9 the drainage tubes were removed and all was going on well, the wounds in the joint being superficial, though bone could be felt through the opening into the tibia ; the limb had been kept fixed. On the 23rd the joint was forcibly flexed and several adhesions broken down ; considerable swelling followed ; the joint shortly settled down again. March 3, a small sequestrum was removed from the tibia as well as a good deal of caseous material. April 3, the limb was put up in plaster of Paris, and the boy sent out on the 5th. He attended as an out-patient subsequently ; several small bits of bone came away, but the wound finally closed, and he has now (February 1883) a sound limb with a fully movable knee, though a little thickening still remains.

The treatment of acute epiphysitis consists in early and free incision down to the bone ; if matter is met with, this is usually sufficient, but, should the pus not have reached the surface, an opening must be at once made into the bone and the abscess emptied, any sequestra found being removed. In any doubtful case it is far better to explore the bone than to run the risk of the abscess bursting into the adjacent joint. Should the joint be already involved, as it almost always is in the acute epiphysitis of infants, it must be

freely opened and drained. For a more detailed account of infantile epiphysitis, see the chapter on DISEASES OF THE JOINTS, p. 696. Messrs. Pick and Page have called attention again to these cases which have been described above, and discussed both in former editions of this book and elsewhere.

Should the mischief have spread to the medulla of the shaft, the diaphysis should be exposed and trephined at one or more spots to give vent to the pus, and the whole medullary cavity should be scraped out, washed, and drained; failing this, amputation is the last resource. For some good cases illustrating this treatment, *vide* T. Jones on 'Diseases of the Bones,' 1887, and 'Medical Chronicle,' Dec. 1886.

The pneumococcus which is responsible for so many acute inflammations in other parts may also cause acute epiphysitis. We have recently (1905) had under our care a baby of 13 months suffering from acute epiphysitis of the lower end of the radius; on opening this swelling pus escaped which was found to contain a diplococcus apparently identical with the pneumococcus. The child had also bronchitis. Recovery was uninterrupted after operation. It is probable that many, if not most, of the cases of acute epiphysitis in infants will turn out on further investigation to be pneumococcal.

A condition known as '**growing fever**' is sometimes met with, usually in children of from 7 to 15 years, though occasionally at both earlier and later ages. The main features are pain in the region of the epiphysial lines, rapid growth and sometimes fever, with considerable constitutional disturbance. Usually the symptoms pass off without any bad result, but in rare cases osteomyelitis may be set up, and the development of exostoses about the epiphysial lines has also been noticed after the occurrence of 'growing fever' (*vide* 'British Medical Journal,' April 14, 1888, p. 820).

In certain cases much anxiety may be caused by the pain and tenderness met with in these children, and on the other hand more serious disease is apt to be neglected on the ground that the pains are 'growing pains.' Slight strain or over-use is apt to bring on or increase the trouble, which is common about the upper tibial epiphysis. (*Vide* also chapter on INJURIES.)

Chronic Periostitis.—Periostitis of less severity, and less rapid in progress, is common enough, and the subacute cases are better classed with the chronic than with the acute, inasmuch as they are more like the former than the latter in their results. Subacute or chronic periostitis occurs in children as the result of injury, as a pyæmic condition, or as the sequela of an exanthem—probably these two sets of cases are very closely allied, if not identical; or it may be caused by syphilis or tubercle. Whichever of these is the cause in any individual case, suppuration often takes place except in traumatic and in many of the syphilitic cases. Since the process is a slow one, it is usually impossible to say whether the lesion began as a sub- or supra-periosteal inflammation; perhaps the whole thickness of the membrane is involved at once, or else, as the bone is usually more or less deeply implicated, the lesion is sub-periosteal in origin.

The disease is characterised by local or diffused thickening of the bone in its early stages; the swelling is tender, painful at times, but usually, unless in subacute cases, there is no implication of the skin. Later on, the swelling, if left to itself, either subsides or softens down, and abscesses form in one or

more spots : on incising these the bone is found bare and rough, with perhaps small scale-like exfoliations, or in other cases, to be described presently, more extensive lesions. The periosteum is sometimes four or five times its usual thickness, and readily peels off the bone, while in old cases there is often some rough spiny deposit of new bone developed around the centre of disease. In traumatic cases in healthy subjects the thickening may subside altogether without any trouble or suppuration, or there may be sufficient new bone formation to cause swelling lasting for months or years without any other symptoms.

In tuberculous children the swelling ('strumous periosteal node') usually slowly increases, often painlessly, though by no means always so ; suppuration finally occurs and matter is discharged, or in rarer instances the inflammation subsides. Generally in the tuberculous cases periostitis is either the result of, or itself leads on to, osteomyelitis (superficial or central caries).

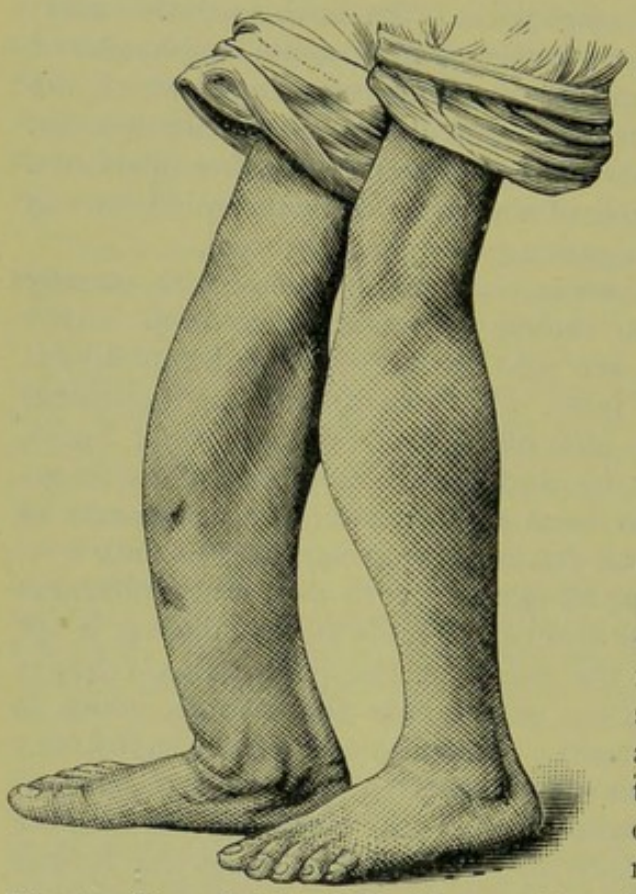

Fig. 157.—Congenital Syphilitic Disease of both Tibiæ (periosteal and endosteal). This figure, from a patient of our own, is reproduced from Mr. Jones's book.

Exanthematous periostitis is found usually in wasted and feeble children, either in the course of, or as a sequel to, one of the specific fevers ; there is often much suppuration, with but little pain or disturbance, and a limb is found occasionally to be little more than a flabby bag of pus, without any pain and without much fever. The child lies wasted and haggard, with rough scaly skin and offensive smell, the hair harsh and often thin, and the veins showing distinctly through the thin, fatless skin. The chronic pyæmic cases so exactly resemble these that it is probable that many of the exanthematous forms are really pyæmic. A fair number of such children recover, others gradually sink of exhaustion or some intercurrent pneumonia or diarrhœa. Much less severe cases are also met with, in which chronic periostitis occurs affecting only a small part of a bone—it may be any bone—and either subsiding or giving rise to only local necrosis ; the ribs and tibia and upper end of the femur seem to be specially often attacked after typhoid fever. For an excellent account of these diseases, *vide* T. Jones on 'Diseases of the Bones,' 1887, p. 40 ; *vide* also chapter on SPINAL DISEASE, for a case of necrosis of a spinous process.

Congenital syphilitic periostitis is usually multiple, and occurs rarely during the first year or two of life, being commonest from about the 5th to

the 15th year. It is, as Hutchinson has pointed out, less amenable to anti-syphilitic treatment than the periostitis of acquired syphilis, and according to him is common in the upper limbs; in our experience symmetrical periostitis of the shafts of the tibiæ ('syphilitic nodes') is far the commonest form, and in some cases it breaks down and large ulcers form on the surface. The amount of thickening may be enormous, as in fig. 157.

CASE.—*Chronic Syphilitic Periostitis of Tibia.*—Lilian G., age 12 years; admitted November 19, 1884. Mother had three miscarriages as the result of her first three pregnancies. Patient when born had an eruption about the buttocks, sores round the mouth, and snuffles; improved at six months old, and has gone on well since, except for a sore eye. Duration, three years; following a slight kick; no swelling till a month later; much pain ever since; has been under treatment (antisyphilitic) as an out-patient for some considerable time. On admission, healthy-looking girl; teeth normal; no obvious signs of syphilis; the right tibia is much thickened, and apparently bowed antero-posteriorly; no fluctuation; the most tender spot is on the front of the lower part of the middle third; the swelling involves nearly the whole shaft; no fever. November 27, tibia trephined at its most painful spot; periosteum much thickened; the bone was much sclerosed and the medullary cavity reduced to a narrow channel; no pus and no cavity found. The reflected periosteum was stitched together with catgut and tube inserted. Operation antiseptic. All went well; she was discharged on December 17; there was no further pain, and when seen as an out-patient, February 1885, she was sound and well, and free from pain.

CASE.—*Syphilitic Periostitis of Tibia.*—John Wm. A., age 6 years. No tuberculous history; one of the children died of convulsions at seven weeks—it had snuffles; three other children living; no miscarriages. Child healthy at birth, weakly since three years old; the leg has been tender for six months, but no swelling was noticed till four days ago; no pain unless touched. On admission, pale, unhealthy child; has remains of double interstitial keratitis and scars at the angle of the mouth; the upper milk incisors have gone, lower incisors small and ill-formed; there is thickening, forming a prominent swelling in the middle of both tibiæ, tender but not red. The tenderness disappeared quickly under treatment (antisyphilitic), the swelling remaining much the same.

Less frequently the upper end of the tibia is involved; in such cases there is not rarely effusion into the knee, not merely passive, but an actual serous synovitis. Other evidence of congenital syphilis is in our experience almost always to be found, though it is not always obvious. One tibia alone may be affected and the disease may be progressive in later life though due to congenital syphilis. Occasionally the evidence of syphilis may be wanting. The pain is often severe, though sometimes it is almost absent.[1] Macnamara believes that the syphilitic telostitis of infants (see chapter on SYPHILIS) is due to interference with nutrition at the epiphysial line from pressure of new-formed periosteal deposit around, and that the telostitis is not inflammatory.[2] Arrest of growth may result just as in the case of older children who are attacked by syphilitic epiphysitis[3] (*vide* Epiphysitis). The palate and bones of the face are not rarely destroyed by congenital syphilis, but this occurs in a late stage of the disease (*vide* fig. 100); the nasal bones are, of course, early affected, and the deformity resulting gives rise to one of the characteristic features of inherited syphilis.

[1] Mr. Moullin has written a good paper on the subject in the *Brit. Med. Jour.* 1884, p. 52.

[2] *Brit. Med. Jour.* July 5, 1884.

[3] Hutchinson, *London Hospital Reports*, vol. ii.

The evidence afforded by thickening of the bone, with tenderness on deep pressure and aching pain, serves to distinguish periostitis generally from any more superficial lesion, while the onset of swelling and pain simultaneously points to the existence of periostitis rather than osteomyelitis, though either, it must be remembered, may give rise to the other. New growths are to be distinguished by their greater rarity, their greater prominence, with often bosses and a well-defined margin, and local patches of softening, as well as by their situation, which is usually at the ends of the bones ; hence they are more likely to be mistaken for osteomyelitis than for periostitis.

The tuberculous and syphilitic lesions are nearly always accompanied by other evidences of their respective diseases, such as tuberculous glands or ulcers, a family history of tubercle, or, on the other hand, syphilitic lesions of the eyes, teeth, &c.[1]

There is difficulty sometimes in distinguishing the lesions of bone due to congenital syphilis from those dependent upon tuberculosis, though we are not inclined to think that the mistake is so often made as Fournier[2] would have us suppose. As already mentioned, the tibia is (as Fournier also points out) the bone most commonly affected by the syphilitic lesions, and the long bones are more often attacked than the short or flat bones, with, perhaps, the exception of the skull, while the diaphysis is more liable to be attacked by syphilis than the epiphyses. New bone formation, severe pain, little tendency to suppuration, though occasionally abscess and necrosis do occur, and evidences of syphilis from the history or presence of other syphilitic lesions, are the principal features of the one group, while the tuberculous cases are characterised by absence of any new bone formation, caries occurring rather than necrosis, by early suppuration, freedom from pain, and the other features already pointed out. The effects of treatment by iodide of potassium will give confirmatory evidence. In any case of doubt antisyphilitic treatment should be given a fair trial, it being remembered that children bear, and often require, large doses of iodide (gr. x.-xx.) to obtain good results. It must not be forgotten that congenital syphilitic lesions may co-exist with tuberculous disease, and in such cases affections apparently tuberculous will not yield until antisyphilitic treatment is employed.

Nearly all the varieties of periostitis are found chiefly in the long bones, though similar lesions may be met with elsewhere, as in the jaws, &c. ; *vide* Diseases of the Mouth, and also the chapter on JOINTS.

Treatment.—In early stages of the disease, if the leg is affected, the child should be kept in bed with a splint on. Cod-liver oil and iron should be given in the tuberculous, hydrarg. c. cretâ or iodide of potassium in the syphilitic cases; the former in children one or two years old, and a combination of the mercury and iodide in older cases being the best treatment.

[1] Dr. Goodhart has met with a remarkable case of bone disease in a child a year old, which was thought to bear relation to osteitis deformans, but was probably syphilitic; there were tenderness, softening, and diffused thickening of the bone ; rickets co-existed.—*Path. Soc. Trans.* vol. xxxiv.

[2] *La Syphilis Héréditaire Tardive.* Paris, 1886. To this work we must refer for an elaborate account of the later lesions of hereditary syphilis,

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Where the arm is affected, a splint should be applied and the child allowed to be up, unless any subacute mischief is going on. Simple traumatic cases require rest and the application of soothing lotions, such as lead, with or without spirit or opium, or the application of belladonna diluted with glycerine or vaseline; in some cases good is done by rubbing in mercurial ointment, or, better, ung. hydrarg. oleat. 5 or 10 per cent., or keeping it applied over the swelling. Some surgeons have faith in the application of iodine; a blister is sometimes undoubtedly of use in relieving pain. If after a fair trial of some weeks no good result has been obtained by these means, and pain still persists, or, of course, earlier than this if suppuration occurs, an incision should be made down upon the bone through the periosteum; if pus is found, or any superficial necrosis, the case is to be treated on ordinary principles; if after this the pain is not relieved, or returns, it may be taken for certain that osteomyelitis exists, either as a primary or secondary condition; and this should specially be borne in mind in tuberculous cases in which osteomyelitis is much more commonly the primary lesion in long bones. If then there is evidence of osteomyelitis, further measures will be required (*vide infra*).

Occasionally in syphilitic cases no absorption takes place under mercurial or iodide treatment; if the pain persists, the bone should be cut down upon and, if necessary, trephined or gouged, so as to open up the sclerosed bone and give vent to any pent-up material (cf. case, p. 685, *antea*). In cases of syphilitic necrosis of the bones of the face or palate a plastic operation may be required, but this should not be attempted until the destructive process has entirely ceased. Where the whole hard palate has been destroyed an obturator may be necessary. We have seen a case where, after ulceration of the palate and pharynx, the soft palate became adherent to the pharyngeal wall, and the obstruction to the nose thus produced caused so much trouble that excision of part of the soft palate became necessary. 'Periostitis albuminosa' is a name given to a form of periostitis in which there is effusion of non-purulent fluid beneath the periosteum. There may or may not be necrosis. There is no hard-and-fast line to be drawn between these cases and chronic purulent periostitis; the exact nature of the effusion may in our experience vary from serum to solid lymph on the one hand or pus on the other; a similar variation occurs in the case of the effusion in central inflammation. We have found the medulla replaced by masses of curd-like lymph with little or no pus.

Chronic Circumscribed Osteomyelitis.—Where chronic osteomyelitis is localised, as, for instance, sometimes in the epiphysial extremities of the long bones, an abscess may result, with or without necrosis; the symptoms are those of acute epiphysitis, already described, only less severe, and the onset of the disease is slower and more insidious. In non-tuberculous cases there is often much sclerosis of bone around the abscess cavity, and the disease may go on for years without any attempt at reaching the surface. In other instances the extension of the inflammation to the surface is marked by slight and slowly increasing thickening of the periosteum, so that the diameter of the bone is somewhat increased, and the tissues over it may be slightly œdematous. The characteristic aching, gnawing pain, especially at night, is sometimes well marked, but in children more often there is

comparatively little pain, and the pus soon finds its way to the surface—both these facts being due, no doubt, to the less resisting nature of the softer bones of children. Hence the more typical features of chronic circumscribed abscess of bone are comparatively seldom seen in young children, but are most marked in young adults. Moreover, in children the distinction between circumscribed and diffuse osteomyelitis is also less defined; though sclerosis of the walls of the cavity does sometimes occur, it is less frequent in children, and the inflammation is more apt to become diffuse. The attacks of pain may be intermittent, so that for weeks or months there is little sign of any thing wrong, and then all the symptoms reappear.

Case.—*Epiphysitis of both Femora, &c.*—John W., age 6; admitted April 12, 1884. Always delicate; for eighteen months past had abscesses; twelve months ago had dropsy; eight months ago had measles; four months ago knee swelled painlessly, was poulticed and opened. On admission, delicate child; abscess scars about neck, &c. Sinus over left upper arm leading to bare bone. Just above right knee is a sinus, and two more in popliteal space, another below the knee; at lower third of leg is a large abscess; sinuses also round left knee. 18th, abscesses on leg and knee opened; 21st, sent out for a while. Readmitted May 19. June 3, explored, and bare bone felt at back of right knee and in arm. June 11, under chloroform. Left thigh explored through incision on outer side; no bare bone felt, and posterior triangular space was healthy, but bone was enlarged, so a circular opening was made with a gouge, and deep in the centre of the bone was found a cavity containing pus and pus-infiltrated bone; on clearing out this a cavity the size of the top of the thumb was left with sclerosed walls. On the right side bare bone was felt behind and above the internal condyle; a precisely similar operation was done and just the same condition found, together with several small hard sequestra. This cavity communicated by a circuitous course with the sinus on the outer side; this was only found out by injecting lotion. A small sequestrum was also removed from the humerus. Wounds syringed out with chloride of zinc and filled with iodoform. Some cellulitis, &c., followed, but patient did fairly well up to a certain point, and was discharged July 31. He was subsequently readmitted with the disease in the right thigh extending, and was still under treatment in 1892. He is now lost sight of.

Fig. 158.—Epiphysitis of the upper end of the right Humerus, with softening and relaxation of the ligaments of the Shoulder Joint. The joint cavity was not involved.

Abscess in bone is not limited to childhood, but very frequently begins before puberty, though many of these patients do not come under treatment until

the disease is of long standing. Though most commonly met with in the cancellous tissue of the extremities of the long bones, abscess may also occur in the shaft, and we have more than once had to trephine for circumscribed abscess in the middle of the shaft (of the femur or tibia) occurring many years after an attack of acute periostitis. Inflammation of bone due to typhoid may become active after a quiescent period of twenty or more years.

Treatment.—As in acute periostitis, there is but one thing to be done in these cases. A free incision should at once be made down upon the bone, and, either with a gouge or trephine, a hole made into the cancellous tissue until the abscess is reached. Before operating the *exact spot* of greatest tenderness should be marked, and this is to be the centre of the incision. We have derived great help from this precaution in finding a small abscess in bone. Some surgeons prefer to do linear osteotomy, i.e. saw across the epiphysis with a fine saw, and thus open up the abscess ; but this plan is in no way better than the other. The bone is usually found soft, red, and rarefied ; often only a drop or two of pus will escape, and this may be overlooked. Even if the abscess is not found, relief is almost sure to follow, and pus will be discharged in a day or two ; at the same time, if no abscess is found, careful exploration should be made in every direction for the matter, to diminish the risk of its opening into the joint. Should a sequestrum be found, it will be of course removed, and the cavity should be well scraped out and drained ; should the adjacent joint be involved, it must be treated like any other suppurating joint.[1]

Chronic Diffuse Osteomyelitis.—This disease is met with chiefly as a tuberculous or as a pyæmic condition ; it may result from extension from a primary periostitis, or originate in the medulla, perhaps most often beginning in the epiphysial line. It is a matter of extreme difficulty, and sometimes impossible, to be sure whether a given lesion has begun as a local periostitis, spreading afterwards to the epiphysial line, or whether the epiphysial lesion is primary and the periostitis secondary.

The tuberculous disease in a well-marked case is a remarkable lesion ; the child has perhaps a history of some long-continued bone trouble coming on after measles or other illness, or after an injury ; external examination shows thickening of a large part of a long bone, with a sinus leading down to a cavity in the shaft. At first sight it appears that the case is one in which either the periostitis is the main lesion, or a small localised central inflammation has reached the surface and then spread along the periosteum ; but on cutting down upon the cavity, and clearing it out, a small sequestrum, infiltrated with pus, and greenish-yellow in colour, is removed. Instead, then, of finding the walls of this cavity formed of healthy but sclerosed bone, they are soft and also infiltrated with pus, showing the same greenish colour as the sequestrum. There is no sharp line of demarcation between this green bone and the surrounding shaft, but patches of rarefied pale bone are seen in parts. On attempting to gouge away the diseased tissue it will often be found to extend throughout a great part of the shaft, and perhaps several inches of cancellous tissue are thus removed before living bone is

[1] The subject of acute suppurative arthritis in infants (acute epiphysitis) is treated more specially under DISEASES OF THE JOINTS.

reached. When all has been removed the cavity slowly fills up, leaving a sinus or two. Some months after, on exploring these sinuses, a similar condition is found; the purulent infiltration has again gone on spreading, and in time it may reach an adjacent joint and set up disease there. In such cases the compact tissue is usually healthy in appearance, though sometimes it is perforated, and there is generally some, but not always great, periosteal thickening. In other instances where the changes have been rather more active, the diseased part becomes isolated and sequestra are thrown off ('chronic circumscribed osteomyelitis,' 'central necrosis'). Sometimes the compact tissue also dies ('total necrosis'). Though this disease most commonly affects the long bones, it may, as already pointed out, attack the jaw; here even the new bone may become infiltrated, and die as fast as it is formed; it is, however, doubtful whether this condition in the case of the jaw is tuberculous (*vide* Diseases of the Alimentary Canal).

CASE.—*Alveolar Abscess; Necrosis of Jaw.*—Joseph P., age 6 years; admitted May 31, 1884. Fairly healthy till four months ago, when he had toothache; tooth extracted, but swelling did not subside. On admission, much swelling over right side of lower jaw. From socket of first lower molar, which is gone, pus and granulation tissue exude. June 4, alveolus cleared out; some small pieces of bone and a rudimentary permanent tooth removed. Discharged June 4. Readmitted June 23, with more pain, swelling, and discharge; external incision made and pus let out. June 26, swelling &c. increased; a large sequestrum removed from inside the mouth, and several more through the external opening; these sequestra were soft, fœtid, and pus-infiltrated, and formed part of the horizontal and ascending rami throughout their entire thickness; the cavity left extended nearly up to the joint; some new bone had been formed and died subsequently. July 9, discharged much relieved.

The scapula, clavicle, ribs, pelvis and sternum, and facial bones are also sometimes attacked, and disease of adjacent joints may occur by extension. Though the malar and upper jaw bones are often affected, we have seldom seen any of the bones of the vault of the skull attacked, except the temporal, and this has been a result of disease of the ear. The occipital we have once seen perforated by tuberculous disease, and in the same child the frontal bone was carious. The process is essentially alike in all these cases. The sequestra are generally soft, and in some cases the pus decomposes and they become fœtid, but this is not by any means generally so in the limb bones.

A similar condition is found in the epiphyses of the long bones without the shaft being involved; sometimes a whole epiphysial nucleus will die and shell out as a sequestrum. We have met with the same condition in the patella, leading to destruction of the knee joint.[1]

CASE.—*Necrosis of the Patella; Disease of Knee Joint.*—John R., age 7¼ years; admitted July 7, 1882. Ten weeks ago had a blow on the left knee, which became painful a week later. On July 2 it began to discharge; his health had been failing since an attack of whooping cough eighteen months ago; phthisis in family. On admission, a fluctuating swelling mapping out the left knee joint, a little redness and venous turgidity; a half-closed sinus lay over the ligt. patellæ; limb nearly straight; no pain. July 18, sinus explored; it was found to lead upwards into a cavity in the patella, from which a seques-

[1] Vide *Lancet*, March 1883; also *Children's Hospital Abstracts*, 1882. Since then we have seen two or three similar cases.

trum the size of a damson stone was removed. The joint was incised on each side, and a free communication found to exist between the joint and the sinus through the patella; coagulated lymph and serous fluid escaped from the joint; operation antiseptic. August 17, has done well, and line of incision has healed except at entry of drainage tube; very little discharge; general condition good; no fever since operation. August 29, discharged in a back splint; readmitted in October; wounds healed; passive movement attempted, but adhesions found to be strong and universal, not giving any hopes of a movable joint, so he was fixed in a back splint with plaster of Paris, and sent out November 15.

In this chronic osteomyelitis, an epiphysial line acts only as an imperfect barrier, and, where the disease begins in it, it usually spreads both upwards towards the joint and downwards into the shaft. When the whole epiphysis is involved, the articular cartilage may be exposed on the removal of the infiltrated bone, and, as its nutrition is cut off from the side of the bone, it usually gives way, and in such cases the joint becomes involved. We have, however, seen a case where complete recovery with a movable joint occurred although the articular cartilage was thus exposed.

CASE.—*Osteomyelitis of Tibia.*—Annie L., age 3 years; admitted November 4, 1884. History good. In June 1884 fell downstairs; in August first complained of pain in left leg; it then began to swell, and has been slowly increasing ever since—rapidly during the last fortnight; health failing; has pain at night, &c. On admission, tense swelling of nearly the whole tibia and the soft parts over it; skin shining, but not red; temperature 98·6°. Three incisions were made over the front and outer side down to the bone, but no pus escaped. She was relieved, pain disappeared, and swelling subsided. She was discharged on November 18. Readmitted December 16. The left tibia is enlarged in nearly its whole length, and is very tender on palpation over its lower third. Some prominence of superficial veins just above the ankle, but no discoloration of skin and no fluctuation; temperature normal. January 8, 1885, under spray, incision made over tibia just above the ankle; periosteum found much thickened; a small gouge was easily pushed into the centre of the bone, and some pus welled up; a quantity of soft disintegrating bone, infiltrated with pus, was gouged away until a fairly healthy surface was reached; drainage tube inserted; iodoform and wood-wool dressing. On January 19 tube removed; and on February 2 wound almost healed, but leg not diminished in size, and presents same general characters as on admission. Readmitted, March 30. The wound from last operation has not healed, and is still discharging; swelling has spread up the tibia as far as knee joint; considerable thickening. April 30, no change in condition; temperature occasionally 100° at night. Esmarch's bandage applied, and incision afterwards made, about 2½ inches long, over lower third of tibia; periosteum detached and a new casing of bone, about ¼ inch thick, exposed; on cutting through this with a chisel, softened bone infiltrated with pus was removed, and at lower end a sequestrum about 2 inches long was extracted. A second incision was afterwards made over upper third of tibia, and the bone found in similar diseased condition; the whole of the interior of the tibia was gouged and scraped out, so that a probe could be passed from the upper to the lower opening; iodoform and wood-wool dressings and back splint applied. May 26, lower wound healing, still large cavity at upper; much discharge; temperature hectic, 96·4°–100·4°; takes food well. June 9, wounds slowly filling up; suppurating glands at angle of jaw opened; temperature 98°–102°. June 29, wounds superficial, but still much discharge. July 20, lower wound almost healed; upper filling up and contracting; less discharge; temperature normal. August 11, still slight discharge from both wounds; sent home on back splint. Readmitted October 24. Leg more swollen than when last in hospital; still two sinuses over left tibia. The limb was finally amputated, as the joint became involved.

The other forms of diffuse inflammation which may attack the marrow of bones have already been mentioned: in the rarefying form the medulla may

be replaced by deep red or maroon-coloured granulation tissue, and the bone may become so soft as readily to break down under the finger ; such condition may, however, be recovered from. We have known a case where the femur was so affected, and recovery took place without any unusual difficulty.

In sclerosing or condensing osteomyelitis the medullary cavity may be almost entirely filled up with irregular dense masses of bone, and sometimes isolated central sequestra exist under such circumstances.[1]

Scattered miliary tubercles may sometimes be found in the medulla of bone as a part of a general tuberculosis ; they are, however, only found *post mortem*, as they give rise to no symptoms during life.

The pyæmic variety of osteomyelitis is occasionally met with. In one of the most characteristic cases that we have seen, a boy 11 years old, who was in the habit of getting wet and drying his clothes on him, complained of pain in the feet ; the right foot and subsequently the knee swelled, the latter suppurated and discharged profusely a fortnight later ; the left elbow, the right hip, and the left knee then were attacked. On admission, ten weeks after the onset of the illness, both hips, both knees, and the right ankle, the left elbow, and the left shoulder, were swollen ; there were bedsores, and he had a systolic murmur and some evidence of pneumonia ; the urine was albuminous ; he was much wasted, and his skin was dry and harsh. A month after admission the left elbow was incised ; at that time there was brawny thickening over the upper part of the same arm ; ten days later, on exploring the humerus, there was found to be extensive but ill-defined mischief in it ; a fortnight after, the disease had extended so that the whole humerus was the seat of osteomyelitis ; pus discharged freely from the medulla at the upper part of the bone. The limb was amputated at the shoulder joint ; in doing so a large axillary abscess was opened. The shoulder joint was healthy, the elbow disorganised ; there was a sequestrum at the surgical neck of the humerus. He recovered fairly well from the operation, but subsequently fresh mischief occurred in the thigh, and he was removed by his friends, probably to die.

Treatment of Chronic Osteomyelitis.—The treatment of the different forms of chronic osteomyelitis has been almost sufficiently indicated in the description of the disease. The general management will be that of tuberculous children ; locally, in the early stages, rest to the part by means of splints, and in some cases confinement to bed, is all that can be done. If the disease does not subside, the bone must be freely exposed—the limb having been made bloodless by the elastic bandage, and the bone gouged away, all tissue that is dead or infiltrated with pus being removed ; if the mischief spreads far along the medulla, a groove must be cut in the bone, and all affected cancellous tissue scraped away. Should no repair take place and the disease spread to an adjacent joint, if the child's health is good, an attempt may yet be made to save the limb by incising the joint and draining it ; in some cases, however, nothing seems to arrest the disease, and amputation is required.

Washing out cavities with carbolic or mercurial lotion (1 in 4,000), and free dusting with iodoform, is perhaps the best wound treatment. In some cases it is a good plan to try the application of the actual cautery to the interior of the bone, in the hope of arresting the tuberculous process. In pyæmic cases incision of abscesses, removal of sequestra, and amputation

[1] A combination of these two conditions appears to have existed in a case recorded by Mr. Paul in the *Med. Press and Circ.* 1884.

are the only local resources, and each case has to be judged on its own requirements.

'Strumous Dactylitis.'—The condition sometimes called 'strumous dactylitis' requires brief mention here. The disease is simply chronic tuber-

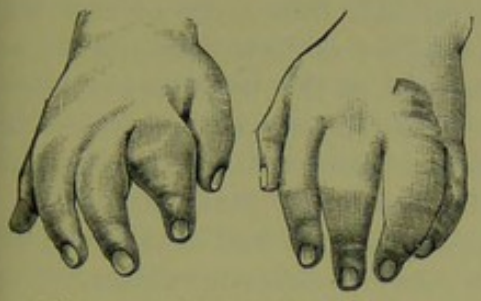

Fig. 159.—Multiple 'Tuberculous Dactylitis.'

Fig. 160.—Shows overgrowth of one Thumb, which had been long the seat of tuberculous disease. This is a rare condition, and should be compared with fig. 156 of overgrowth of the tibia.

culous osteomyelitis, or more rarely periostitis, attacking usually the first phalanx of one or more fingers; sometimes the metacarpal or metatarsal bones are affected. The disease usually begins as a hard, painless swelling of that segment of the finger, though occasionally there is a good deal of pain,

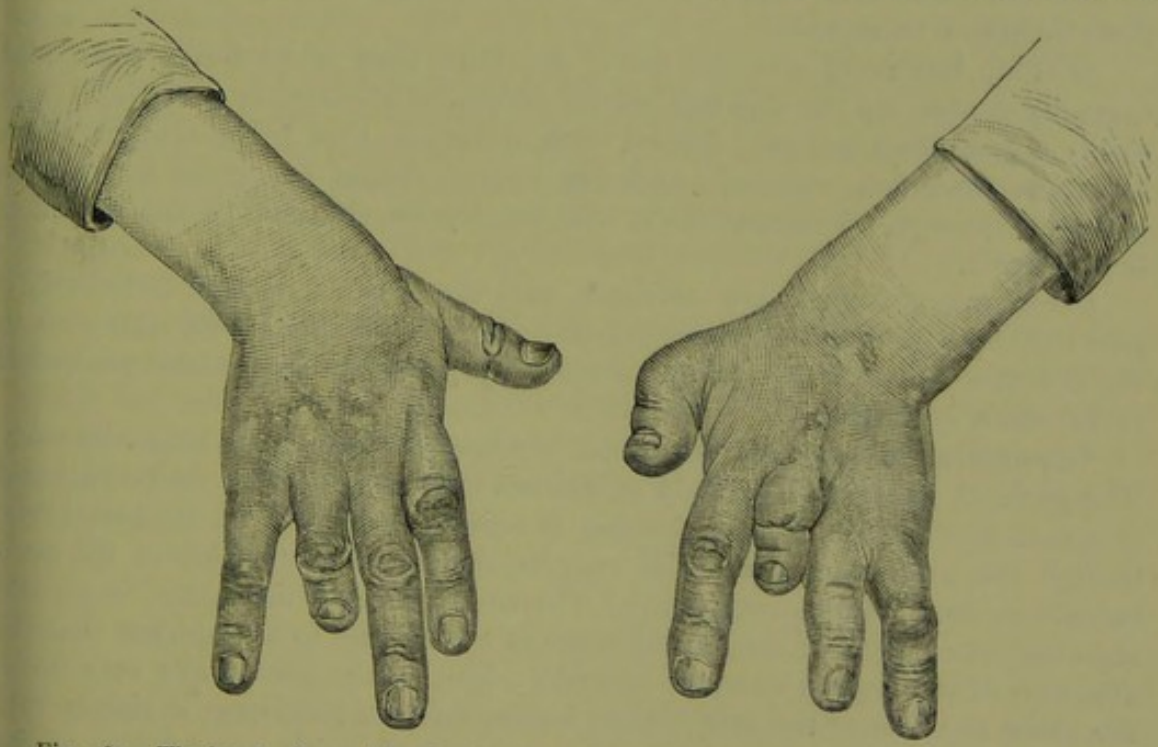

Fig. 161.—The hands of an adult, showing the effects of Tuberculous Dactylitis in childhood.

and always some tenderness. If no treatment is employed, the swelling increases, the soft parts become involved, abscesses [1] appear usually at the

[1] It must be understood that here as elsewhere the words 'abscess' and 'pus' are, in relation to tuberculous lesions, used in a sense implying the naked-eye appearance rather than the actual pathological condition. The 'pus' is broken-down caseous tuberculous material diluted with serum, and mixed with simple inflammatory products, and not the true pus of an acute abscess. (*Vide* Watson Cheyne's Lectures, *Brit. Med. Jour.* 1890, for a good description of the process.)

sides of the finger, and on their bursting or being opened thick curdy pus, with, perhaps, some bony detritus, escapes. On further examination, a large cavity is found occupying the site of the old shaft, which is either entirely gone or remains in part as a cheesy sequestrum, or in some cases, if the abscess is opened early, appears to be simply bare. Around the cavity, which is filled with pus and caseous matter, is a thin layer of new bone formed by the periosteum. As successive layers of new bone have been laid down and absorbed, so-called 'expansion' of the bone has occurred. After removal of all the cheesy matter and sequestra the finger may gradually shrink and get well, but is shortened, distorted, and usually weak and useless. Sometimes the destruction is so great that amputation is required. When seen in the earlier stages, constitutional treatment, with fixation of the finger on a splint and gentle pressure, will sometimes succeed in arresting the disease. It has been recommended to excise the bone subperiosteally in the early stage, and this would no doubt cut short the disease, but the finger is not likely to be of much use. It is better treatment to wait patiently, and keeping the finger quietly fixed on a splint to try the effects of pressure and general hygiene; when sequestra are present they must, of course, be removed, and should no progress be made the cavity must be cleared out—but, as a rule, a more useful finger is obtained by expectant than by active treatment.

Should, however, abscess form, the best plan is to freely open and carefully scrape out the abscess cavity, removing all caseous material. The cavity should then be well dusted with iodoform and boric acid or some iodoform emulsion injected, and the wound should be closed by sutures without drainage. Primary union will usually be obtained if the wound is kept aseptic.

Often many fingers are affected, and the disease is most commonly a part of 'General Surgical Tuberculosis'; it is most frequently met with in the first few years of life. The disease is probably sometimes periosteal rather than endosteal.

'Syphilitic Dactylitis,' so called, is more often described than met with. The general appearance closely resembles that of 'strumous dactylitis,' and it is said that in children the disease is usually primarily an osteomyelitis, though the gummatous material may be deposited first either in the periosteum or soft tissues overlying it. The occurrence of 'dactylitis' in a child showing other signs of congenital syphilis would lead to a suspicion that the affection of the fingers was also specific. The results are usually very much the same as those of the tuberculous lesion, and the treatment is simply that of syphilis. We have (1905) seen a case in which, with a condition of the hands exactly resembling tuberculous dactylitis, there were lesions of the front of both tibiæ and of the nose which were probably syphilitic. The child was about a year old and the father had had syphilis. Probably the two diseases coexisted.

'Leontiasis Ossea' is a disease in which the bones of the face, especially the upper and lower jaws and the malar bones, undergo hypertrophy. The disease begins in early life and may go on indefinitely. In a case we saw which had been under the care of Dr. Brown, of Bacup, and Mr. T. Jones, the disease began at 9 years of age, and the patient when we saw him was 28.

We had under our care, in 1899, a boy in whom the disease began as a slowly increasing thickening of the ascending ramus of the lower jaw ; the temporal bone, maxilla, and malar, and the nasal process of the opposite maxilla were later affected. No medicinal treatment had any effect. A girl æt. 11 years was seen in 1903 whose mother stated that seven or eight years before, the child's nose began to enlarge. We found marked thickening of the nasal processes of the superior maxillæ, the nasal bones and the glabella. There was no nasal obstruction and there were no polypi, but the septum was thickened and the voice was altered. There was no syphilitic history. Some pain was felt in the forehead.

Photographs taken at 4 years, 6 years, 8 years, and 11 years, all showed progressive increase in the facial thickening.

Fragilitas ossium or **Osteopsathyrosis** is a condition in which there is a simple atrophy of bone, i.e. the bone is congenitally defective in amount though perfect in structure as far as it goes. This weakness leads to frequent fracture without obvious violence, or, at any rate, from very slight strains. Often many fractures are found to exist at the same time.

Evidence of rickets may be absent or very slight, and the fractures unite well.

CASE.—Annie P., æt. 2½ years, was admitted April 22, 1884. Her parents and three other children were healthy. The child was small at birth, and on the second day the right thigh was found to be fractured. A month later the right humerus broke while moving the arm ; a distinct crack was heard at the time. After another month the left thigh broke, then the left humerus. At twelve months old the right thigh broke a second time. All these fractures united well. The child was suckled up to 11 months old and the mother had plenty of breast-milk, which was, however, said to have been deficient in casein. The child appeared healthy. There was slight evidence of rickets about the epiphyses and the ribs. There was thickening and some distortion at the site of the various fractures.

Cranio-tabes has been noticed and a tendency to bending of the ribs in some instances. There is still doubt as to the etiology of this condition, which has been variously described as *Fœtal rickets*, *osteogenesis imperfecta*, as well as by the names given above. Probably it is due to defective nutrition *in utero*, but it is not simply rickets. (*Vide* chapters on RICKETS and on INJURIES.)

CHAPTER XXX

DISEASES OF THE JOINTS

Diseases of the Joints.—There is no essential difference between the joint diseases of children and those of adults, but certain forms of disease are found most typically, or even almost entirely, in childhood. The conditions of growth as regards the relations of the epiphyses to the adjacent joints and to the shaft of the bone are, however, most important factors in determining the occurrence of disease and the kind of lesion met with, and, further, the liability of children to the various exanthemata is of much importance in regard to joint affections. Ordinary acute synovitis from injury or cold is in no way peculiar to, nor even specially common in, children, and need not be discussed here ; while hip disease, acute suppurative arthritis of infants, scarlatinal and pneumococcic synovitis, and even the common tuberculous pulpy disease, are instances of the modifying effects of the conditions of childhood upon forms of lesion which are also to be met with in adults.

In early life the lesions of joints are more complex than in adults, for the reason already alluded to, that not only may disease begin in the joint structures proper, but it may often reach the articulation by extension from the neighbouring epiphysis or epiphysial line. It is generally said that bone lesions are limited by the epiphysial zone and do not extend to the bone below ; this, as already shown, is only partially true, and, besides this, disease spreads frequently from a starting point in the epiphysial line, or from the periosteum of the diaphysis, and extends to the capsule, and so to the synovial membrane. There is, however, often effusion into a joint adjacent to bone disease without actual continuity of disease. (For further details see chapter on BONE DISEASES.)

Joint disease, then, in children may arise as a simple acute serous synovitis, which may subside, suppurate, or become chronic. Chronic simple serous synovitis is, however, rare in children. There may be a primary acute or chronic tuberculous synovitis. Pyæmia, pneumococcic infection, or certain of the exanthems, notably scarlatina and typhoid, may give rise to an acute, sometimes suppurative, synovitis, while measles and whooping cough, as well as scarlet fever and typhoid, may result in a development of tuberculous lesions. Finally, the joint disease may arise by extension from the shaft, epiphysial line, or from the epiphysis itself, and possibly from the ligaments and tendon sheaths in exceptional cases. The specific fevers are not so often as is sometimes stated the direct cause of joint disease : it is in most cases rather that the depressing effect of the fevers makes the child more liable to the onset of disease ; thus of 125 cases

of joint disease, taken consecutively from our records, including cases of disease of the hip, knee, shoulder, elbow, ankle and tarsus, and wrist joints, in only six cases was the joint affection a sequela of measles, in four of scarlet fever, in two of typhoid, and in three of whooping cough. Only those cases were reckoned in which there was no interval of health between the exanthem and the joint trouble.

In certain joints bone lesions are far more commonly primary, as in the hip, and perhaps the shoulder ; in other joints, as in the knee, ankle, and wrist, bone disease when present is much more often secondary to a primary synovial inflammation ; while in other joints again, as in the elbow, either starting point is common.

The hip is by far the most frequently diseased joint in children, and the knee comes next. Of 698 cases of joint disease under our care in the out-patient department of the Children's Hospital in three years, 369 were cases of hip disease, 160 of knee disease, and all the other joints together amounted to 169. Disease of the spine is excluded from this calculation.

For any detailed account of the pathology and symptoms of each diseased joint we must refer to the special works of Barwell, Macnamara, Howard Marsh, Hueter, and others ; space will only allow of selection of the hip and knee as types of the two forms of joint disease found in childhood, with a brief reference to the other most commonly affected articulations. Hip disease stands so much by itself that its consideration will be most conveniently postponed till after that of the other joints.

Chronic disease of the knee joint may be taken as the type of joint disease beginning in synovial membrane—pulpy disease, chronic synovitis, tuberculous synovitis, white swelling, and various other titles, all implying the same condition.

Here we may say at once that practically all the cases of chronic disease of joints marked by great thickening of synovial membrane, with little or no tendency to accumulation of fluid, but with great tendency to the formation of small multiple 'abscesses' in the thickness of the gelatinous tissue, are truly tuberculous in the most strict sense. In some cases a considerable amount of fluid, either serous with caseous material and flakes of lymph, or more puriform, is found in the joint ; this is, however, not a common condition in children. In many instances evidence of tubercle elsewhere and a tuberculous family history will be found ;[1] in many, death ultimately results from tuberculosis of other organs. The anatomical characters of tubercle are constantly to be found in the pulpy tissue, and, though not so constantly or readily, yet in a large number of instances tubercle bacilli may be detected.

The usual history of a case of chronic tuberculous synovitis of the knee joint in a child is as follows. There is perhaps a history of phthisis or joint disease in the family ; the child has been healthy, till at the age of, say, 4 years it was attacked by measles or some other exanthem. It was slow in recovery, and was never quite strong afterwards ; a year later, perhaps, it

[1] In 192 histories of chronic joint disease under our care (the spine being included), in 43 (+ 6 doubtful cases) there was a tuberculous family history ; in 61 (+ 1 doubtful case) the disease had followed an injury. In 19 cases out of 111 patients there was more than one lesion, i.e. there was evidence of tubercle elsewhere.

received some injury to the knee. Shortly after the knee swelled, but gave rise to no great pain or inconvenience, except a slight limping and feeling of tiredness; the swelling slowly increased and became somewhat more painful, especially at night, with night startings. We cannot too strongly insist upon the fact that tuberculous disease of joints may go on for months, steadily getting worse, without any pain at all, and with but little impairment of mobility; this so frequently occurs, and yet is so frequently a cause of mistakes, that we desire to emphasise the statement here. At this time the child, we will suppose, comes under observation. The knee is found markedly larger in circumference than its fellow, its natural hollows are obliterated, it may or may not be slightly hotter than the other, there is slight flexion, and usually it cannot be fully extended, any attempt to do so causing pain. There is considerable pain on pressure over the inner tuberosity of the tibia, and to a less degree over the outer side. The swelling is soft, elastic, and pseudo-fluctuating: it may exactly follow the normal outlines of the joint, or be more globular, the upper synovial pouch not being thickened; occasionally the swelling is almost limited to the upper sac. There is pretty free mobility of the joint at this stage, unless an attack of acute inflammation has supervened upon the chronic mischief. Such a case left to itself will later on become more flexed and less mobile, abscesses will form and burst at the sides or front of the joint, the swelling will increase, and the veins over the surface may become dilated and full; the tibia will become subluxated backwards and outwards, and at the same time rotated outwards upon the femur; the limb will become wasted and powerless. In many cases pain increases and the child's health suffers, until at last the pain and discharge, or the invasion of other organs by tubercle, wears him out.

The severity of the symptoms varies greatly: in some instances pain and stiffness exist throughout; in others free, though not usually full, mobility and absence of pain may be found during nearly the whole course of the disease.

If a knee joint, such as the one described, is laid open, the synovial membrane is found everywhere converted into a thick, pinkish-grey or yellowish, semi-transparent material, soft and gelatinous to the touch, but in parts tough and elastic; in parts the grey tissue is streaked with opaque fibrous bands, and here and there caseous foci will be found softening and breaking down—these are especially common towards the posterior part of each femoral condyle. These breaking-down foci do not usually communicate with the cavity of the joint itself, which is largely filled up by the thick granulation masses, and contains little or no fluid.

The pulpy tissue grows over the cartilages at first in delicate vascular tendrils or films, but afterwards these become thicker and form fleshy pads replacing the cartilage at the edge and lying in pits dug out of its surface, so that finally only a small central island of healthy cartilage remains in the middle of each condyle and each articular surface of the tibia.

Often granulation sprouts spread beneath the cartilage and, detaching it from the bone, give rise to superficial rarefying ostitis, 'subchondral caries,' which causes necrosis and separation of the articular cartilages.

The semilunar cartilages are, as it were, embedded in the gelatinous tissue, and in some far-advanced cases can hardly be distinguished; usually,

however, they are readily made out. The crucial ligaments are coated over with the pulpy tissue, and are often very vascular, with bright streaks of vessels running along them ; on scraping away this tissue the ligaments are found to have nearly their natural appearance, except that here and there a little sprout has forced its way between their fasciculi. The degree of destruction, however, of course varies in different cases, and in some the tuberculous focus is, at first, strictly limited to one patch of synovial membrane.

The cavity of the joint is often subdivided into loculi by adhesions between masses of the granulation tissue. On gouging out one of the granulation pits in the cartilage, it will be found in some cases not to extend through, in others the bone beneath is reached and locally eroded.

The capsule and lateral ligaments, &c., are much thickened, and this gives rise to the deceptive sensation of bony thickening so often met with in the knee. However much it may appear that there is enlargement of the bones in a case of chronic disease of the knee, it is almost perfectly safe to say that the thickening is in the soft parts alone, and that there is no new bone formation. It is only very rarely that a layer of periosteal new bone is found beyond the limits of the capsule. The presence of new bone about a chronic tuberculous joint is usually a sign of repair and of subsidence of the disease ; sometimes it is associated with central bone disease (chronic osteomyelitis), never, we think, with progressive synovial disease alone. Mr. Watson Cheyne, however, states that microscopically thickening of bone trabeculæ precedes tuberculous infiltration in caries of the articular ends of bones.

There is usually more or less atrophy of the bone adjacent to a chronically diseased joint. The cancellous tissue is more open in texture, and the compact tissue thinner than in health. Wasting of the bones, in fact, takes place, just as of the muscles and other tissues around the joint. These changes are general. When local patches of marked rarefaction are present, that part must be considered the seat of actual disease.

In the great majority of cases of disease of the knee the bone is healthy, unless the disease is far advanced ; when this is so, islets of soft rarefying bone and carious patches will be found, the latter in their early stages being recognised by the yellow and red mottling in the neighbourhood of the articular cartilage, with some rarefaction. It is often very difficult to be certain of the condition of bone in very early stages of disease : patches of various shades of yellow and red are met with in perfectly healthy bone ; where there is any local rarefaction or *opaque* yellow deposit disease is present. In some instances sequestra of varying size are found—most commonly in the femur, less often in the tibia ; usually the necrosis is at the back of one or other condyle ; we have, however, found it in the middle of the intercondyloid notch. When necrosis does occur the disease often tunnels a considerable way through the bone, or rather it has probably begun in the epiphysial line or epiphysis itself, and extended towards the joint.

As Prof. Howard Marsh has pointed out, a condition of 'quiet strumous disease' may exist, leading to a stiff joint without any active stage or suppuration ; we have seen such joints occasionally, and they are to be distinguished

by having a greater amount of solid thickening than occurs in serous synovitis, but less than in the ordinary tuberculous joint.

Tuberculous Disease of the Shoulder is rare in children; there is hardly sufficient evidence to show how often the disease begins in the synovial membrane and how often in bone. The swelling forms a globular mass, most prominent in front, and stiffness of the joint is usually marked. When suppuration occurs the abscesses usually point behind or in front of the deltoid, occasionally in the posterior triangle; no information as to the primary lesion can be obtained from the position of the sinuses, since extra-articular abscesses due to epiphysitis discharge in the same spots. Disease in the epiphysial line may or may not lead to destruction of the joint. In one interesting case we removed, as a sequestrum, part of the upper end of the diaphysis, including the epiphysial line, and subsequently nearly the whole shaft of the humerus; the inflammation had spread from the periosteum to the capsule, and the ligaments became so relaxed that there was a deep groove below the acromion, the humerus having dropped away from the scapula; the joint did not suppurate, and all went on well (fig. 158).

We have only two or three times found it necessary to excise the shoulder joint in children; in all the other cases the disease has subsided, or the case has been lost sight of. In one instance, where there was much necrosis, a very useful limb resulted with ¾-inch shortening, and but little wasting, but the joint was hardly at all mobile.

CASE.—*Disease of Shoulder Joint; Excision.*—Lewis H., age 4 years; admitted July 19, 1882. Three years ago the left arm was seen to be stiff and painful; abscesses formed about the shoulder and were opened; no bone removed; for the last eighteen months had been discharging a little constantly, and lately the child had lost flesh; no phthisis in family: other children healthy. On admission, rather pale, but fairly nourished boy; general thickening all round the left shoulder; a patch of red thinned integument, with pus beneath, in front of the insertion of the deltoid, and a sinus at the posterior border of the muscle; the pectoral fold bulged downwards and forwards; there was pain on movement. July 26, much discharge, especially on pressure about the axilla; very little mobility, even under chloroform, slight power of rotation alone remaining. August 2, the upper end of the humerus was excised, together with about an inch of the shaft, by a single straight incision at the anterior border of the deltoid; two loose sequestra were found in an abscess cavity surrounding the head of the humerus; the joint was entirely destroyed; the glenoid cavity and acromion were roughened; there was some deposit of new bone around the upper part of the shaft of the humerus; the part removed was not entirely necrosed, but there was a large cavity in it; terebene dressings, hand slung up to chest; some rise of temperature followed. Went on well, but slowly; at one time some bare white bone was seen, but this vascularised subsequently, except a small part removed on August 26, and two more small pieces which came away in September. Passive movement was begun on September 23, and on the 28th more free movement was made under chloroform. He had chicken-pox in October, and was discharged with sinuses still open on November 8. Passive movement failed subsequently to give him any great amount of mobility. February 1883, he is well and strong, and has good use of the arm, but the movement is almost entirely of the scapula; the limb is not much wasted, and there is ¾-inch shortening.

Disease of the Elbow Joint arises either as a primary synovitis or about equally often as disease of bone; in the latter case the olecranon, or one of the condyles, most often the outer, is first attacked. Well-marked cheesy masses are often found in one or other condyle, but any extensive disease of

the radius is very rare. Swelling extends all round the joint, but usually appears first over the radio-humeral line at the back of the joint. Later the front of the joint becomes swollen ; this is sometimes due to glandular enlargement, comparable to the swelling of the inguinal and iliac glands in hip disease ; in other cases the supra-condyloid gland suppurates. When the olecranon is the seat of the primary lesion the sinus is usually over it and leads directly, or nearly so, down upon it.

In old neglected cases, the number of sinuses is sometimes considerable, and the soft parts are undermined and much destroyed by pulpy infiltration. The joint is kept slightly flexed, and there is usually much muscular wasting. Occasionally we think the disease begins in the olecranon bursa, which is so common a starting-point for mischief in older patients ; this bursa is sometimes chronically enlarged in children. Stiffness is an early and marked feature of disease of this complex joint, though the mobility of the fingers is good, even if there is much infiltration of the muscular attachments about the elbow.

CASE.—Joseph L. D., age 3 years 11 months ; admitted January 27, 1882. Left elbow injured by a fall in April 1881 ; has been swollen ever since. On admission, healthy-looking child ; the left elbow was flexed and the hand semi-pronated ; very little mobility ; two sinuses at the upper and back part of the joint led down to rough bone ; a little tenderness, but no pain ; general swelling all round the joint. February 2, the joint was excised ; disease primarily synovial ; cartilage diseased, especially on head of radius ; operation not antiseptic ; the limb was put upon an angular splint. On the 13th passive motion was begun. On March 1 passive movement could be carried through the full range in all directions, and there was a little power of active movement ; the wound was nearly healed ; discharged. October 3, 1882, at out-patients' ; elbow quite healed ; had almost perfect range of mobility in every way, and the arm was strong ; he could lift a chair with it.

The Wrist Joint is perhaps even more rarely affected with tuberculosis than the shoulder, but in children we have on a few occasions had to excise the joint ; in all, the wrist joint itself, as well as the whole carpus, was disorganised, the disease having spread among the synovial sacs. In one instance the mischief began in the base of the second metacarpal bone, in the others the starting-point was apparently synovial. In two of the cases an excellent result followed, the whole of the carpus, the bases of the metacarpal bones, and the lower ends of the radius and ulna having been removed by a single median dorsal incision between the tendons of the extensor indicis and the extensor secundi internodii pollicis ; no tendon was cut through, though necessarily those attached to the parts removed were stripped back. In both of these cases a nearly perfectly mobile joint was obtained with almost full mobility at the metacarpo-phalangeal articulation —the point of greatest difficulty in disease of the wrist.

CASE.—*Disease of Wrist Joint.*—Annie E., age 6 years. Admitted March 25, 1885. History unimportant. No cause known for swelling of left wrist, which began six months before admission ; much pain ; poulticed for three months. On admission, a strumous-looking child ; on palmar aspect of left radius at lower end is a sinus ; much thickening round wrist ; fluctuation in front of carpus ; movements of fingers perfect ; those at carpal joints absent. April 16, whole carpus except pisiform bone removed by longitudinal incision on dorsum ; some bones broken down and unrecognisable ; cavity scraped, and drained

through palmar sinus. May 1, wound has progressed fairly and is now healing. 15th, sent home; tube still in wound; arm on splint; result very good; a strong and mobile hand (fig. 162).

One patient remained sound when last seen; the other, after keeping well for a long time, developed tuberculous teno-synovitis. In the third case the carpus alone was taken away, with an even better result. The operation mentioned is practically Langenbeck's; it is much simpler than Lister's method, and we think much superior to it: the bones which are not already softened and destroyed shell out easily from the pulpy material in which they are embedded. The position of the sinuses in carpal disease is inconstant, but the general appearance is shown in fig. 162.

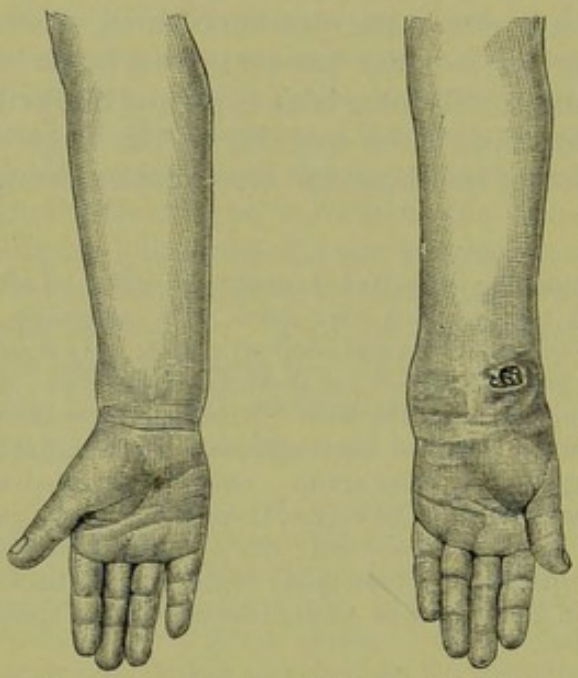

Fig. 162.—Tuberculous Disease of the Wrist.

Chronic Tuberculous Disease of the Ankle is much less frequent than that of the knee; but in four years we had 43 cases of disease of the ankle or tarsus admitted as in-patients at the Children's Hospital. Of these, excluding disease of the os calcis, most of the cases were probably primarily synovial, but in the tarsus extension of disease around the small bones so interferes with their nutrition, and so readily spreads to their interior, that in late cases there is always more or less destruction of bone. We can only recollect three or four instances of primary necrosis of the astragalus setting up disease of the ankle joint; but it is much more common to find mischief spreading from the lower epiphysis of the tibia to the joint.

Except the posterior calcaneo-astragaloid joint, the anterior calcaneo-astragaloid and its continuation the astragalo-scaphoid joints are, perhaps, the most commonly affected of the tarsal articulations; but the common sac or any of the tarsal joints may be attacked by disease, which then spreads from one joint to another. Calcaneo-astragaloid disease is very frequently the result of necrosis of the os calcis, and it not rarely extends upwards to the ankle joint itself.

Disease of the ankle joint is marked by swelling at the back of the joint, obliterating the hollows on each side of the tendo Achillis, and then spreading round and below each malleolus, especially the inner (fig. 163); the front of the joint also becomes swollen, and acquires a peculiar flatness or squareness of outline as a result of loss of salience of the extensor tendons. The foot is usually kept with the toes pointed, at other times it is dorsiflexed; the leg rapidly wastes; later, sinuses appear, usually above or behind the malleoli. It must be remembered that disease often extends from the joint into the sheaths of the neighbouring tendons, and in such cases suppuration or swelling may track up the leg or along the foot for a considerable

distance ; the general conditions do not differ from those met with in the knee. In disease of the tarsal joints the foot is swollen in the position corresponding to the affected articulation, and movement of the particular joints may be painful. This is not, however, a very trustworthy symptom in tuberculous disease, though of much value in acute inflammation. When the common sac is involved the foot assumes a bulbous look, with the toes pointed and pressed closely against one another. The disease often spreads beneath the extensor or along the plantar tendons, and gives rise to widespread mischief in the soft parts, so that a sinus by no means always indicates disease of the nearest joint. The arch of the foot is seldom lost, in consequence of the resistance of the rigid structures in the sole of the foot. With two exceptions, the disease is usually primarily synovial : one is that already mentioned of caries or necrosis of the os calcis, which often extends to the calcaneo-astragaloid joints ; and the other, that it is common for disease of the first metatarsal bone to extend backwards to the joint between it and the internal cuneiform. (For an account of acute tuberculous disease of joints, *vide infra*, p. 709.)

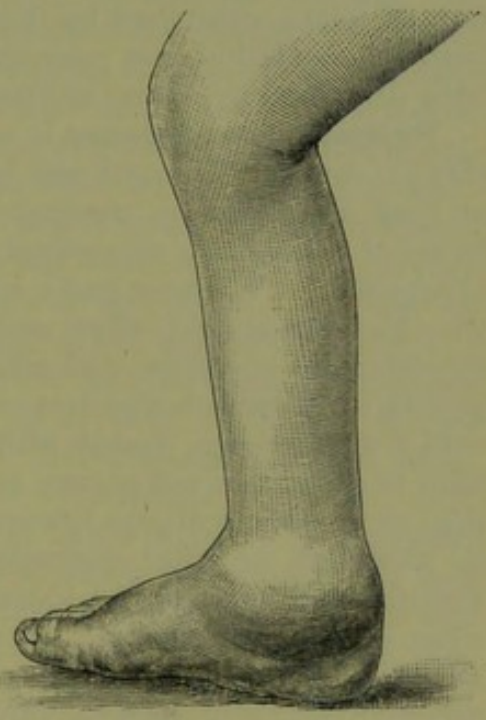

Fig. 163.—Tuberculous Disease of the Ankle Joint.

It is sometimes difficult to be sure whether an abscess on the dorsum of the foot—the most common situation for pointing in tarsal disease—is connected with the joints or is merely peri-articular : in some cases pain on pressure or movement of individual joints, localised by pressing back towards the ankle individual toes in turn, in others swelling over some particular joint or in the sole, will indicate a deep lesion ; but often exploration is required before a certain conclusion can be arrived at.

Acute simple Serous or Suppurative Synovitis is uncommon in childhood except as the result of injury or rheumatic fever ; any joint may be affected, and the symptoms in no way differ from those seen in adults. There is swelling, which, being due to distension of the synovial sac, follows its outlines ; heat and pain, with immobility and some constitutional disturbance, are also present. The inflammation commonly subsides readily by treatment with splints and ice or evaporating lotions, and leaves no ill results. In some cases, however, usually in unhealthy children, or where there has been a wound of the joint, suppuration occurs ; all the symptoms are then greatly aggravated, any movement is exceedingly painful, and the temperature may rise to 103°–104°.

The acuteness and severity of the symptoms vary much in these cases : in one instance the hip joint suppurated, nearly the whole thigh was occupied by a large abscess, the head of the femur was partially destroyed, and the mischief extended to the knee joint, which also suppurated ; both joints were incised, but the child sank and died. Pus was found in the knee,

with superficial erosion of cartilages ; the synovial membrane was thick and hyperæmic, the thigh was infiltrated with sero-purulent fluid, and the acetabulum was granulation-lined.

In other cases there is a thick 'mucous' discharge and the cartilages are not destroyed : in these cases incision generally results in recovery with a mobile joint. This form of disease most commonly occurs in children under 2 years of age, and is met with in the knee—less often in the shoulder, elbow, hip, or foot. Somewhat like the above-mentioned catarrhal inflammation of joints, described by Volkmann, appears to be a form of painless purulent exudation, not connected with pyæmia or epiphysitis, which has been described by Atkin, of Sheffield.

Pyæmic Joint Disease is not rare in children, and may run an acute or chronic course. The articular lesions may be the only evidence of pyæmia, or they may occur in conjunction with bone or visceral abscesses. Both forms of disease are exceedingly dangerous, though neither by any means always fatal. We have had a case under our care of a boy aged 3½ years, who had pneumonia after measles, and subsequently suppuration in one shoulder and one knee, with effusion into one of his ankles, and double empyema, together with abscesses in other parts ; this child recovered perfectly, with a mobile knee, though with a somewhat stiff shoulder. Effusion into a joint in pyæmia is not always purulent, nor does the presence of pus in a joint or elsewhere always demand incision and drainage ; the effusion may be absorbed, or, after aspiration, may not recur, and on examination the articular cartilage may be found quite smooth and healthy, or only somewhat yellow and opaque. In other cases, however, the cartilage becomes necrotic, or it may rapidly melt away entirely or in patches, leaving the articular lamina of bone smooth and bare ; this is perhaps the most typical condition of acute pyæmia.

Pneumococcic Arthritis.—No doubt many of the 'pyæmic' cases have been examples of pneumococcic arthritis, which has only become a generally recognised disease within the last few years. It occurs at all ages, but is perhaps more frequent in infancy. It may or may not be associated with similar infections in other organs. The inflammation goes on to suppuration with sometimes disorganisation of the joint, but not invariably so. The pain and constitutional disturbance are inconstant, and may be little marked. The mortality is high, death resulting either from some coincident infection or from exhaustion. The character of the fluid in the joint varies from thick pus to thin serum, and the latter is often of less favourable omen than the former. In these cases free incision and washing out is called for, and the pus or serum will be found to contain usually the characteristic diplococcus, and the same organisms will be found in the blood.

The peculiar pallor which has been noticed in these cases may be explained by this general blood infection. Of all the complications, or perhaps it might be more correct to say, of all the sites of primary infection the middle ear seems to be one of the most common.

It is highly probable that nearly all the cases of 'acute suppurative arthritis' of infants and of acute epiphysitis are really due to the pneumococcus. For a good account, with cases and bibliography, *vide* Dunn, Robinson and Fletcher, 'Lancet,' August 1, 1903.

As the pneumococcus is very commonly to be found in the mouth secretions, it is not difficult to account for infection under suitable conditions.

Acute Suppurative Arthritis of Infants, first described by Sir T. Smith,[1] is a remarkably well-defined affection of fairly frequent occurrence. It is limited usually to children under a year old, though we have occasionally seen it in older children, the eldest being nearly 2 years of age. Pathologically the disease is an acute epiphysitis leading to rapid destruction of the ossifying centre of the bone it attacks, with perforation into and disorganisation of the adjacent joint. In one instance the epiphysial nucleus of the head of the femur was found lying loose in an abscess cavity, or rather in a sinus leading from the joint. A large number of the infants so attacked die of pyæmia. The hip is the joint most frequently affected, the knee standing next. Of ten cases of our own the hip was involved in eight instances—six times alone ; in one other case the knee was involved by direct extension, and in another the wrist, shoulder, and hip were implicated. In two instances the disease followed whooping cough, in one it came on after an injury, and in one some evidence of the onset of the disease *in utero* was obtained. We have adopted Sir T. Smith's view that the lesion is primarily epiphysial ; and it is so certainly in the majority of cases, but in one or two we have not found evidence of anything more than synovial disease ; these would perhaps rather correspond to Volkmann's 'catarrhal synovitis'; and, on the other hand, we have met with several cases in which the abscess pointed outside the joint, the cavity of which was not involved. In one instance the lesions were secondary to a cervical abscess, and there was epiphysitis of one shoulder and a peri-articular abscess of the other, so that sometimes at least the presence of an abscess about a joint in an infant is not due to an epiphysitis, and sometimes it is not an arthritis. Battle believes it to be usually an affection of the end of the diaphysis primarily. It is often difficult to make out the connection between the abscess and the joint, but with care it may be found in most cases. The severity of the disease varies considerably ; in some instances the mischief goes on for two or three months, in others it is fatal in a few days. The characteristic features are the age of the child ; the existence of great swelling round the affected joint, often involving nearly the whole limb and not uncommonly 'flying about'—i.e. one limb becomes swollen and then subsides, then the swelling appears in one of the other limbs, and finally the disease becomes localised in one joint only, leaving the parts first attacked uninjured. This curious fugitive feature of the disease perhaps indicates its relation to pyæmia, and recalls the 'wandering' type of erysipelas seen in childhood. In acute cases there is much fever, but there may be little rise in temperature in the more chronic ones. We have seen a case in which tubercle was apparently engrafted on a case of 'acute suppurative arthritis' of the hip.

The symptoms and course of the disease point to thrombosis, extending from the vascular cancellous tissue, or to embolism, but we have not verified this condition *post mortem.* The size of the abscesses is sometimes remarkable ; in one case the whole thigh, from the hip to the knee, was a bag of pus, both joints being involved.

[1] Morrant Baker, John Poland, and one of the present writers, as well as others, have also contributed to the literature of the subject.

These children are generally, though not always, much prostrated and often very anæmic, worn out by pain and rapid outpouring of pus.

Treatment consists in early and free incision into the abscess, opening the joint if it is swollen, and keeping it well drained. Stimulants and abundant nourishment must be given. It is not necessary to put the limb in a splint in infants, but it is a good plan to tie it up in a pillow so as to keep it steady ; there is little or no fear of a stiff joint. Probably half the acute cases die. If recovery takes place, the limb is usually shorter and weaker than the other, but there may be a practically perfect recovery, and there is generally good mobility. We have several times seen older children with weak limbs clearly the result of this disease in infancy. Arrest of growth is less likely to occur where the hip is involved than the knee. The two following are fairly typical cases.

We have left the above account of the clinical history of these cases untouched ; but, as we have said, there is little doubt that many of them are instances of pneumococcic infection.

CASE.—'*Acute Suppurative Arthritis' of Hip.*—Alfred W., age 9 months. Admitted May 3, 1884. History good ; never very strong ; no known cause ; swelling about hip one month ago. On admission, pale, but not thin ; abscess round right hip ; grating felt in joint. Incision, head of bone gone. 5th, takes food well ; much discharge ; temperature subnormal. Did moderately, but on 15th still looked pale and ill. Sent home on 24th with wound superficial. Subsequently fresh suppuration occurred, but after a hard struggle the limb became sound and well, with good mobility and little shortening.

CASE.—'*Acute Suppurative Arthritis' of Knee.*—Mary H., age 9 months. Admitted March 21, 1885. Family history good ; child first noticed to be feverish and restless nine days ago ; the knee then swelled rapidly, and was very tender ; the swelling is now less than it was a few days ago. On admission, a well-nourished child ; right knee swollen, hot, tense, and shining ; fluctuation felt readily ; girth 10 in. as compared with 7½ in. on the left side ; temperature 97°. Joint freely incised on outer side, and a quantity of pus escaped. 23rd, swelling gone down ; a fair amount of discharge ; takes food well, and sleeps well ; temperature 101°. April 1, pus tracking upwards and inwards ; a larger tube inserted. 13th, swelling less ; doing well. May 2, all swelling gone ; tube removed. 11th, wound healed ; all well.

Exanthematous Synovitis, or that form of joint disease which occurs in connection with the specific fevers, has already been alluded to in discussing those affections, and scarlatinal synovitis or rheumatism has been fully described (p. 275). A second variety occurs generally, but not always, later in the course of the fever, and usually in connection with severe throat lesions. The affected joint suppurates and becomes disorganised ; this is clearly a pyæmic condition. It must also be remembered that the exanthems are sometimes a determining cause of the appearance of a tuberculous lesion. Synovitis, probably pyæmic, occurs as a rare complication of diphtheria. An exanthem such as scarlet fever or measles, occurring in the course of a joint disease, usually gives rise to suppuration and rapid destruction of the joint ; in some cases, however, it appears that, as in the case of erysipelas, the more active inflammation does good by causing melting away or absorption of the chronic inflammatory material.

'Pathological dislocation,' i.e. displacement of the articular extremity of a bone, as a result of softening of ligaments, is sometimes met with in cases of exanthematous synovitis, and we have seen it more than once

in post-typhoid inflammation of the hip joint. Both hips may be attacked at once.

Typhoid Arthritis occurs most frequently in the young, i.e. under 20 years. The joint affection may occur quite early in the disease, may attack several joints, and speedily subside, or, on the other hand, may go on to suppuration. This suppurative form of arthritis may be due to the general septic condition from the depression caused by the fever or by bedsores.

Another form of typhoid arthritis attacks chiefly the larger joints, and especially the hip. The inflammation may subside, lead to anchylosis, or rarely go on to suppuration. It may appear either early or late in the course of the fever, is not very dangerous to life, but is exceedingly likely to lead to dislocation, especially when the hip is attacked. Occasionally a 'typhoid spine' is met with.

Scarlatinal Arthritis has already been described under Scarlet Fever, *q.v.* Often multiple and attacking the smaller joints, it may also implicate the large ; it often subsides, though, especially if there is a mixed infection, suppuration may occur. Even after suppuration and free incision of a joint, good mobility may be preserved.

A serous synovitis has been noticed as occurring in the desquamative as well as in the eruptive stage of the fever.

Influenzal Arthritis is said by Marsh to occur commonly in the hip. It is associated with much periosteal swelling. The symptoms are acute, suppuration is rare, anchylosis may follow. It is likely to be mistaken for pneumococcic or tuberculous arthritis.

CASE.—Maggie G., æt. 15, had influenza in 1898 with inflammation of both knees, hips and ankles. All the joints recovered except the left knee, which remained stiff though not painful. She had varied treatment and was admitted to hospital in February 1900. The left knee was then flexed, and, though mobile, could not be fully extended ; this, with a little synovial thickening, was the only lesion remaining. Extension followed by fixation was employed.

Still's Infantile Arthritis (*vide* p. 487).—Dr. Still has described three forms of arthritis as occurring in children. In one the lesions are poly-articular and associated with enlarged lymph glands and spleen. The disease occurs before the second dentition, is chronic in its course as a rule, though it may be acute. It usually causes a gradual stiffening of the joints without suppuration, bone thickening, or true anchylosis. There is chronic pyrexia and permanent crippling. *Post-mortem* : a chronic synovitis with thickened ligaments, but no degeneration of cartilage or bone is found. It will be noticed that the characters of this form of joint disease are quite those of an infective, or, as it might be called, an *absorption arthritis.*

A second variety is associated with cartilaginous and bony lesions, and a third with fibrous changes and possibly heart disease.

Chronic Polyarthritis (**Osteoarthritis**) of a form resembling that seen in adults, occurs occasionally in children, and we have once or twice seen it. The physical features of thickened synovial fringes, or more or less osteophytic marginal growth, are also sometimes found in a single joint. It must be remembered that such cases may be or may become tuberculous, and we have seen a joint which had the characters of chronic 'rheumatic

arthritis' well marked, which subsequently became an ordinary pulpy knee; the two conditions may be seen co-existing in one joint.

CASE.—*Chronic Osteoarthritis.*—Mary Jane E., age 13 years; admitted February 25, 1884. No rheumatic or gouty history. Duration since August 1882, when she had pains in her shoulders, which subsided in a week. Nine months ago had pain in left hip, which lasted four months; then the left knee was attacked; both were swollen; no other joint affected; pains worse in wet weather; not increased in bed; sweats a good deal at nights; urine often contains red lithates. On admission, well nourished; slight eczema of face; heart sounds normal; right knee a little swollen; no crackling or thickening; no osteophytes. Left knee, thickened synovial fringes; well-marked crackling; edges of both condyles distinctly lipped. Her condition improved with blistering and iodide of potassium, and she was sent out on March 15.

All these cases of chronic multiple joint disease are probably due either to traumatic lesions or to infective processes by absorption from some focus in other parts of the body. In any case of multiple chronic joint disease in children, as in adults, careful search should be made for infective foci. Failing evidence of syphilis and tubercle, inquiry must be directed to the possibility of absorption from the digestive, respiratory, genito-urinary or other systems, not forgetting the ears, teeth and throat, and other possible centres of infection.

The more marked the tendency to close fibrous union or even anchylosis in these cases, the more probable is it that the joint lesion is an *absorption arthritis.*

Syphilitic Synovitis is occasionally met with; we have, however, only seen a few cases of pure synovitis in the first few months of life in congenitally syphilitic children; the most common condition is syphilitic telostitis. A subacute recurrent syphilitic synovitis occurring in older children is met with; it sometimes rapidly subsides under antisyphilitic treatment, as in the following instance; but this is not always the case—it is sometimes rather intractable.

CASE.—*Syphilitic Synovitis of Knee.*—Jane B., age 8 years 3 months; admitted October 31, 1882. A history of syphilis in the brothers and sisters, of whom there have been twelve, seven being dead; patient herself had always been hearty; two years ago the left knee swelled without known cause, but recovered completely in fourteen days; the eyes had been bad since May 1882; the right eye was first affected, and the left was only attacked three weeks ago; has not had much photophobia; the left knee began to swell on October 29; she had a good deal of pain in it. On admission, the left knee was much distended with fluid, and was slightly hotter than the right; she had well-marked interstitial keratitis, which was, however, subsiding; facial aspect and teeth also characteristic; no other signs marked. Under hyd. c. cret. and pot. iod., together with a back splint for the knee, all the swelling rapidly subsided, the eyes improved, and she was discharged, nearly well, on November 21.

Clutton has noticed the occurrence of symmetrical synovitis of the knee in congenital syphilis, and Gutterbock other cases of asymmetrical effusion; we have seen the same thing associated with periostitis of both tibiæ. Carrington and Lane record a case of suppurative synovitis of the hip, knee, shoulder, and both elbows in a child with congenital syphilis; there was rickets also present, but no epiphysitis.

The best treatment of these cases is the administration of iodide of potassium in full doses, as children take it well, with hydrarg. c. cretâ,

while mercury ointment should be rubbed into the part affected ; if there is much pain, blisters will sometimes give relief. **Gonorrhœal rheumatism** is sometimes met with in children in association with vaginitis or ophthalmia neonatorum, as pointed out by Clement Lucas and others. We have seen an infant a few weeks old in which a stiff flexed wrist remained as the result of what was described as 'erysipelas of the hand.' The swelling of the hand was noticed on the evening of the day the child was born, and it had also purulent ophthalmia.

Fig. 164.—Congenital Syphilitic Synovitis of both Wrists.

Acute Tuberculous Synovitis is not a very common affection ; it does, however, occur, and rapidly goes on to suppuration in quite young children. The most typical instance we have seen was in a baby 10 months old, in whom suppuration of the ankle occurred a week or two after a scald over the joint. On incision a few drachms of curdy pus escaped. A week later the child died of pneumonia and was found to have generalised tuberculosis ; the lungs, liver, kidneys, spleen and brain were all affected. Here, from the condition of the tuberculous masses in the brain, it was clear that tuberculosis existed at the time of the injury to the skin over the ankle, and the joint subsequently became tuberculous. The case serves to illustrate the fact that in the first year or two of life suppuration occurs as a result of inflammation more readily than in older children. Acute tuberculous disease also

sometimes follows strains or fractures in the neighbourhood of joints; thus we have seen advanced pulpy disease of the elbow, in a girl of 8 years, nine days after an injury which loosened the epiphysis of the inner condyle of the humerus. The following case is also noteworthy as an illustration of the occasionally acute onset of the disease:

CASE.—*Acute Pulpy Knee.*—Harry A., age 3 years 9 months; admitted January 4, 1885. No tuberculous history; had measles at two years of age, followed by whooping cough; disease of knee first noticed fourteen days ago; no cause known. On admission, stout, well-nourished boy; right knee is much enlarged, joint hollows obliterated; swelling elastic, no distinct fluctuation; movements very limited and painful; right knee 10¾ in., left knee 9 in.; extension applied. 17th, knee straight; no night pain; general condition good. 21st, as some fluid was thought to be present, the knee was aspirated, and two drachms of sero-pus drawn off. 25th, temperature normal; general health good, but there is still fluid in the joint. February 4, the knee was enlarged to its original size, a Thomas's splint was applied, and he was sent home. Readmitted April 29. He wore the splint up to readmission, and has been doing fairly well till lately. On admission, the swelling has increased to 11 in. and extends some distance up the thigh; the veins are full, and the skin tense and shining; the patella floats; free incisions were made into the joint; a large quantity of turbid serum escaped from the incision on the outer side, while from the inner one, which was somewhat lower down, pus flowed; operation antiseptic; drainage as usual; the wound was dressed on May 2 and 12, when there was not much discharge and the knee was quiet; temperature never above 99·4°. 26th, still a good deal of swelling; some thick, cheesy pus squeezed out; the knee did not improve much, and on June 29 he was taken home by his friends. July 6, readmitted; knee as on discharge. 18th, temperature 102°; some retention of pus on inner side of thigh above knee. 23rd, excision of joint; much thick pulpy material, cartilage eroded, but surface of tibia healthy, except a small portion at the inner margin, which was gouged away; surface of femur bare and rough, and bone soft and showed several points of pus; when gouged the bone was quite soft, yellow and infiltrated with pus; this was removed, leaving a cavity ½ in. long and ¼ in. deep in the inner condyle; the bone surface and the upper synovial cavity were cauterised with the thermo-cautery, dusted with iodoform, and the limb was put up in a Howse's splint; wood-wool dressing; on section of the part of the femur removed a yellow caseous mass was found surrounded by soft bone; there was much shock for some hours, which was treated by opium, warmth, and alcohol; did fairly well, and temperature was never above 100° till 29th, when the knee was dressed for the first time, the temperature having run up suddenly to 104° (?); wound looked well and was quite sweet; pads of wood-wool uniformly soaked; temperature fell and was not above 101° after 30th. August 3, free discharge, doing well, but splint soiled; it was removed, and replaced next day; union seemed firm. 8th, tube removed; there was afterwards some trouble with the splints, which needed changing, and the wound on the 14th was no longer aseptic; the tibia became displaced somewhat backwards and some fresh suppuration followed; this was combated by making the boy lie on his face for half the day; he slowly improved, and on October 16 the wounds were nearly healed, and he was sent to Convalescent Hospital. April 3, 1886, one sinus, the rest of the wound well shrunk; not yet firm, but in good position; fat and well.

The *treatment* of the various joint affections can only be briefly given here; it is impossible to mention all the applications and apparatus that have been devised. In *acute non-suppurative* joint affections of the upper limb, in the case of the shoulder it is sufficient to strap the arm to the side, or, if the child is very young, to bind the limb with a flannel bandage across the chest; lead lotion in infancy and an ice bag in older children is the only further application required. For the elbow nothing is better than a common inside or outside angular splint which must reach from the axilla to beyond

the end of the fingers; all short splints, leaving the wrist and fingers free, are obviously insufficient. For the wrist a straight palmar or dorsal splint reaching from the elbow to beyond the finger tips should be applied.

For the hip a Bryant's or Thomas's splint should be put on. For the knee and ankle the ordinary back splint with a foot-piece should be used, taking care that when the knee is the part injured the splint reaches well up to the buttock. A Thomas's knee splint answers excellently for all stages of knee-joint disease, but the child must of course be kept in bed for acute affections of the joints of the lower limb.

When *suppuration* occurs free incisions should be made into the joint and drainage tubes inserted; where there is no previous opening, and the wounds are aseptic, washing out of the joint may be employed, and the wound then closed by sutures, or the cavity may be drained, choosing a dependent position for the incisions, and avoiding the dangerous anatomical area of each joint. In subacute cases, with sero-purulent fluid or even pus in the joint, aspiration should be tried once or twice before free incisions are made; but the joint must not be allowed to become distended with fluid, since this frequently leads to subsequent ligamentous weakness.

In *chronic non-purulent effusion*, and in cases where a simple synovitis has left thickening behind, elastic pressure by a Martin's bandage lightly applied, or by common bandages applied over a thick layer of absorbent wool, does good service. Friction is often useful, and blisters frequently relieve pain and promote absorption. Care must be taken not to be misled by the presence of adhesions remaining after subsidence of disease into thinking that progressive mischief exists. A joint that has been acutely or subacutely inflamed, and after a week or two of treatment remains stiff, a little swollen, cold, and tender on pressure over one or two spots, with intense pain at perhaps one spot *on any movement beyond a certain point, though movement may be free up to that point*, is the seat of adhesions, and requires the breaking down of these bands under chloroform. In such cases inquiry should always be made to ascertain that there is no evidence of any tuberculous taint before moving the joint. After breaking down adhesions the limb should be kept quiet for twenty-four hours and effusion prevented by pressure or cold; and then, if all is quiet, active movement should be begun. We hold strongly the opinion that in all cases, whether traumatic or not, when once any definite adhesion has been broken down active movement is right and passive movement is wrong. Passive movement is always likely to inflict fresh injury on young scar tissue, and so lead to fresh and denser cicatrices. Active movement, since it should be within the 'limits of pain,' will stop short of injury to the tissue of repair, and will moreover not frighten or discourage the patient. While recognising the effect of adhesions in and about joints, it is well to remember that it is much less common to meet with cases of this kind among children than among adults or adolescents; probably because the restless activity of childhood prevents the joint from being kept still after the acute and painful stage is over.

When a joint has suppurated no premature attempts at procuring mobility should be made. As soon as the joint has been soundly healed for a week or two all apparatus should be left off, and the child allowed to try for itself—left, in fact, to do as it likes, in reason—it will seldom do too much.

If after a few days no progress in mobility is being made, chloroform should be given and the joint carefully examined. It is generally possible to make out whether the adhesions are few and cordlike, or general ; in the latter case a permanently stiff joint will almost certainly result, in the former the adhesions should be at once broken down. Where a stiff joint is arranged for, the limb must for many months, often years, be provided with a splint to keep it in the desired position. Children's joints are very slow to anchylose.

We have no great belief in inunction with Scott's ointment, still less in painting with tincture of iodine, as modes of treating chronic joint lesions, but pressure and friction are invaluable when acute mischief has subsided. Oleate of mercury is perhaps the best application.

In all cases of *synovial tuberculosis* in the early pre-suppurative stages but one form of local treatment is, we believe, of much value—absolute fixation, with or without pressure. Where there is acute pain or a subacute attack in the course of chronic disease counter-irritants in the shape of blisters or the actual cautery are useful to relieve the pain, but we do not think they do any great good otherwise. We have tried and given up injections of iodine and carbolic acid into the pulpy tissue, and we cannot say we think Scott's dressing is of any great use, except as a means of pressure. For the upper extremity the plans mentioned for acute disease, combined with elastic compression, are all that is required ; for the elbow and wrist the splint may be made permanent by fixing it on with plaster of Paris, or substituting light iron strips in the plaster for the wooden splint, or a poroplastic splint may be used. It is common to see figures of appliances for disease of the elbow and wrist in which the fingers are left free and can be moved ; this seems to us opposed to all principles of keeping the joints at rest, inasmuch as every movement of the fingers must necessarily disturb both elbow and wrist joints. The joints of the lower extremity must be considered more in detail.

Injection of iodoform into tuberculous synovial membrane is in some cases undoubtedly followed by local shrinking and cicatrisation of the tuberculous material. The effect is, however, very local, and the mode of treatment tedious and only applicable to a limited number of cases.

Treatment of Tuberculous Disease of the Knee Joint.—In early stages, where there is no dislocation and little flexion of the knee, the limb should be fixed upon a back splint with a foot-piece, and as long as the symptoms are acute the child should be kept in bed. If there is much flexion and pain the limb should be straightened gently under chloroform, and a splint then applied with an ice bag over the knee for the first twenty-four hours ; where there is flexion, but not much pain, an extension should be put on by a weight fixed with strapping below the knee,[1] or a Macintyre's splint may be used—we prefer the weight. As soon as the acute symptoms have passed off and the limb is nearly straight—it need not be quite so—a Thomas's knee splint with patten and crutches should be provided and the child allowed to get about ; if there is much thickening, elastic pressure should be employed at the same time. Where the Thomas's splint cannot be obtained, or the friends cannot be trusted to look after the splint, or the child

[1] One pound of weight for each year of the child's age up to six years is a good general rule.

is too young to use crutches, a plaster-of-Paris casing should be put on, strengthened by the iron strips, as shown in fig. 168. As Mr. Paul, of Liverpool, has suggested, it is a good plan to cover the metal with rubber tubing. The child, if it is old enough, may get about with patten and crutches after the plaster of Paris is applied. Children under 4 years of age cannot usually be trusted to use crutches, and must be kept off their feet and taken out of doors in a perambulator or carriage. Cod-liver oil and iron, careful dieting, and fresh, above all sea air—the great medicine for tuberculous bones and joints—should be the general treatment where possible. As long as there is no suppuration a fair trial should be given to the plan described; it is simple, and we know nothing better. There must be no taking off of splints for washing or to see how the joint is getting on—one movement of a joint may undo weeks of rest; leather and lace-up splints are for this reason not so good for hospital patients as plaster of Paris, though we greatly prefer a Thomas's splint where it is possible. Plaster of Paris has several objections: it is messy to apply and impossible to keep clean, it conceals abominations of all sorts, it is apt to cause sores, it is heavy, it requires periodical renewals, it is prone to bring about a chronic venous engorgement of a part, which makes a limb flabby, and congested, and swollen, and ill nourished, and therefore slow in repair. In spite of all these objections, it is better to put on a plaster-of-Paris splint than to have a joint imperfectly kept at rest. Where the nurse can be trusted not to play pranks with the joint, such as allowing the child to bend it, or stand upon the limb, washing is a luxury that may be occasionally indulged in, but fixation comes first. If in spite of this treatment the joint gets worse, operation is necessary; but in the case of the knee a very large proportion of patients will get better, and this because the disease is mainly synovial. Bier's treatment of tuberculous joints by producing congestion by means of bandages applied above and below, so as to retain blood in the vessels of the part, has not commended itself to us.

When a joint such as the knee, in spite of efficient treatment for two or three months, steadily gets worse, pain and swelling increase, and the child's health begins to suffer, more active means must be taken, and these will become necessary much sooner in acute than in chronic cases. If the pulpy material is rapidly breaking down, and suppurating, and yet the child's health is keeping good, success is sometimes obtained by fixing the limb on an interrupted splint, or, better, in plaster of Paris, and then opening and carefully draining the abscesses, taking care, if the whole joint cavity is suppurating, to drain at the back of the joint, or the lowest point of the abscess sac if the suppuration is localised. By this means a certain number of these children will do well, and acquire sound, straight, and in some instances movable limbs. The plan is, however, only exceptionally applicable. If there is no suppuration, but the pulpy swelling increases, the best mode of treatment is Erasion.

Erasion, or, as it is sometimes called, arthrectomy, consists in the case of the knee in opening the joint freely by a semilunar or other incision, just as in the ordinary mode of excising the knee; the skin is reflected and the capsule removed on each side of the patella and patellar ligament, or, better, the patella is sawn across and the fragments turned upwards and downwards; if necessary, free vertical incisions must be made to

reach as high as the upper limit of the synovial pouches. It is well not to dissect up the skin from the underlying tissue more than can be helped, as the pressure of the dressing which should be firmly applied sometimes interferes with the circulation in the edges of the wound and delays union. Next, every particle of pulpy granulation tissue is carefully cut away with scalpel or scissors; all the infiltrated capsule and the semilunar cartilages are removed and the articular cartilage scraped quite clean, any granulation tissue being carefully picked out from pits in the cartilage, and, if necessary, any foci of disease in the bone gouged away. This process must be most thorough, and extreme flexion of the limb is required fully to expose and clean the back part of the joint; the crucial ligaments are scraped, but if sound preserved; the lateral ligaments are divided. The upper synovial sac must be thoroughly cleaned out. The most difficult part of the operation is getting away the posterior part of the semilunar cartilages and the synovial membrane at the back of the joint. The process is a tedious one, often lasting three quarters of an hour. As soon as all bleeding has been stopped the limb is fixed on an excision or other splint

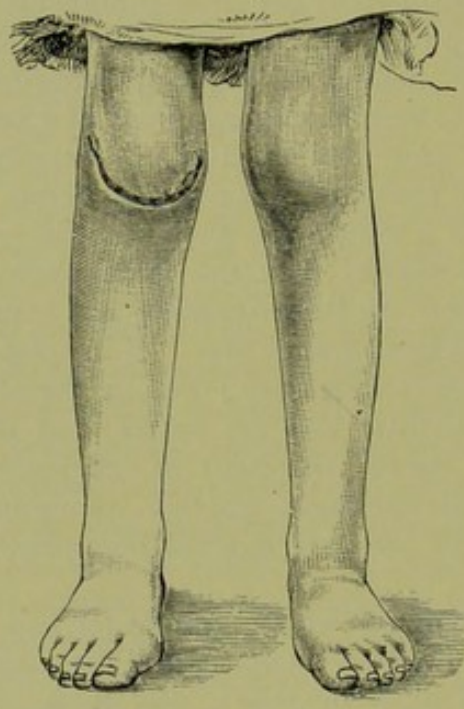

Fig. 165.

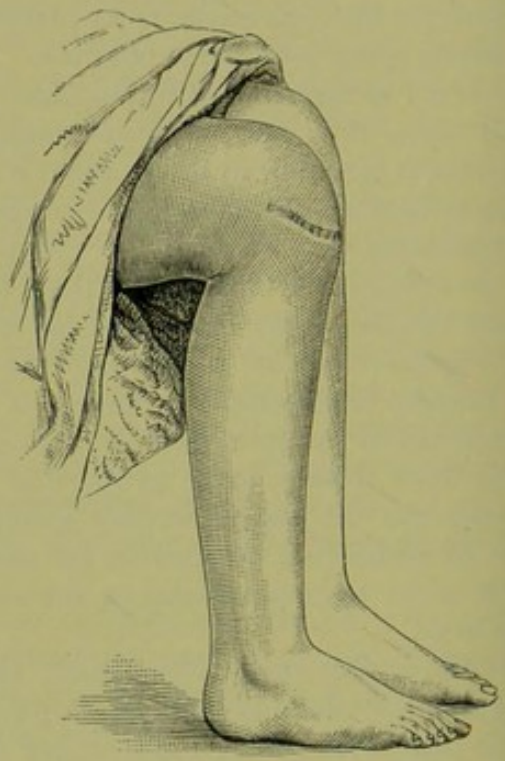

Fig. 166.

Show the condition of Lizzie N. after erasion, and the free mobility of the joint.

and dressed in the usual method, antiseptically. Drainage, if used, should be at the back of the joint on each side, the tubes being carried through openings made behind the joint, but in recent years we have used no drainage and closed the wound entirely. When this is done it is important to arrest all bleeding as perfectly as possible. Usually healing throughout by primary union is obtained. We prefer to Esmarch the limb, or at least put on an elastic tourniquet before beginning the operation. We usually put on a simple interrupted wooden splint at first, and in three weeks or so put on a Paul or Thomas's splint. For a series of cases *vide* 'Med. Chron.' vol. ii. 1885, and 'Annals of Surgery.' We introduced the operation in its complete form in January 1881, and the first case was that recorded and figured below. The late Mr. Greig Smith, of Bristol, had, however, he told us, performed the same operation on an elbow in the previous year, but the case was not published until after our first case was recorded. There is, however, we believe, no doubt that Mr. Greig Smith was actually the first surgeon to perform erasion, though our case was the first published and his was unknown to us till long afterwards. We desire to give him full credit for his work.

CASE.—Lizzie N., age 13 years 9 months; old pulpy disease; joint erased, all synovial membrane, much of capsule, semilunar cartilages, and a largish patch of carious bone removed, as well as a good deal of articular cartilage scraped away; result, a perfectly movable, sound, painless joint, used as freely as the other; ligamentum patellæ not divided. She was under observation for nearly four years after the operation, and, except that she was liable to occasional serous effusion into both knees as a result of overwork, she remained well. The knee operated on differs little from the other except for the presence of the scar upon it. In July 1889 this patient was again seen, and the knee remained perfectly sound and mobile.

Erasion, we think, is applicable to cases of fairly early disease which have resisted efficient treatment by splints, &c. Though in the case recorded we obtained a freely movable joint, we have never had such a perfect result since, nor do we think it wise to try for mobility, except in a few instances where the wound heals at once, and the adhesions are few. Erasion, if it fails, leaves the limb still fit for excision; where it succeeds, the limb is as sound as after excision, but without shortening.

The more we see of these cases, the more we feel sure that erasion is the proper operation, and that excision is hardly ever required, while the result is far better from erasion than excision. We prefer erasion, as above described, for the knee, but the general rules of treatment must, of course, vary with the particular joints, stability and absence of shortening being the cardinal points for the lower limb, mobility for the upper. Mere scraping through sinuses is of but little use, though if fistulæ exist they should be well cleared out. Repeated daily injections of a few drops of pure turpentine into tuberculous sinuses is we find often a very efficient means, and a painless one, of procuring healing. Since the case above reported was operated on, many other 'arthrectomies' have been performed, and, on the whole, with very good results. Erasion is practically the only operation done at the Children's Hospital for tuberculous disease of the knee. Excision and amputation are almost unknown there for this joint. We have read many articles, some faintly praising, others condemning, the operation, and a few cordially advocating it. We and our colleague, Mr. Collier, have, provided the operation is properly done, seen no reason to be dissatisfied with it, and can only venture to suggest that failure is due in some degree to incomplete operations.

Should it be decided that the case is too far advanced for erasion, **excision** of the joint should be performed. We, however, have so seldom of late years found it necessary in children that details of the operation need not be given.

As soon as the anæsthetic has passed off, opium should be freely given.[1] As soon as the wound is healed, or in less favourable cases as soon as only sinuses remain open, the limb should be fixed afresh in a plaster splint or put upon a Thomas's splint, and in about two months the child may be allowed to get about with a patten and crutches; but the case is by no means done with, since nearly every case of excision, or of erasion for that matter, of the knee in children, unless thoroughly well looked after and a stiff apparatus kept constantly on for from two to four years, according to

[1] ɱi for each year of the child's age is the usual dose, and this should be repeated in an hour or more if required.

the child's age, will become crooked. Occasionally, after excision of the knee, a more or less movable joint has resulted, but we do not look upon this as an object to be aimed at, but rather as a failure of the operation, inasmuch as flexion and dislocation are likely to result where no bony union is obtained. Flexion, with dislocation backwards and outwards, is the common deformity, but we have seen a general curve of the limb develop, or distortion at the epiphysial line of the tibia. This deformity is one of the great difficulties and drawbacks in excision of the knee ; the operation itself is not a very dangerous one : we did some twenty-five cases in children without a death, though some required subsequent amputation—this was the end of four of our first twenty-three cases. In recent years we have hardly ever excised a knee ; this operation has in our practice been almost entirely superseded by erasion.

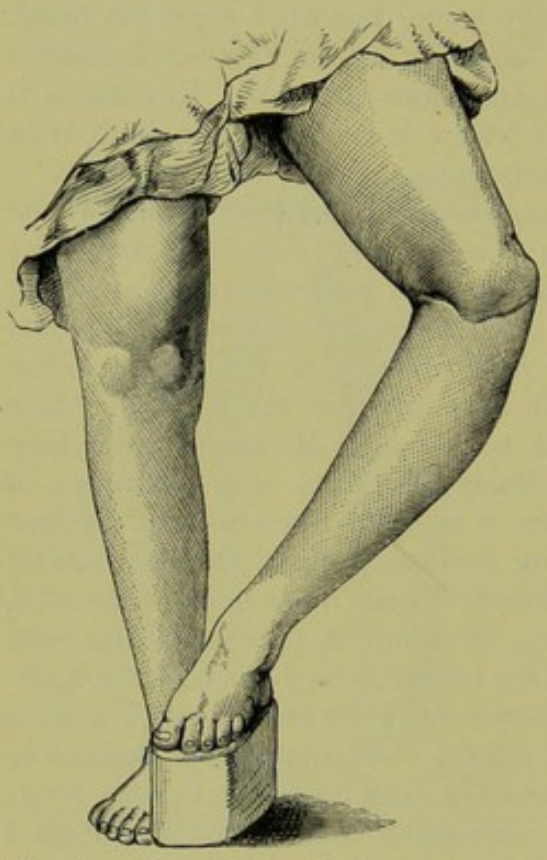

Fig. 167.—Shows the result of premature use of the limb after excision. The operation had been done at another hospital, and the patient was subsequently admitted under the care of our colleague, Mr. T. Jones. There was bony anchylosis in the position seen in the figure.

The amount of shortening resulting varies much : in three cases, after an interval of about three years, it averaged 1½ in. Though the results after excision of the knee are necessarily imperfect, it must be remembered that they are to be compared with prolonged suffering, danger to life, and amputation as the alternatives.

Mobility after erasion is occasionally acquired and may be perfect. We are doubtful as to the desirability of trying to get it, and rather prefer to let the case take its own course and become mobile or remain stiff according to the degree of perfection of the joint. Our colleague, Mr. Collier, has tried by persistent movement of the patella to obtain a more mobile joint, but the method is not always applicable.

In neglected cases of disease of the knee, even though the disease may have to a great extent subsided, the joint often remains flexed and subluxated to such a degree that the limb is nearly or quite useless. If there is well-marked dislocation backwards, little can be hoped for in the way of reduction ; all the tendons and ligaments become so shortened and contracted that, except in a recent case, little good can be done by extension or attempts at straightening—indeed, in some cases these attempts only make matters worse. Where there is flexion, but no, or only slight, displacement, extension by weights should be patiently used for some weeks ; if no result follows, chloroform should be given and an attempt made to straighten the limb by forcible, though not violent, manipulations, frequent extension and flexion movements being employed to break down any adhesions in or around the joint. Should it be clear that muscular

contracture is an important factor in the resistance, the tight hamstrings should be divided, but we would dissuade from any violent efforts, especially if there has been much suppuration in the popliteal space ; in such cases there is much risk of laceration of vessels. Should the attempt succeed, the limb is brought straight, fixed upon a back splint for a day or two, and then an immovable apparatus or Thomas's splint applied. Joints will often straighten when somewhat flexed and even when slightly subluxated, merely by prolonged wearing of a Thomas's splint. Whitman, of New York, advises reduction by placing the child prone, fixing the tibia, and using the femur as a lever ; with this is combined massage and stretching of the muscles.

Should it be found impossible to straighten the limb by these means, the choice lies between excision of the joint and osteotomy. We have employed both with good results, but they are applicable to somewhat different conditions. Suppose the joint allows considerable movement, although it cannot be straightened sufficiently to be of use, osteotomy is likely to leave an unsteady limb ; on the other hand, an acutely flexed limb requires removal of a very large amount of bone in excision before the leg and thigh can be brought into a straight line. We think, then, that osteotomy is best for cases of stiff joint with great flexion ; excision for those where there is more mobility, less flexion, and more displacement. The late M. Beck and B. Pollard advocate division of the crucial ligaments with subsequent reduction in cases of subluxation, and have recorded a few cases ; we think the application of the method likely to be limited, since division of these ligaments certainly does not allow of reduction in all cases.

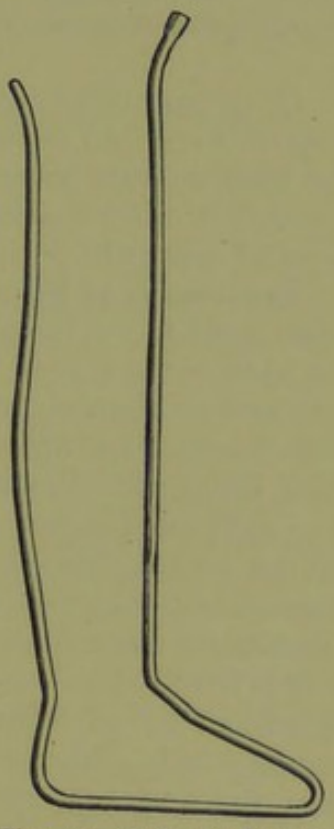

Fig. 168.—Splint for Disease of the Ankle and Tarsus. It is made of iron, covered with india-rubber tubing, as suggested by Mr. Paul. The splint is fixed to the limb with plaster-of-Paris bandages.

Osteotomy in such cases is not a difficult operation ; a longitudinal incision is made about three or four inches in length on the front of the thigh from the patella upwards, the femur is exposed, and a sufficient wedge of bone removed from its anterior surface to allow the limb to be brought straight. We prefer this plan to simple section, which may cause dangerous pressure on the popliteal vessels and be followed by gangrene. In one of our cases after excision we could not nearly straighten the limb at the time, but by keeping up extension after the excision the limb was gradually brought almost straight. The following case illustrates the value of osteotomy in certain circumstances :

CASE.—*Necrosis of Tibia. Angular Flexion of Knee. Osteotomy.*—Ralph H., age 13 years ; admitted January 12, 1885. History good ; well till two years ago ; complained of pain in knee, which soon swelled ; no cause known ; twelve months later had some dead bone taken from the leg ; discharge has continued till now. On admission, well-nourished boy ; was sent in for amputation ; the left tibia was enlarged and longer than the

right; on the inner side were scars of former operations, and a large sinus over the upper end of the bone; the leg is flexed nearly to a right angle; hamstrings tense; toes pointed; foot cannot be straightened. 24th, has had 6 lbs. extension on since admission, but the knee is no straighter. February 12, has had on a Thomas's knee splint since last note, and has been getting up; no improvement. 13th, under chloroform an attempt was made to straighten the limb forcibly; a few adhesions gave way, but no sensible improvement followed; back splint. 20th, an incision 3 in. long was made in the axis of the femur above the knee, the periosteum was peeled back, and a large wedge of bone removed with an osteotome; the limb could then be nearly straightened; operation antiseptic. 24th, tube removed. March 11, limb put up in back splint with movable foot-piece; wound healed and limb straight. 20th, fair union of shaft; leg straight; foot in good position; gets up with the Thomas's splint. Sent home on 24th. January 30, 1886, leg straight, walks without splint, sound and well; toes still somewhat pointed.

In another recent case the joint was much flexed, but mobile through a certain range; on excising the joint it was found impossible to straighten the limb without greatly shortening it, so an osteotomy was done to the junction of the lower and middle thirds of the femur, and the limb was then brought into good position.

Treatment of Pulpy Disease of the Ankle Joint.—The same general rules apply to the treatment of tuberculous disease of the ankle as to that of the knee in the earlier stages of the disease, and many good results will be obtained by simple pressure and fixation. To carry out this plan the best means are to use either the apparatus shown in fig. 168, or a short metal back splint with a foot-piece, the child being allowed to get about with a Thomas's knee splint. Should suppuration occur, and the joint not recover by the means described, the prospect is a somewhat poor one: however, erasion and resection of the ankle for tuberculous disease are now fairly satisfactory operations, though the disease sometimes spreads and amputation is required. Amputation is, however, in these days almost a discarded operation, except at the hip joint, at least so far as the surgery of childhood is concerned. We did not amputate a limb at the Children's Hospital for joint disease during one period of three years, except once where the mischief in the knee was the result of extension in a case of acute necrosis. A patient trial of fixation, pressure, and, if necessary, repeated removals of the disease, should be given, even after suppuration occurs, provided the child's health is maintained, but the prospects of such cases in disease of the ankle are not nearly so good as in the knee. The following is an instance of a satisfactory result after erasion of the ankle:

CASE.—Peter H., age 8 years 8 months; admitted January 30, 1882. Ten weeks ago the right ankle became swollen; no cause known; had been treated with cold water, strapping, &c.; never had much pain in it. On admission, fairly nourished but muddy-complexioned boy; there was much swelling round the right ankle joint on all sides, with increased heat and redness on the outer side, but little or no tenderness to pressure, though movement of the joint was painful; the circumference was an inch and three-quarters greater than the opposite side; the position was semi-extended and rotated slightly inwards. On February 9th the joint was opened by a transverse incision (Mr. Holmes's plan) across the front of the joint dividing all the extensor tendons, &c.; much pulpy synovitis existed with 'subchondral caries'; all the pulpy tissue, as well as the loosened cartilages, was removed as far as possible, and a drainage tube passed across the joint, a groove being cut in the upper surface of the astragalus to prevent the tube from being nipped; the tendons were then stitched together with catgut and the wound closed; no attempt was made to unite

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nerves, and the anterior tibial artery was twisted; sponge pressure was applied around the joint, and the operation was antiseptic; finally the limb was fixed on a back splint with a foot-piece; a little oozing followed at the first dressing; on the following day the appearance of the foot was natural below the line of incision; a little superficial ulceration occurred at the outer aspect of the front of the foot, and union of the edges was slow, but by March 13 the incision had healed except at the drainage-tube openings; no pus had been discharged up to this time. On April 20 some sensation was perceived on the dorsum of the foot. There was no discharge, and on May 28 he was sent out with plaster of Paris over an Esmarch's splint and a sponge dressing still applied; after this progress was very slow, some thickening remaining about the ankle, and occasionally a small part of the cicatrix would ulcerate and break down. February 1885, foot sound and well, but toes are somewhat pointed, and he 'throws' the foot in walking. He gets about well with a boot and without any support. A good deal of new bone formation about line of incision, but some mobility.

We have also had some excellent results after excision of the ankle:

CASE.—*Disease of Right Ankle; Necrosis of Astragalus.*—Richard T., age 4 years 5 months; admitted September 18, 1882. Family history good. History: Well till six months ago, when the ankle began to swell and has gradually got worse; no pain; no injury; can walk. On admission, fairly healthy child; somewhat rickety; right ankle swollen; bulging on each side of extensor tendons and round each malleolus, especially on inner side and in front of tendo Achillis. September 30, ankle joint aspirated; a little serum drawn off, and some tr. iodi injected. October 20, no improvement; an incision behind the inner malleolus gave exit to two teaspoonfuls of gelatinous and almost melon-seed-like material. October 28, wound healed; joint refilled. November 16, temperature rose; 104·2° on 18th. November 23, joint opened; a large, loose sequestrum of the astragalus was found and removed; the whole astragalus was then taken away, and the lower end of the tibia and fibula resected, as well as the upper surface of the os calcis and the inferior tibio-fibular joint. The joint was opened by a transverse incision across the front; the tibial and extensor tendons were stitched together afterwards. Operation antiseptic; sponge pressure, and subsequently salicylic silk. January 13, antiseptics left off, had been doing fairly, but slowly; still some swelling. February 11, sent out in plaster of Paris over an iron splint round foot; wound not healed. He finally got a good sound foot.

If excision is performed the astragalus should always be removed entirely and all tuberculous material taken away; there is then a fair prospect of a good foot, and only when this fails should amputation be done. The prospects after excision are much better now than they were before recent improvements in the management of such cases. We have had some very satisfactory stumps after Pirogoff's operation, and watched them for years; and, although it occasionally fails, where it is successful it gives a much better stump than Syme's amputation. If removal of the foot is too long postponed, disease is apt to spread up into the tibia and along the sheaths of the tendons, and then amputation higher up the limb will be called for; but the question of amputation, as already pointed out, very rarely arises. (See also Treatment of Tarsal Disease.)

In cases of tuberculous disease of the ankle that resist treatment by other means we now usually excise the joint; at least, we open the joint by the method described, remove the astragalus and all tuberculous material and close the wound. The results are most satisfactory. Care must be taken to avoid over-extension of the foot (pointing of the toes), but this is the only difficulty likely to arise. As in the case of other joints, amputation is the rarest of operations.

Treatment of Tarsal Disease.—It has already been pointed out that, except in the case of the os calcis, disease of the tarsus is usually synovial in origin, hence it should be treated on the general principles of such lesions —absolute fixation of the foot, with entire rest from any strain—and the usual hygienic means should be employed in addition. The apparatus already referred to for disease of the ankle is the best means with which we are acquainted of carrying out this plan, and to it a patient trial should be given. Should, however, this treatment fail, complete removal of the disease by operation is required. Amputation is practically never necessary. It is impossible here to discuss the question fully, but the conclusions to which our experience has led us are these. If there are definite sequestra of one or more tarsal bones, these should be removed; the fact that there is necrosis often means that a line of demarcation has formed and recovery may follow. It cannot be stated absolutely, because, as already pointed out in the case of the leg, even where sequestra exist tuberculous infiltration of surrounding bone may be present. If there is general synovial disease with caries, it is best to expose freely the affected parts by turning up a dorsal flap of the soft structures and removing the diseased tissues; but so long as any affected synovial membrane or carious bone remains recurrence is to be expected. In such cases the best plan is total resection of the tarsus—i.e. removal of all the tarsal bones, with or without the exception of the back part of the os calcis, which, if sound, may be left to form a support for the heel.

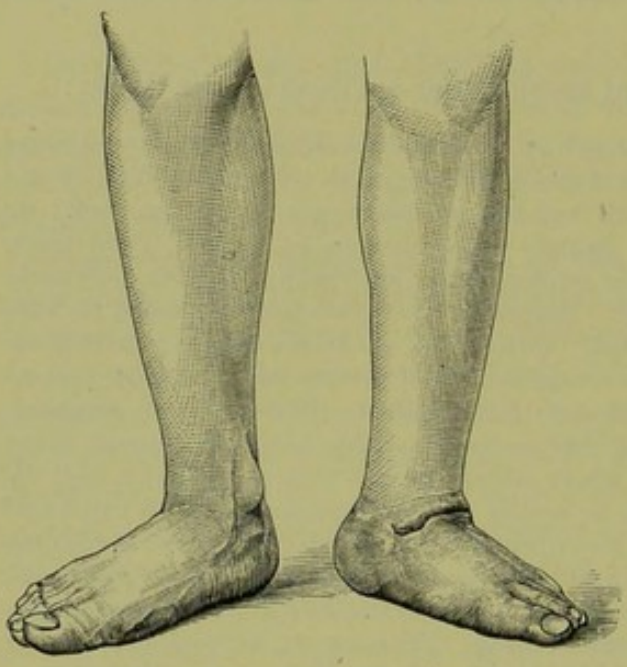


Fig. 169.—Shows a foot after resection of the whole Tarsus on the left side except the back of the os calcis. Annie E. Both feet are flat.

The simple transverse dorsal incision turning up a dorsal flap is, we think, the best method; it exposes the parts fully, the divided tendons can be stitched together afterwards, and the use of the foot is wonderfully little impaired. After the operation the foot may be at first kept merely upon a back splint with a foot-piece, but as the cavity begins to fill up and the parts consolidate, the iron splint (Paul's splint) with plaster of Paris forms the best appliance.

By this method excellent results, far superior to those of a Pirogoff's or Syme's amputation, will be obtained (fig. 169).

Case.—Annie E., age 17, sprained her foot in the winter of 1883–84, and came under our care in the Royal Infirmary in November 1884. She was then a fairly healthy-looking girl, with disease of the anterior calcaneo-astragaloid and astragalo-scaphoid joints, as well as swelling of nearly the whole foot; there was a sore below the inner malleolus. After treatment by rest and fixation, part of the astragalus and scaphoid were removed in January 1885. In May the disease was still progressing, and the whole of the tarsus, with

the exception of the posterior part of the os calcis, was taken away, the bases of the metatarsal bones and the malleoli being also removed; some of the tendons were stitched together, otherwise no attempt at adjustment of the deeper structures was made. In the spring of 1886 the foot was as seen in fig. 169; she could 'spring' upon it to a certain extent; there was fair mobility and power; and she did her housework with no other support than a Martin's bandage.—*Vide* 'Med. Chron.' September 1886. In 1899 the foot still remained sound. We have had a good many similar cases.

Should the disease recur, amputation may possibly be required, but this is far less likely to be necessary than after mere gouging or scraping operations. Partial resection of the tarsus, *except for necrosis*, is rarely successful—i.e. where there is mischief spreading about among the tarsal joints it is of little use to remove merely an individual bone or two bones. Unless a clean sweep is made of the disease it will probably recur. The exception to this rule is the os calcis, but as in this bone the disease is usually central, it stands by itself; removal of the entire os calcis without any other bone is a highly successful and very valuable operation, and is often called for.

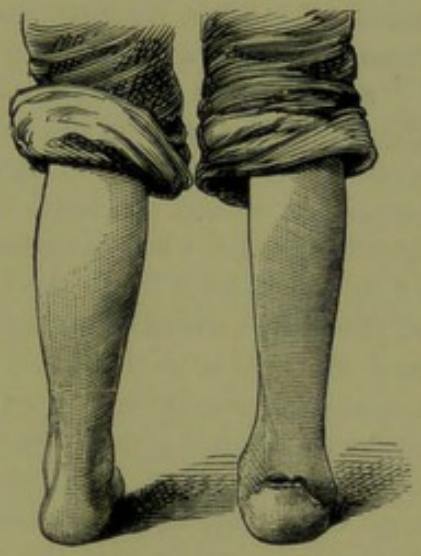


Fig. 170.—Shows the result of excision of the Os Calcis. There is nearly complete restoration of the bone.

CASE.—*Disease of Calcaneo-astragaloid Joint; Caries of Os Calcis; Excision.*—Norman G., age 2 years 4 months; admitted June 11, 1883. Family history phthisical. History: measles ten months ago; swelling of foot followed; has been under treatment for it. On admission, sinus in sole of right foot over calcaneo-cuboid joint, another below outer malleolus; much thickening about os calcis, movement of ankle free. June 14, explored; sinus led into os calcis, and probably to calcaneo-astragaloid joint; drainage. July 7, put up in plaster of Paris with ankle splint and discharged; splint had to be removed in a few days on account of swelling; back splint put on; had varicella July 11. Readmitted July 24; foot worse; discharge increased. August 1, flap turned forwards from heel, and os calcis excised; found carious, with a large cavity; operation subperiosteal; did well; discharged August 25. February 1884, the foot healed and become sound and useful; a small fresh collection of pus has, however, just reformed; the os calcis has been largely reproduced, and the foot is fairly well shaped. May 1884, sound and well; walks excellently.

The treatment of tarsal disease, then, is rest and pressure first; failing this—and it should have full trial—removal of sequestra if there are any; if not, resection of the whole tarsus, or at least of such part of it as shall include all the joints communicating with the seat of disease. Tarsectomy for disease is not practised nearly as much as it ought to be in spite of repeated advocacy of it here and elsewhere. It is a successful and valuable operation, and has in our experience wholly superseded amputation of the foot; for disease of the os calcis removal of it alone is the better plan, and when done subperiosteally there is usually a most perfect reformation of bone (fig. 170).

After total resection of the tarsus we much prefer to keep the foot in its natural position and allow the parts to adjust themselves, rather than artificially produce a sort of equinus foot as proposed by Wladimiroff.[1]

[1] A paper by one of the present writers in *Med. Chron.* 1886 may be referred to.

Disease of the phalanges and metatarsal bones of the toes differs in no way from the corresponding disease of the fingers, and requires the same management except that amputation may be resorted to in the foot earlier than in the hand, since the loss of a toe is of less consequence than that of a finger.

Disease of the first metatarsal bone and of the metatarso-phalangeal joint of the great toe is common, and of importance, since it is liable to be followed by considerable lameness. Failing rest and general measures, the question of amputation or resection remains ; either is followed by a certain amount of crippling, but resection of the first metatarsal bone is so frequently unsuccessful that the most speedily satisfactory result is probably that of amputation. We usually resect the bone as a first resort, and only amputate failing this ; but we must confess that even when resection succeeds the toe is so shrunken and short as to be of little use.

Sacro-iliac Disease is not very rare in children ; it is usually, we think, the result of extension of chronic tuberculous disease from the adjacent bone, most often the ilium—at any rate, necrosis is common, and we have removed sequestra which included the articular surface of the ilium. The disease usually runs a chronic course, and gives rise to comparatively little pain ; often attention is first called to it by the presence of an abscess over the back of the joint ; sometimes, however, the matter forms at the intrapelvic surface and may point in the groin or track down behind the rectum : under such circumstances there may be pain down the leg from pressure upon the sacral nerves. Pain is sometimes felt in walking from the weight of the body bearing upon the diseased joint, and pressure directly upon the joint or upon the iliac crests, or, again, traction upon the iliac crests, tending to draw them backwards, gives rise to pain. It is occasionally possible to make out mobility of the ilium upon the sacrum, and we have seen displacement of the bones as a result of disease. Caries of the spine may cause sacro-iliac disease from the burrowing of pus into the joint, and in most of the cases we have seen there has been disease of bone or joints elsewhere.

Sacro-iliac disease is best treated by rest in bed on a firm mattress, no sitting up being allowed. Should an abscess form and increase in size in spite of treatment, it should be opened and any diseased bone removed. Golding Bird has exposed and removed diseased bone in these cases by trephining. As soon as the acute symptoms, if any are present, have passed off, the child should have a double Thomas's hip splint applied : he may then be moved out of doors on a couch with safety. If the position of the abscess prevents the application of the splint in the ordinary way, the apparatus may be so arranged that on the affected side the splint is applied to the outer side instead of to the back of the limb (*vide* figs. in chapter on SPINAL DISEASE). If the child recovers, there will probably be some arrest of growth of the pelvis on that side, and a lateral curvature of the spine.

We have not seen a case of acute non-tuberculous sacro-iliac disease, and the strength of the articulation is such that any acute traumatic mischief is unlikely to be met with.

Disease of the Temporo-maxillary Joint occasionally occurs in children as the result of scarlet fever, injury, or necrosis of the jaw or of the temporal or malar bones, or arises by extension from the ear, and gives rise to stiffness

and inability to open the mouth, and later to distortion of the face from arrest of growth. Pain in movements of the jaw and swelling over the joint are the usual symptoms; when suppuration occurs it usually points over the articulation. We have seen the joint suppurate in a case of pyæmia which was associated with acute suppurative arthritis in an infant.

The treatment consists in opening the abscess, should one form, and feeding the child on soft food; unnecessary disturbance of the joint is to be avoided. Should the jaw become stiff, attempts should be made to overcome the stiffness by means of a Maunder's screw, used several times daily after forcible opening of the mouth under an anæsthetic, just as in peri-articular adhesions from suppuration in the neighbourhood of the joint.

CASE.—*Spurious Ankylosis of Jaw, with Atrophy of the Bone.*—Thomas C., age 8 years 4 months; admitted June 21, 1882. Had 'low fever and inflammation of the lungs' at two years, and since then his jaw has been stiff, so that he lives on liquids and sop; was thought to have hydrocephalus; soon after he became ill he had otorrhœa, which continued with intervals until the time of admission. On admission was only able to open his mouth about a quarter of an inch; nearly all his teeth were carious; he spoke fairly well and seemed to be in good health; the jaw was much atrophied, so that the upper teeth far overhung the lower; the jaw was forcibly prised open under chloroform, and subsequently Maunder's screw was used, with the result of increasing his gape to more than an inch, and enabling him to masticate fairly well; the use of the screw was continued up to February 1883.

Failing this plan one of the forms of operation for the establishment of a false joint should be performed; probably the most satisfactory in permanent results is resection of the head of the bone by an incision parallel to and below the zygoma, taking care to avoid injury to the facial nerve, but we have not met with a case requiring the operation.

Disease of the Acromio-clavicular and Sterno-clavicular Joints is occasionally met with; it should be treated by fixation of the arm to the side. If suppuration occurs the joints should be freely opened and the tuberculous material removed. We have found sequestra in the acromio-clavicular joint (*vide* GENERAL SURGICAL TUBERCULOSIS). A certain amount of disability in use of the limb may result.

'Hysterical Joints' (*vide* HYSTERIA).—Though the utmost caution must be used before deciding that any joint trouble in children is not due to organic disease provided persistent complaint of the joint is made, it is an unquestionable fact that cases of so-called 'Hysterical joints' are occasionally met with. We have seen children with such a condition affecting the spine and more rarely the hip. The great clue to the nature of the case is the incompatibility of the objective signs with the complaints made by the child. If with a history of long-continued complaints there is no local evidence of disease, and if the site of the alleged pain is inconsistent with the known nerve distribution, and if also the pain is exaggerated, we should carefully consider the possibility of a 'neurosis,' and this the more if the personal and family history supports such a view. We saw in 1895 a girl of about 12 years of age, who a fortnight after being sent to work complained of pain in the hip and subsequently in the knee. She was supposed to be suffering from hip disease. On examination she was a stout, healthy, but excitable-looking child. She walked a little lame, and complained of pain in the region

of the anterior superior spine of the ilium and in the knee. There was neither swelling nor rigidity of the joint, but alleged great tenderness on pressure. Further examination showed that pressure on various other points gave rise to extreme expression of pain, but by leading questions complaint could be elicited of pain in other parts of the body where there was no reason at all to suspect the presence of disease. The complaints were incompatible with what we know of organic disease, and the case was clearly shown to be hysterical. She quickly got quite well.

(For 'Chronic Synovitis of Adolescents,' *vide* chapter on HIP DISEASE.)

Nævi of Synovial Membranes.—Several cases of angiomata of synovial membranes are recorded by Eve.[1] They appear to be most common in children and young people, though not actually shown to be congenital. We have also seen a case of this kind. The importance of the condition lies in the fact that it may be mistaken for tuberculous disease, or if operated upon without due care may give rise to serious bleeding. In the case we

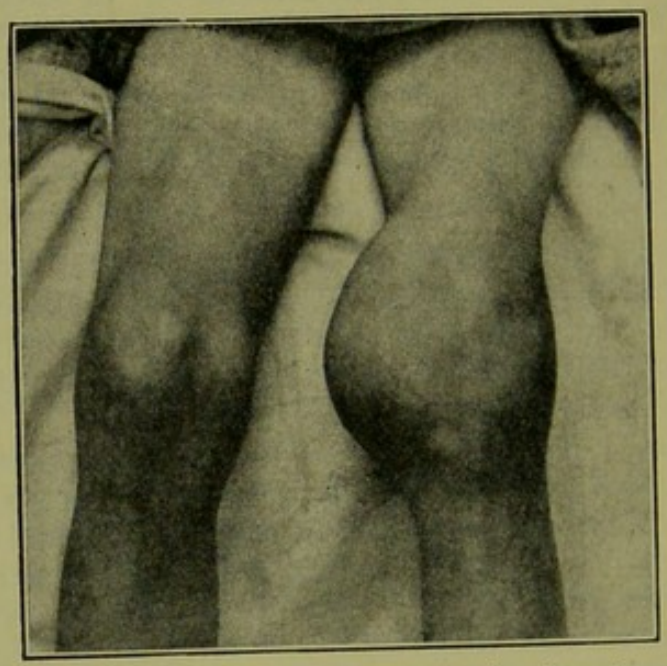


Fig. 171.—Hæmophilic Arthritis of the Knee in a Boy of 13 years. (Dr. Dreschfeld's case, 1905.)

saw the surgeon who cut into the swelling had to amputate the limb a few hours later.

(For 'Nævi of Joints,' *vide* also section on 'Nævus.')

Hæmophilic Arthritis, or inflammation following extravasation of blood into a joint in a child the subject of hæmophilia, may be met with as a sudden hæmarthrosis with acute inflammatory symptoms, or as a condition in which after repeated hæmorrhages chronic changes have occurred resembling those seen in chronic osteo-arthritis. One or many joints may be affected, and there may or may not be a history of injury. In the acute cases the joint is hot and painful and the symptoms usually slowly subside, leaving, after repeated attacks, weakness of the ligaments, thickening of the synovial membrane, with changes in the cartilage, which may become

[1] *Brit. Med. Jour.* May 16, 1903.

thickened, roughened, and fibrous. The bones also may be nodulated. Much crippling may result from this condition. The diagnosis usually depends merely upon the recognition of the hæmophilia, though we have seen tuberculous disease of the knee in a hæmophilic child.

The treatment is that of an ordinary synovitis, but more prolonged care is required, and in the chronic cases special precautions against further attacks are necessary, as each attack inflicts further injury upon the joint.

(*Vide* also under 'Hæmophilia,' p. 464 *et seq.*)

CASE.—A boy of 3½ years was seen in April 1901. At 3 months old he hurt his right hand; it swelled up and was black and very painful and did not get well for three months. At 14 months he had troublesome bleeding from a tooth socket. At Easter 1900 he had a scrotal extravasation after a fall. Other extravasations have followed slight blows. At the end of October 1900 he fell off a chair and the next morning the left knee was swollen; a splint was applied for two days, but the swelling never quite subsided, although he was able to run about afterwards. On January 7, 1901, the knee again swelled without known cause. A splint was applied and lotions and pressure employed. After use of the splint movement was begun, but the pain and swelling returned, and after a further rest of seven weeks, recurrence again took place.

There was no known history of 'bleeders' in the family, but all the relations on the mother's side had died except one sister, whose children had shown no signs of hæmophilia.

At the time of the child's visit he was found to be a delicate-looking boy with the left knee joint still full of fluid.

CHAPTER XXXI

HIP DISEASE

Hip Disease[1] in the ordinary sense of the term—i.e. tuberculous disease of the hip joint—is almost entirely an affection of childhood; thus only 73 patients, the subjects of this disease, were over twenty years of age out of a total of 619 cases collected by ourselves, and probably in most of these the disease had begun at an earlier age. It is somewhat more commonly met with in boys than in girls, and is much more frequent among the poorer than the well-to-do classes. Mention has already been made in general terms of the pathology and causation of the disease: that the hip may be taken as the joint in which primary tuberculosis of the bones forming the articulation is most frequent. Indeed, our own belief, based mainly upon examination of

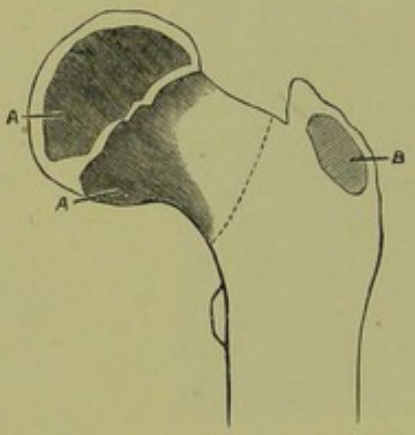


Fig. 172.—Diagram showing at A, A (in vertical shading) the parts most commonly affected in Hip Disease. B is the trochanteric epiphysis. The lower A points to the 'calcar.' (Altered from Barwell.)

Fig. 173.—There is a large sequestrum in the neck. The head, which is still cartilage-covered, but is almost detached, is propped up by a quill. Vascular perforations are seen in the marginal cartilage. Removed *post mortem*.

some 150 cases of excision of our own, is that in true chronic morbus coxæ, such as we ordinarily see, and also in the acute and rapidly destructive cases, the disease begins almost invariably in the bone. In older patients a primary synovitis is more frequent, but in children an acute, subacute, or chronic inflammation of the upper epiphysis of the femur or its neighbourhood is by far the most common condition. In some cases the disease begins in the neck of the femur, and when this is so it is generally the under surface that

[1] For a more detailed account of Hip Disease in Childhood than space allows here the reader is referred to the monograph by one of the present writers: *Hip Disease in Childhood*, by G. A. Wright (Longmans & Co. 1887). Also to a work by Dr. R. W. Lovett of Boston, 1892.

is attacked, and this is the part on which the greatest strain comes in injuries applied direct to the trochanter, and also the part least abundantly supplied with vessels (figs. 172 and 173).

In some cases the disease is primarily acetabular, but much more frequently the initial lesion is femoral, though rapid destruction of the acetabulum may occur secondarily. In one hundred cases of our own the acetabulum was necrosed or perforated in twenty-seven, but in many of these the disease was probably primarily femoral. The part of the epiphysis usually first involved is the immediate neighbourhood of the epiphysial line. The occurrence of synovitis of the hip joint is not, of course, denied by us, but we believe that two entirely different classes of cases come under observation : the one is a simple synovitis, usually traumatic, a lesion that occurs in the healthy and unhealthy alike, and is as amenable to treatment in the hip as elsewhere. The other class is one composed of tuberculous patients ; from some injury, or even slight overstrain only of the part, the cancellous tissue of the bone has its normal circulation slightly interfered with ; inflammation follows, and inflammation in a tuberculous subject is only too prone to follow the usual course of a tuberculous lesion, and the special anatomical features of the hip joint make it especially liable to serious and progressive disease. Necrosis of the pelvis or femur is common in the course of this disease ; thus in our first hundred cases of excision there were seventeen instances in which sequestra were found, either in or detached from the femur, and the acetabulum contained sequestra in twenty-two cases.

The naked-eye characters of a typical specimen from hip disease in an advanced stage are the following : The cartilage is all gone or hanging in tags or worm-eaten plates, or it may be merely loosened and thinned with a layer of granulations underlying it (fig. 174) ; the synovial membrane is red and vascular, somewhat thickened, but rarely to anything like the degree already described in the case of the knee joint. The bone, as seen in section, varies somewhat, but certain characters are very constant. Sometimes the whole upper epiphysis is detached and forms a hard, loose, marble-like sequestrum ; in a larger number the upper epiphysis is destroyed to a greater or less extent : sometimes only a small part of it is actually gone, but in all it is of a dull yellowish-white colour. In some late cases the colour is opaque, and the bone is putty-like, with or without obvious rarefaction ; in earlier cases there is a mottled appearance, patches of dark red hyperæmic bone alternating with dull yellow areas, and here and there a soft patch of granulation tissue. Sequestra may be present, and the epiphysial cartilage may be little altered, perforated, or entirely destroyed.

Fig. 174.—There is disease on both sides of the epiphysial line. On the under surface of the neck is the rough depression caused by pressure against the rim of the acetabulum. There was pathological dislocation. A section has been made through the upper end of the femur.

Occasionally the disease spreads far down the shaft ; more commonly the bone below the level of the great trochanter is congested, with more or less rarefaction, but no extensive disease. Corresponding lesions are found in the acetabulum, which is often rough and eroded, and its walls absorbed, so that the cavity is wider and shallower than in health. Occasionally there is very extensive caries or necrosis of the pelvis, and, indeed, nearly the whole innominate bone may be diseased. It must be remembered that even

when the pelvis is perforated there is a thick wall of dense fibrous material intervening between the pelvic organs and the joint cavity, so that, although the bone is bare on both aspects, and much of it requires removal, there is no danger of injury to the viscera. The joint itself usually contains pus and false membrane, with broken-down caseous granulations and detritus. The conditions commonly found in the acetabulum have been already mentioned; it should, however, be stated that in the later stages of the disease what is called 'travelling acetabulum' may be produced where repair to some extent is going on; the rim of the acetabulum is destroyed by what looks like a sort of ploughing-up process, and when repair begins new bone is formed higher up on the dorsum of the ilium to form a socket for the end of the femur. In some instances the innominate may be separated into its component bones, as in two specimens in our collection. (See fig. 175.)

In other cases suppuration may occur within the pelvis, either as a result of perforation of the acetabulum or of extension of inflammation through the thickness of the bone, or of pus, as it not unfrequently does, tracking over the brim of the pelvis and then gravitating downward. We have seen several cases where pus has burrowed up the sheath of the psoas and so got within the pelvic cavity.

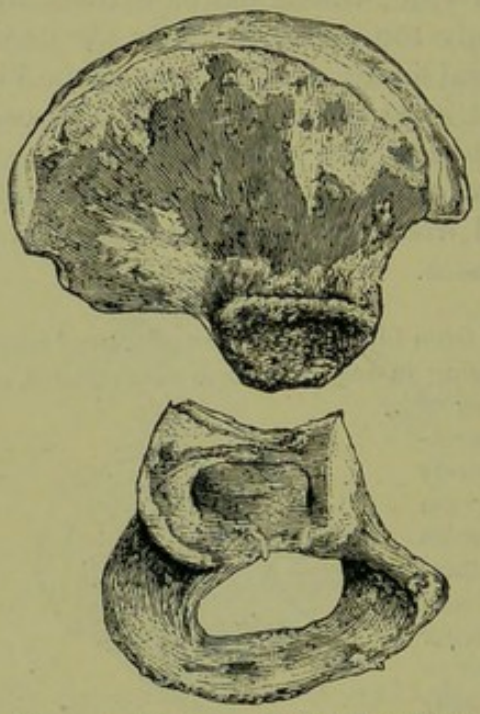


Fig. 175.—Shows extensive Acetabular disease. The ilium is completely detached from the other two bones, and is largely necrosed; white scale-like patches of new bone are seen on the surface. The disease was acute.

The remains of the head of the femur may lie in the little altered acetabulum, or be drawn upward upon the dorsum, or even project through the acetabulum into the pelvis; it has been found fixed to the acetabulum, though quite detached from the femur, or, rarely, firmly impacted, as we have seen it. The amount of acetabular disease depends, apart from the possibility of the origin of the affection there, upon the fact that when once the joint cavity is involved, a large surface—i.e. the whole acetabulum—is at once exposed to irritation, and so the process in it is more rapid; it also depends upon how much the head of the femur has been allowed to press upon the pelvis.

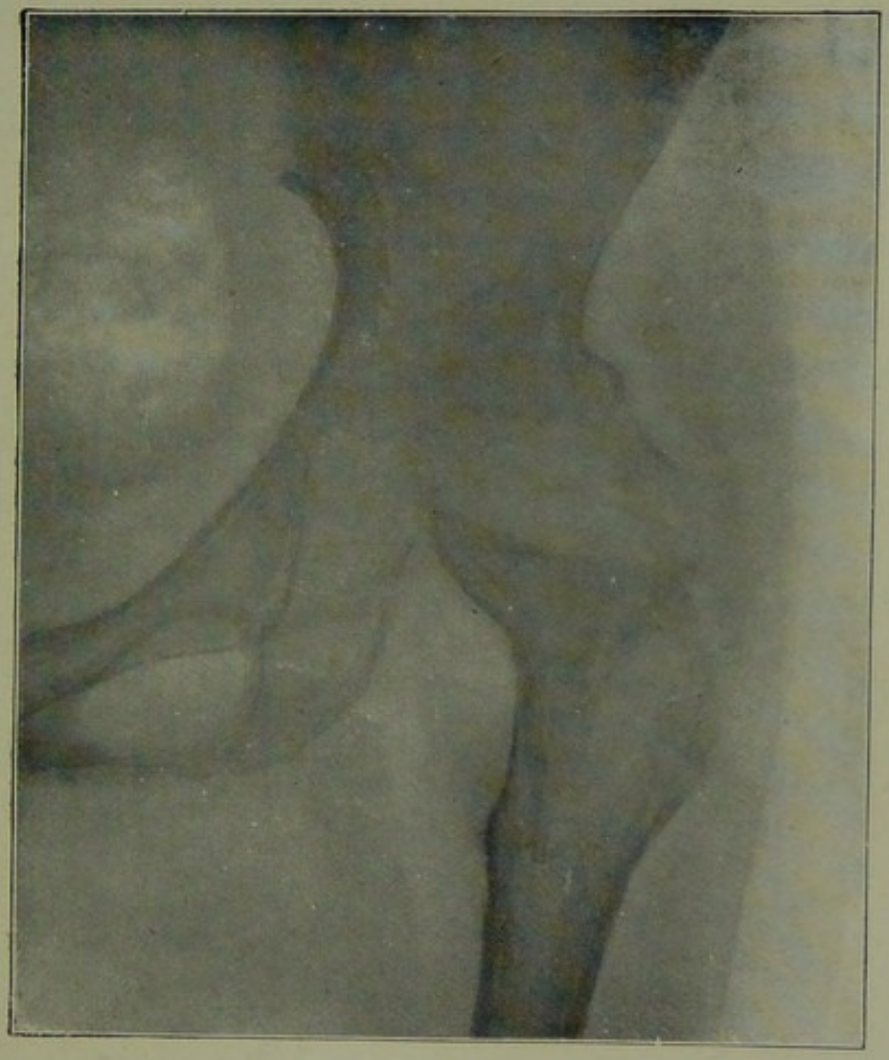
It is very rare to find any attempt at a new formation of bone while the disease is progressing, while, after removal of the upper end of the femur, new bone may be rapidly formed; in this, of course, the hip resembles other joints. The rapid formation of new bone after excision is a strong indication for that operation, in that it shows that nature is unable to begin repair until the disease is removed.

The etiology and pathology of morbus coxæ, then, may be summed up as follows:

1. Hip disease is a local tuberculosis.

2. Any slight or severe injury, over-use, &c., or the onset of a specific fever, may prove an exciting cause.

PLATE I.



Hip Disease, with 'travelling acetabulum.'

3. Injury in a healthy child may produce synovitis, or even acute inflammation of bone about the hip, as elsewhere, but this does not, except very rarely, lead to chronic hip disease.

4. In the vast majority of the cases of morbus coxæ the disease begins as an osteomyelitis of the upper epiphysis of the femur, or of the immediate neighbourhood of the epiphysial line, or not very rarely of the acetabular epiphysis.

5. This particular osteomyelitis tends to destruction, and usually runs a chronic course with caseation of the inflammatory material, and resolution can rarely, if ever, be expected when the disease is well established.

6. The occurrence of the disease in childhood is explained by the physiological and anatomical peculiarities existing before puberty.

Besides the common chronic hip disease, there is a form of **acute hip disease** which may run its course in a few weeks, or even days, and produce as much or more destruction of parts than months or years have done in the chronic cases. Instances of this condition are not very rare ; every hospital surgeon sees them occasionally. Some of these cases are probably pyæmic, others belong to the class of 'acute suppurative arthritis of infants' (*vide* p. 705) ; others, again, are acute traumatic inflammation, synovial or osteomyelitic ; possibly in some partial separation of the upper epiphysis may occur, with rapid necrosis ; others, again, are probably cases of acute periostitis of a nature similar to that occurring in the shaft of the femur, tibia, &c. These last may result in widespread suppuration and necrosis of the pelvis and femur. An acutely destructive condition may come on in the course of chronic disease.

Lastly, acute tuberculosis sometimes leads to rapid suppuration.

Symptoms.—In describing the symptoms of hip disease it will be convenient to take them one by one, and discuss the views and explanations of each symptom before passing on to the next, and finally to group them together in a type case.

Pain.—Pain is a prominent feature of most cases of hip disease from the beginning ; at least until complete disorganisation of the joint and displacement or destruction of the head or recovery.

The seat and degree of pain are, however, alike very variable. Thus pain may be referred to the hip itself, the buttock, the back or front of the thigh, the knee in front or behind, or any part of the leg or foot. It may be localised or diffused, so that the patient strokes the whole thigh down in some cases when asked where his pain is, and but rarely points to any one spot. There is no consistent relation to be made out between the seat of pain and the position or extent of disease. Probably the front and inner side of the knee is the most frequent seat of pain. Tenderness, however, is often much more localised to the position of the joint, but even that is very variable. Pain is, undoubtedly, often remittent ; sometimes an interval of some weeks intervenes, even without treatment, between the attacks. We have seen cases where the child had been walking about with a shortened, distorted limb, but had never had any pain from beginning to end ; and others, with large abscesses, who have also been throughout free from pain ; while the agonising pain of those who have to endure 'night starting' is only too familiar to all who have been residents in hospitals.

In considering the question of pain, it is well to bear in mind the number of different sources of nerve supply to the joint.

It is not practicable, nor very important, to distinguish by a knowledge of the nerve distribution the exact patch of synovial membrane or ligament that is locally inflamed : its only value, if it were possible, would be from a prognostic point of view ; but here history, duration, and other symptoms are more trustworthy. There is, however, no doubt that 'night pains' give us evidence of extension of the disease to the articular surface.

It is, then, clear that pain in cases of hip disease is variable in its seat, or rather that it may occur in a great many different places ; of these, special attention has always been paid to pain in the knee, and several explanations are given of this pain. In the majority of cases it is probably due to 'transferred sensation' from one of three sources, the anterior crural, the sciatic, or the obturator nerves, branches of which are distributed to the front and back of the joint. In our experience, the pain in the knee is generally rather vaguely referred to the front of the knee, the child passing its outstretched hand over the whole of the front of the joint. The pain is referred rather to the distribution of the anterior crural than to that of the obturator.

Pain in the hip is not usually a marked sign in the sense of there being any constant pain ; tenderness on pressure over the front or back of the capsule, and pain in pressing the trochanter inward or the head of the bone upward, is, of course, present in all acute cases, and in a large proportion of the chronic ones.

Night startings or pains are a prominent and important feature in acute and subacute cases ; they may be altogether absent in chronic disease—except where acute mischief has supervened upon chronic—and they may be absent throughout the whole course of a case. When they do occur, they indicate that inflammation has extended to the joint surfaces ; and further, that our means, whatever they may have been, of treating the lesion have been inefficient so long as these startings continue. Their cause is too well recognised to need discussing. The rigid muscles, acting under the influence of 'joint sense' (Barwell), contract spasmodically to fix and immobilise the joint surfaces ; as sleep comes on, with its accompanying muscular relaxation, some friction or pressure of the tender surfaces together takes place, causes acute pain, a sudden awakening with a cry, and a violent spasm of the muscles to fix the joint again. This may be repeated many times in a night, and is a strong indication for treatment. These night pains are very uncommon after excision : where they do occur they mean that disease is extending in the pelvis, and probably the femur is not kept sufficiently far away from the acetabulum to prevent pressure upon it ; in such cases, then, it is well to increase the extending force, though in some cases too great extension may increase pain. Tenderness or pain on pressure has been already alluded to. When superficial tenderness really exists, the fears of the child, if he has already been ungently handled, being taken into account, it means that suppuration has occurred in the soft parts and is becoming superficial, or, in very acute cases, it seems that really all the parts in the neighbourhood of the joint are hyperæsthetic ; it is certainly the case that in no joint does inflammation extend so widely among the soft tissues as in hip disease.

When, however, no pain is produced, except on deep pressure applied over the head of the bone, it is probable that the disease is limited to the bone, and has not yet set up mischief of any serious nature within the joint, or, at least, that any such change is a very chronic one. It is well to bear in mind that pressure on an inflamed ligament is very painful indeed—a fact easily verified in chronic synovitis of the knee—and it is possible that the pain in these cases may be due to extension of the disease to the capsule rather than to the inflammation in the bone itself.

Certain movements of the joint are more painful in case of inflammation than others, and it is true that a patient may have quite, or almost, painless power of flexion of the joint, and yet be quite unable to bear rotation or abduction.

Night startings may exist and be due to hip disease without any recollection of pain on awakening ; but Howard Marsh cautions us against mistaking the cries of nightmare for those of night starting.

It is well to remember that inflamed inguinal or iliac glands may cause pain and tenderness, which must be distinguished from that of the joint itself.

Lameness.—Limping or lameness is the symptom usually first noticed by the parents in the case of children with chronic hip disease. Even this, however, may be preceded by a feeling of tiredness or ill-defined aching about the limb after exercise, the aching passing off after rest, but recurring again after less and less exertion. The limping may be quite painless at first, and differs in appearance from the well-marked 'drop' seen in later stages, when there is shortening of the limb. At this time the child generally shows a tendency to rest the affected leg, and throw the weight upon the sound limb at every opportunity. Later, well-marked lameness comes on, and is accompanied by pain. It is at this time that the mistakes in diagnosis are so often made ; the obvious symptoms are lameness and often pain in the knee or thigh ; there is no other marked sign, and the condition is supposed to be disease of the knee or 'weakness' with 'growing pains,' and so on. This stage requires careful and exact investigation to discover it, and at the same time is the period at which treatment is most effectual. Later in the disease lameness is due either to actual shortening, or to tilting of the pelvis to take the strain off the tender limb, or to flexion.

Heat.—Increased temperature in the joint is, of course, only perceptible where the inflammation is acute, and from the thickness of the parts covering the joint is not readily ascertained ; it is not, therefore, a symptom of much value, except in the third stage, where superficial swelling combined with heat indicates the presence of suppuration outside the joint. In some cases of acute synovitis, pure and simple, a local rise of temperature may be made out, and is a valuable indication of acute inflammation of the soft tissues.

Swelling.—Swelling is one of the most important symptoms. In the first place, local swelling over the front and back of the joint—i.e. just external to the femoral vessels or pushing them forward, and just behind the trochanter, obliterating the normal hollow—indicates effusion into the synovial sac, and, with a recent history of injury, suggests an acute synovitis. With a longer history such swelling is due to the secondary inflammation of the joint by extension from osteomyelitis.

Swelling of the great trochanter indicates suppuration, or rather caseation within the joint, and when well marked we believe may be relied upon as pathognomonic of it; it is true that this thickening may disappear under treatment, but none the less has there been puriform material there which has been absorbed as far as its fluid portion goes, and if once that thickening has occurred we do not think any case is free from danger of relapse. This thickening results from extension of the disease from the interior of the bone to the surface.

Periarticular or 'adjacent' abscess certainly does occur, but not so commonly, we think, as some writers describe. Swelling of the inguinal glands is considered by Mr. Barwell to indicate osteitis. We would go even further, and say that when considerable it often indicates disease of the pelvis rather than of the femur. It is common to find some enlargement of inguinal glands in tuberculous children, but we think they seldom suppurate unless the pelvis is diseased. The condition of the iliac glands will be noticed again.

Muscular Spasm.—Spasm of the muscles around the hip is, as in the case of other joints, an almost universal condition—quite universal, if we except those cases of osteomyelitis where the inflammation is as yet limited to the bone, and the few cases where the joint is slowly and painlessly disorganised—cases already alluded to under the section on 'Pain.'

The spasm is due, as is well known, to two causes: reflex spasm from irritation of the terminal nerve filaments supplying the articulation, the stimulus being reflected in accordance with Hilton's laws to the muscles moving that joint—Barwell's 'joint sense'; and secondly, a voluntary contraction of the muscles to prevent movement of the painful surfaces the one upon the other.

It is well known to what the particular position of the joint in disease is due; flexion and abduction, as long as it remains a closed cavity, is the position of least tension, and therefore of least pain; the aggregate mass of flexors, too, is stronger than the extensors here as elsewhere, so that flexion is the position of rest.

The rigidity of the spasm is very great indeed, so much so that in many cases, without painful manipulation, it is impossible to say from mere physical examination that the joint is not ankylosed. In most cases, however, there is a certain limited range of movement allowed through, perhaps, 10° in the middle of flexion, and in many cases a considerably larger range, while in some it is only in extreme flexion and extension that spasm exists.

Nocturnal spasm has already been alluded to under the section on 'Pain.'

Fixation or Rigidity.—Fixation of the joint, apart from muscular spasm, may depend upon any one of three causes, but can only exist in the second or third stage of the disease, or as a result of quiescent or cured disease. The causes are adhesions within or around the joint, matting together of muscles so that their power is lost, or bony ankylosis. Chloroform at once reveals the nature of the rigidity, whether it is due to mere muscle spasm, when, of course, it will disappear; or to adhesion or permanent muscular contracture, when it can generally be sufficiently overcome to show that there is no bony union of the parts.

Grating or Crepitation.—Grating felt on movement of the hip joint can be produced by one cause only, the presence of exposed bone. This may be due either to erosion of cartilage allowing the bare head of the femur to grate against bare acetabulum, or to sequestra grating against one another, or to the upper end of the femur rubbing against its own bare and detached head. It is, therefore, where it can be felt, an absolute and pathognomonic indication of the presence of dead or carious bone. But it must be remembered that it can usually only be obtained under an anæsthetic, when free movement without pain can be procured.

Abscess.—The vast majority of cases of hip disease, unless seen in the early stage and adequately treated, go on to suppuration. A certain number of cases get well by the process of removal of the inflamed end of the bone without suppuration—a *caries sicca* ; but the greater number by far go on to the formation of pus. Yet of this number by no means all develop abscesses which open and discharge externally. Suppuration within the cavity of the joint takes place and even bursts the capsule, and yet, by absorption of the fluid and removal more slowly of the solid elements, the swelling caused by the abscess may disappear and the case recover. Still, we are convinced that nearly every case of chronic disease of the hip, if not cured in an early

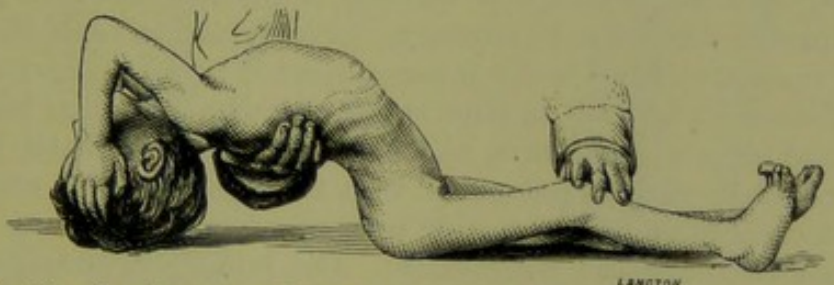


Fig. 176.—Showing the extreme Lordosis produced by partial correction of the deformity in a case where rectangular flexion existed.

stage, would be found, if the joint were examined, to contain pus or puriform liquid at a certain period of its course.

When the joint cavity suppurates the pus may take very various courses after it has burst from the joint, but usually it issues at the posterior part, sometimes on the inner, sometimes on the outer side. It may then pass forward beneath the rectus femoris and point at the anterior border of the tensor vaginæ femoris ; it may travel down the thigh and point at a lower part of the edge of this muscle ; it may gravitate backward and open at the upper or posterior border of the great trochanter, or, farther still, at the lower border of the gluteus maximus ; it may reach to the perinæum, extend along the adductor tendons, and come to the surface at the inner side of the thigh ; or, again, it may pierce the skin just at the inner angle of the fold of the groin between the scrotum or labium and the thigh. It may travel up the sheath of the psoas and point above Poupart's ligament, or, travelling over the brim of the pelvis, may then gravitate downwards and burst into the rectum or the ischio-rectal fossa, or escape through the sciatic notch. We have records of two cases where pus was discharged through the rectum, and we are inclined to think it is commoner than is supposed, and that the disappearance of abscesses about the joint is sometimes to be thus accounted for. A bad result does not necessarily follow, and some cases are probably

glandular abscesses not directly connected with the joint; in other instances fæcal matter has been discharged into the joint.

Abscesses in the neighbourhood of the hip not due to disease of that joint must be carefully distinguished from those which either directly communicate with the joint cavity or result from the breaking down of tuberculous matter in the walls of the articulation.

From the cases we have watched we think the conclusion may be drawn that when an abscess points on the front of the limb, above a line drawn through the upper border of the great trochanter, there is disease of the pelvis, and this is the more certain the higher and the more internal the opening. Abscess pointing between the scrotum and labium and the thigh we always look upon as of serious import, indicating pelvic caries. The peculiar conical projection to be felt on pressure above Poupart's ligament, as pointed out by Barwell, is rather due, in our opinion, to enlargement of the iliac glands than to periosteal pelvic thickening in many cases; like thickening to be felt by rectal examination at the site of the acetabulum on the inner wall of the pelvis, it is to be looked upon as a grave sign and one pointing to marked pelvic disease, and, as already stated, suppuration of glands is also suggestive of acetabular disease.

Wasting of Limb.—Muscular wasting of the affected limb is an early and prominent condition in hip disease—so early and so rapid that it is, and with good reason, ascribed to the result of trophic nerve changes rather than to mere disuse. The limb in later stages assumes a peculiar bulbous look, the thigh and leg are small, thin, and weak, while the hip itself is rounded, swollen, and distended as compared with the opposite side, and coldness and venous congestion are commonly present, often with œdema of the foot from venous or lymphatic obstruction. The bone, too, undergoes a great amount of atrophy, the denser layer is thinned, and the spaces of the cancellous tissue enlarged, so that the bone becomes diminished both in diameter and in strength. Such is the condition which has in several cases led to fracture of the bone in attempts at thrusting the upper extremity out of the wound in the operation of excision, and this is a fact to be remembered in the forcible straightening of the limb.

Arrest of growth under such circumstances is to be expected, and does occur, but to a much less extent than would be imagined, as will be seen in the section on 'Results of Excision.'

Outline of Region of Hip.—Two points are always described in connection with disease of the hip as being characteristic of it—loss of the fold of the groin, and flattening and widening of the buttock with lowering and partial obliteration of its fold. These conditions are worth noting, although they are not always present, nor always characteristic of hip disease when they are present. The fold of the groin is most completely obliterated when the limb is abducted and rotated out, especially if there is also swelling of the front of the joint or glandular enlargement. On the other hand, the fold is exaggerated in adduction and rotation inwards; in this position in girls the labium will be compressed, flattened, and partially or entirely hidden.

The *rima natium* is inclined upwards and towards the diseased side, which is simply the appearance produced by lowering of the buttock in the second stage; in the third it of course takes the opposite direction.

Dislocation and Shortening.—The older writers on hip disease spoke of dislocation as one of the common results of the destruction of the joint. Probably they were misled, in the absence of actual dissection, by the shortening, adduction, and inversion of the limb which occur in the third stage.

As a matter of fact, it is probable that without injury true dislocation of the head of the femur out of the acetabulum rarely occurs. Several conditions may exist and give rise to the appearance of dislocation, the most common being destruction of the head of the femur ; the truncated upper end of the bone is then drawn upwards by the muscles attached to the trochanters, so that the upper border of the great trochanter rises above Nélaton's line ; here, as the head of the bone no longer exists, true dislocation can hardly be said to have occurred. Occasionally, however, true dislocation of the head of the femur on to the dorsum does occur—we have met with several instances of it.

Fig. 177.—Shows the position assumed in the second stage of Hip Disease. Flexion, abduction, rotation outwards, apparent lengthening. Right hip disease.

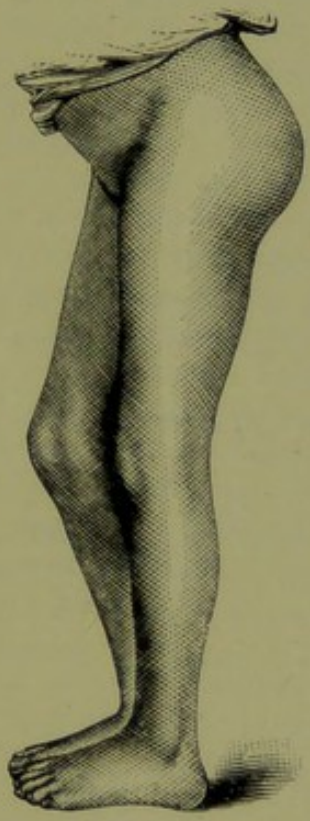


Fig. 178.—A side view of fig. 177.

Apparently lengthening of the limb is due to a lowering and throwing forward of the pelvis on the affected side ; apparent shortening, on the other hand, to the pelvis being raised and thrown behind the sound side. Or, to take the same fact in another way, the apparently lengthened limb is flexed and abducted, the apparently shortened limb is flexed and adducted, the two conditions being usually, but not always, associated with rotation outward and inward respectively.

Taking the usual classification of the course of the disease into three stages, the position assumed successively by the limb will be—in the first

stage, flexion to a variable degree, with or without slight abduction, and possibly rotation outward; in the second stage, flexion, usually well marked, with abduction usually, and rotation outward, producing apparent lengthening—sometimes, however, there is adduction, and sometimes mere flexion, with no rotation, or with rotation inward; in the third stage there is always flexion, and most commonly adduction and rotation inward, with apparent or real shortening, but there may be abduction and rotation outward. Thus position, though a valuable, is not an absolute guide, and requires to be checked by the other symptoms present.

Diagnosis.—The diagnosis of disease of the hip is as difficult in some cases as it is easy in others. In well-marked cases where the disease is advanced it usually is quite readily diagnosed, while, on the other hand, few diseases are so closely simulated by a large number of other affections as disease of the hip, and the variety of symptoms that it presents is in itself a fruitful source of mistake. It will, perhaps, most conduce to a clear understanding of the subject if we first tabulate the diseases for which hip disease is most likely to be mistaken.

1. Acute rheumatism.
2. Bursitis of the psoas or one of the gluteal bursæ.
3. Ostitis or periostitis of the great trochanter.
4. Periostitis of the upper end of the femur.
5. Sacro-iliac disease.
6. Psoas abscess.
7. Iliac abscess.
8. Gluteal abscess, traumatic, or spinal.
9. Abscess connected with disease of the pelvis.
10. Appendicular abscess, suppuration around the sigmoid flexure of the colon, pelvic glandular abscess, or chronic adenitis, or possibly renal disease.
11. Superficial abscess, glandular or other, and deep abscess around the joint.
12. Infantile paralysis.
13. Syphilitic synovitis or telostitis.
14. Hysteria.
15. 'Congenital dislocation' of the hip, or other congenital conditions.
16. Rickets, including coxa vara.
17. Disease of the knee.
18. Fracture of the neck of the femur, separation of the upper epiphysis or dislocation.
19. Acute synovitis.

Of these diseases only a few of the more important need be selected here. Inflammation of the gluteal bursæ, of which that between the gluteus maximus and the great trochanter is the most commonly affected, may simulate hip disease. In this case a large gluteal abscess may be mistaken for abscess connected with the joint, or if the abscess has burst the long track left may lead upwards, and be indistinguishable from one communicating with the joint; the absence of shortening, of adduction, or of grating on movement of the joint, which will also move freely through a certain range, absence of pain on movement, and of fulness in front of and behind the joint, are the diagnostic points.

Disease of the great trochanter is more difficult to distinguish, and it must be remembered that inflammation may extend from the shaft to the joint; but, although in trochanteric disease sinuses may exist in the same positions as those in which they are found in morbus coxæ, the smoothness and freedom from grating, as well as the wide range of mobility of the joint, will serve to distinguish between the two; other abscesses in the neighbourhood of the joint are recognised by their history, which is usually too short for chronic hip disease, and not acute enough or sufficiently severe for acute joint inflammation. They are also recognisable by the freedom and smoothness of the movements of the joint through a certain range, even though that range may be a limited one. Absence of pain and tenderness in some part of the joint circumference will be contributory evidence.

Infantile paralysis simulates hip disease in the lameness to which it gives rise, but is distinguished from it by the absence of pain and swelling, and especially by *freedom of mobility*, and by an amount of wasting and coldness of the limb disproportionate to the other symptoms, as well as by the history of the disease; it is, however, worth noting that in the 'British Medical Journal' for 1877 Mr. Savory records a case of acute hip disease in a leg affected by infantile paralysis.

Syphilitic disease is distinguished by other evidences of syphilis, by the slight tendency there is to suppuration, and by its amenability to mercurial or iodide treatment. We have, however, seen chronic hip disease in a congenitally syphilitic child.

Sacro-iliac disease and psoas abscess may both simulate hip disease in regard to the position in which they give rise to pain, and as to flexion of the joint; it is, however, only necessary to examine the spine and sacro-iliac articulations to find in most cases symptoms incompatible with disease of the hip alone, while in simple psoitis flexion and inward rotation are free.

It must be remembered, at the same time, that the abscess within the psoas sheath, resulting from either of these diseases, may open into the hip joint, and so a secondary hip disease may be developed. It is not, we believe, very rare for psoas abscess to do so; and, although we have only had one opportunity of verifying the fact *post mortem*, we have in several instances believed such to be the case. Spinal caries and hip disease may, of course, co-exist independently of each other, and this is not rare. It is sometimes impossible to be sure that disease of the hip does not exist where an iliac or psoas abscess has burrowed down and surrounds the hip joint on all sides; the symptoms are then often identical, and only the discovery of the spinal or iliac disease can clear up the case. In other instances free mobility of the joint through a certain range in all directions excludes hip disease. Rectal examination enables us to distinguish between hip disease and spinal gluteal abscess, since in the latter the abscess can be felt to extend upwards over the brim of the pelvis.

Abscess connected with the cœcum, or sigmoid flexure, is not uncommonly mistaken for hip disease. Such cases closely resemble iliac abscesses from other causes, with the addition of symptoms indicating connection with or proximity to the large bowel.[1]

[1] *Vide* paper 'On Some Forms of Abdominal Abscess occurring in Children,' by G. A. Wright, in *Arch. of Pædiatrics*, 1884; also *Lancet*, 1890.

Congenital atrophy of the femur is not likely to be mistaken for recent disease, but may, perhaps, be a result of intra-uterine affection of the joint.

One of the commoner sources of error is enlargement of the iliac or of the inguinal glands; pain, lameness, flexion, and some rigidity of the joint are found; on examination by deep pressure above Poupart's ligament the enlarged glands may be felt, and palpation is painful; careful search, however, will show rigidity only in extension or slightly in abduction as well, while flexion, abduction, and rotation are free; there is no trochanteric thickening and no evidence of effusion into the joint. It must be remembered that the glandular enlargement may be due to hip disease itself.

It is always well to use the 'method of exclusion' in doubtful cases, and to bear in mind that there is no one symptom pathognomonic of hip disease, but that, as in other morbid conditions, several factors have to be taken into account in forming a diagnosis. *Free, smooth, painless mobility is perhaps the most satisfactory evidence of the absence of hip disease.*

To sum up the diagnostic points of hip disease. A patient who is a child, who walks lame, especially after a little exercise, who has thickening of the trochanter, some tenderness on pressure over the hip joint, and pain, together with slight flexion and some immobility of the joint, without evidence of spinal or sacro-iliac disease or pain in any part higher than the hip, and in whom pain is increased by abduction or rotation inwards, has got disease of the hip. We would here lay stress upon the fact that there is not the smallest necessity for hurting a child in an examination for hip disease. It is true that pressure upon the trochanter or heel, what is expressively called by American surgeons 'crowding the joint surfaces together,' gives rise to pain in disease of the joint, but it is neither a necessary nor a pathognomonic sign. Night starting is a valuable, but not a constant nor always trustworthy symptom. Later in the disease the problem is usually easily solved, but not always, for, as indicated above, disease of the trochanter or abscess around the joint, as well as bursitis, may resemble hip disease very closely; in such cases the position and swelling of hip disease, as well as its rigidity, are very closely simulated, and we must rely on other points. Such conditions can, however, only be mistaken for the later stages of the disease, in which there will be shortening of the limb, raising of the trochanter, and probably grating in the joint if examination is made under chloroform. It is only occasionally that we see a child in quite the first stage before the mischief has reached the surface of the bone; in such case pain, lameness, slight flexion, and slight rigidity are the principal signs. Usually the patient is brought in the early second stage, when trochanteric blurring is found.

Believing, as we do, that chronic hip disease in children begins invariably, or nearly so, as an osteomyelitis, we cannot follow Barwell's distinctions in the diagnosis of this condition from synovitis; but see p. 727. We do, however, think that *acute* synovitis can be distinguished from the early stages of true hip disease by the greater pain on movement of the joint, with absence of trochanteric thickening, and under chloroform free and perfect mobility; there may be also swelling in front of the joint, but this depends upon the amount of the effusion. In simple traumatic synovitis the mischief

immediately follows the injury, while in the bone lesion there is usually an interval of two or three weeks, or often months, between the accident and the onset of symptoms ; thus the child falls, cries for a few minutes, but is then well again, and in a month's time begins to limp. This evidence of the history is most important. Careful inquiry should always be made in every case for any previous trouble about the hip, since the acute symptoms may be grafted upon old latent disease. We have seen a case in which recovery from hip disease was nearly complete, when the parents took the child to a quack who forcibly moved the joint ; several weeks elapsed before the effect of this violence was seen in a recrudescence of the disease.

Acute osteomyelitis is readily diagnosed ; great constitutional disturbance, fever and prostration, great pain, amounting to agony on the least movement, *helplessness of the limb*, rapid and extensive swelling, with venous turgidity, make the diagnosis easy.

Prof. Howard Marsh gives us most useful information on the diagnosis of hip disease. Thus, he points out that, though flexion may be free in some cases, the flexed limb is carried into abduction, and not straight up towards the abdomen ; again, flexion may be limited in cases of gluteal, or extension in cases of psoas abscess, but in hip disease both are limited in their more extreme degrees, even if free in part of the range of mobility. His caution as to the dangers of frightening the muscles into spasm is also well worth remembering. In examining children it is always wise to manipulate the sound limb first, as this gives the child confidence that he is not going to be hurt, and he is less likely to voluntarily hold the joint stiff. Rectal examination for thickening of the inner wall of the acetabulum we have found to be of great value in doubtful cases, and it certainly should be employed if there is any suspicion of primary acetabular disease ; under such circumstances it may be the only way to clear up the doubt. An excellent account of it is given in Dhourdin's work, 'De la Coxalgie Cotyloïdienne.'

In examining a child for suspected hip disease in an early stage the course of procedure should be as follows. First, the child's confidence should be gained, so that it will not be afraid ; next, all clothing should be removed and a blanket wrapped round the patient, who should be allowed to walk to a flat hard couch or table covered with a rug. The position of the limb and the child's gait should be carefully watched. Then, with the child lying straight and flat upon its back, any abduction of the limb should be looked for, an imaginary test line passing downwards from the middle of the sternum through the umbilicus and pubes being taken as the guide. The length of the two limbs, taking into account the pelvic tilting, is now to be compared. The next point is to notice whether the affected limb is put down flat upon the table—i.e. whether the thigh and knee are flexed or the back arched (lordosis)—also whether there is any wasting of the limb. The surgeon should then take the *sound* limb gently in the hand and fully flex it, looking for any movement of the pelvis ; as soon as the full degree of flexion has been ascertained the affected limb should be very gently raised and its range of mobility compared with that of the sound side, a finger being kept on the anterior superior spine of the ilium to feel for any tilting of the pelvis. Should there be any lordosis due to fixed flexion of the hip,

this will disappear as the limb is raised and be increased by extending the leg. The finger, or better the thumb, should then be gently pressed into each iliac fossa to feel for swelling there, due to enlarged glands or the presence of an abscess; fulness below Poupart's ligament should also be looked for. If no restriction of movement has been found, abduction, adduction, and rotation should be tested and the two sides compared.

The child should next turn over and lie on its face—it is generally better to allow it to turn in its own way; the shape of the buttock, the thickness of the trochanters, the gluteal fold, and rima natium are now inspected and the range of extension further investigated. The spine and sacro-iliac joints should be examined at this stage, swelling of the knee joint and thickening of the shaft of the femur having been previously searched for. If there is still a doubt, a finger should be passed into the rectum, and the inner wall of the pelvis examined for thickening, or abscess, or enlarged glands; for this proceeding it is often necessary to give an anæsthetic. Where disease begins in the acetabulum, but has not yet reached the cavity of the joint, pain and slight lameness may be the only obvious symptoms. Mobility of the joint may be almost perfect. In such cases the presence of thickening felt per rectum as well as by deep pressure in the iliac fossa is all-important as a means of diagnosis.

No one symptom alone is sufficient for a diagnosis in early stages, but limitation of movement to some extent, and trochanteric thickening, are perhaps the two most valuable signs of joint disease.

We would here deprecate the use of any of the means of diagnosis which necessitate giving pain to the patient. The presence of disease is recognisable by the painless mode of examination in all cases where it can be made out at all. In all cases examination for hip disease should be made with the child completely stripped, and lying on a *flat hard* couch or table.

Prognosis.—As regards the prognosis and the results of affections of the hip joint when treated by means other than operation, it is necessary to distinguish clearly between the two morbid conditions of acute synovitis and osteomyelitis, acute or chronic: the former recover perfectly with freely movable joints under proper treatment, and show no after ill effects, though the treatment required is usually longer than that for other joints. On the other hand, cases of true hip disease, *unless effectually treated in the early stage*, very rarely recover without more or less destruction of the upper epiphysis of the femur, usually accompanied by abscess, and always result in shortening with more or less deformity, and a very large majority die before reaching adult life.

Even when tuberculous disease of the hip seems to have subsided, relapses are exceedingly common after some slight injury or intercurrent illness. It is important, however, to distinguish between relapses due to a fresh lighting up of disease and the presence of an abscess the result of irritation by some quiescent local product of former inflammation—the residual abscess of Paget.

As to the usefulness of the limb after recovery from hip disease without operation, more or less shortening is to be expected in all cases, either as a result of malposition, retraction of the femur upon the dorsum ilii, actual

destruction of bone, or arrest of growth of the femur; the last is the least important factor, since increase of length in the femur takes place almost entirely at the lower end, and what shortening there is is due rather to general arrest of growth of the limb than to destruction of the upper growing line.

In private practice, where hip disease is seen early and treated more effectually than it can be in hospital practice, the prospect of recovery is much better, though even here a perfect result is rare; it will, however, be obtained under exceptionally favourable conditions. A movable joint may be obtained where the disease comes under treatment in its early stage, or even after destruction of the joint there may be a certain amount of mobility, though this is less frequent than it is after excision.

In fatal cases of hip disease death is generally due to tuberculosis or exhaustion, with hectic or lardaceous disease; sometimes an intercurrent exanthem proves fatal. Hence it is seen that the prognosis depends very largely upon whether early and efficient treatment, of which that by Thomas's splint is undoubtedly the best, can be obtained. The cases least likely to do well without operation are those in which there is a great amount of thickening, and those in which, in spite of fixation, pain continues, while under any

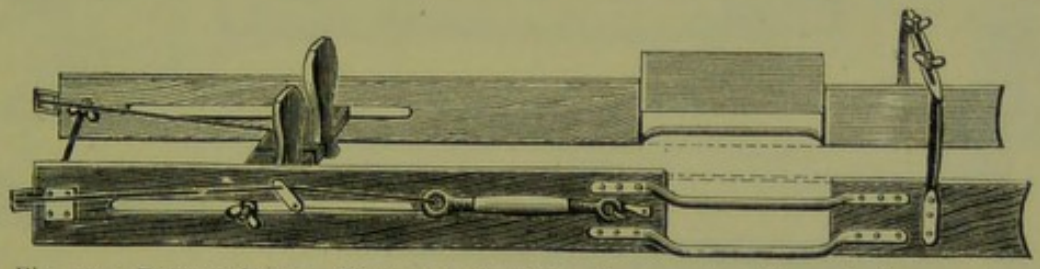


Fig. 179.—Bryant's Splint. We have had sliding pieces made to fill up the interruptions when required this is seen in the figure.

circumstances the prognosis is bad if there is extensive pelvic caries (not necrosis).

Treatment.—First, the ideal treatment consists in seeing the case early, keeping the child in bed until by simple extension or a Bryant's splint the limb is straightened; then a Thomas's splint should be applied,[1] and the child allowed to get up and about, out of doors, by the seaside. Good food, cod-liver oil and iron, with occasional administrations of rhubarb and soda if any dyspeptic troubles appear, comprise the rest of the management. Two years should be the time given for rigid treatment; after this the splint may be gradually laid aside, and the child allowed to go about with a patten and crutches for a few weeks; if there is still no sign of disease, walking upon the affected limb may be gradually permitted. During the time of treatment the greatest care must be taken not to allow the foot of the affected side to touch the ground, and to avoid all falls or strains of the joint.

American surgeons use to a great extent 'traction splints' of various forms, in which, while the patient gets about more or less, extension is kept up.[2] The weak point in most of these appliances is that the joint is not fixed,

[1] Or the limb may be straightened by means of the Thomas's splint.

[2] For a good account of these splints we must refer to Dr. Lovett's work on *Disease of the Hip*, 1892.

though fixation of the joint is now pretty generally recognised as essential, and Thomas's splint is we believe more constantly used.

In hospital practice the nearest approach to the above lines of treatment should of course be carried out, but *if there is progressive disease*, and the management is unsatisfactory, the question of operation must be considered. If sinuses exist with receding disease, diminishing discharge, and puckering in of cicatrices, or if with an abscess the mischief is quite quiescent or receding, non-operative treatment should be adopted for a time, if it can be thoroughly carried out ; if not, or if no progress is made in a few weeks, the diseased part should be removed.

In applying extension by weight it should be made an invariable rule to make traction from the condyles of the femur, and not from below the knee. A case is on record in which prolonged extension applied below the knee resulted in separation of the upper epiphysis of the tibia. It is also objectionable in that it throws strain upon the knee joint, and is more apt to slip off.

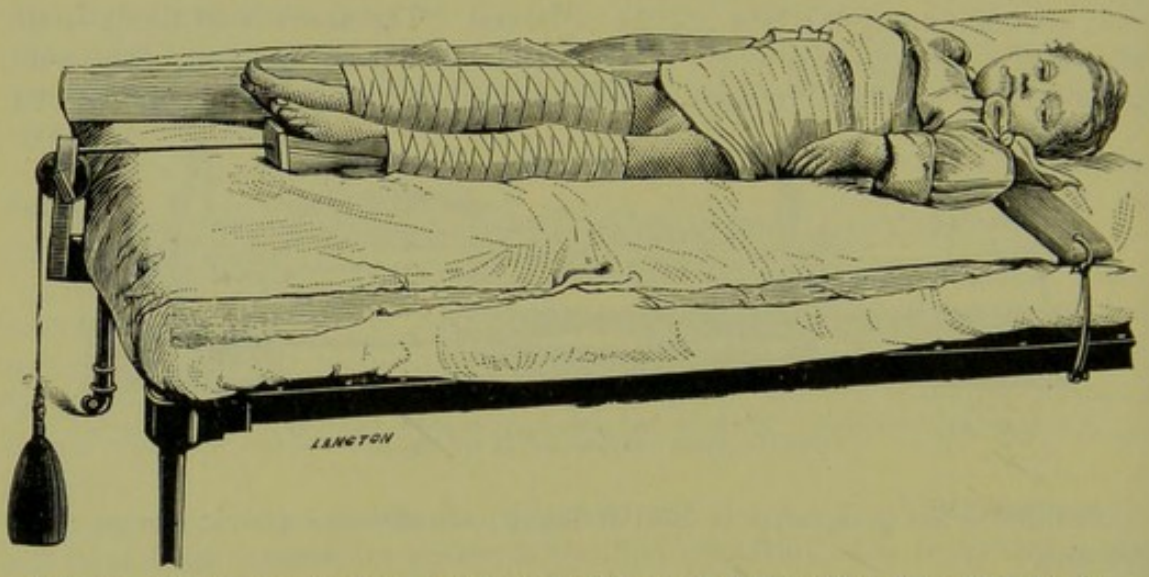


Fig. 180.—Shows extension by a weight applied above the knee, with a long splint on the sound side. Also the simple plan of keeping the child from sitting up by means of the board running behind the shoulders and fastened to the side of the bed. The shoulders are fastened to this board, and the arms are left free below the elbow. The bed on which the child lies is somewhat too soft.

The strapping should always, if possible, be applied for some hours before the weight is attached, in order that the plaster may get set, and not be dragged off by the weight. The strapping (of which Leslie's brown holland is the best) should be kept from the skin by a strip of lint or flannel bandage, or part of a stocking, to protect the sharp edge of the tibia and the prominences of the joint from pressure (fig. 180).

We have found that too great extension may be a cause of painful spasms, and it is well to bear this in mind, that too great extending force and too little are alike inefficient. In cases where treatment without operation is carried out, as for instance where adhesions, the result of old inflammation, exist, or muscular contraction has taken place, the deformity may be remedied in many instances by the ordinary extension apparatus, by a weight or by Bryant's splint. In other cases, where simple extension is inefficient, or too tedious, it may be necessary forcibly to straighten the

limb under chloroform, and then fix it by splints in its new position. The advisability of forcible straightening is a somewhat disputed point and is not in all cases free from risk, not only of laceration of important structures, but of setting up fresh inflammation in the joint or what remains of it.

Prof. Howard Marsh,[1] and in 1836 Sir Benjamin Brodie, advised that the extension should be made in the axis of the misplaced limb, and that the direction should be altered as the limb regains its normal position. We do not think this a matter of great importance. If it is desired to carry out this plan, probably Hodgen's splint for fracture of the thigh would be the most efficient apparatus.

It is sometimes a matter of difficulty to remedy the malposition of the limb in cases of fixation in combined flexion and adduction or abduction. Here, where possible, gradual reduction by a Bryant's splint is the best treatment (fig. 179) ; failing this—and it cannot be always used—a long splint on one side, with a weight to the mal-placed side, should be tried (fig. 180) ; and, failing this, careful straightening under chloroform. Where there is much abduction Volkmann applies a weight to each leg, the heavier one being attached to the sound side (A. H. Tubby). These methods are, we think, better than remedying the deformity by weights applied laterally. In more acute cases, where the deformity is mainly due to spasm, gradual extension is best, but by some means the limb must be got as quickly as possible into good position.

Thomas's apparatus is a very valuable appliance, and is undoubtedly the best splint we have for patients able to be up (figs. 181 and 182). The splint requires careful attention to detail, both in fitting it and in management ; it is of use, first, in the early stages of disease, where it is possible to give the child the chance of long-continued and perfect rest, with general hygienic measures ; and, secondly, after excision, to keep the limb quiet for a time until the parts are sufficiently consolidated to allow of movement being begun. We have habitually used it for many years.

The question of when to excise a hip joint is no doubt a difficult one, but the conclusion we have come to is this. Treatment, short of excision, when once suppuration occurs, is, *if the disease is progressing*, useful only as a palliative. Our opinion, bearing in mind Mr. Holmes's valuable remarks on the social circumstances of these patients, is that where there is an abscess outside the joint, or, without this, great trochanteric thickening, with much pain that does not yield to treatment by rest and efficient cleaning out of the 'abscess,' excision ought to be performed. In private practice cases are usually seen in the first or early second stage, and it is possible to ensure that the Thomas's splint shall be kept on and no strain thrown upon the joint : hence recovery without operation is the rule. We have not excised more than half a dozen hips in private practice. While fully aware that abscesses disappear and tuberculous lesions cicatrise under favourable circumstances, we think that in the case of the hip delay is unwise among the hospital class, with whom it is as yet impossible to deal on the same lines as with the well-to-do. In almost every instance we have found much more extensive disease than might be expected from the external evidence,

[1] *Brit. Med. Jour.* July 1876.

unless the pathology of the affection is borne in mind, and we believe that, once this chronic osteomyelitis is fully established, excision *in a large proportion of hospital cases* is the proper course. Nature, of course, in many cases will, unaided, get rid of the dead bone by slow and tedious processes, but the number of children who can survive the process of elimination is very small, while the mortality after early excision is not great, and the failures are mainly in those instances where the operation has been put off till too late. Where actual necrosis, or caries of the head of the femur, with destruction of bone and cartilage, and often sequestra of varying size in the acetabulum, or at least caries of it, is known to exist, we think few advocates of non-operative treatment will be found. It is then, as Mr. Bryant points

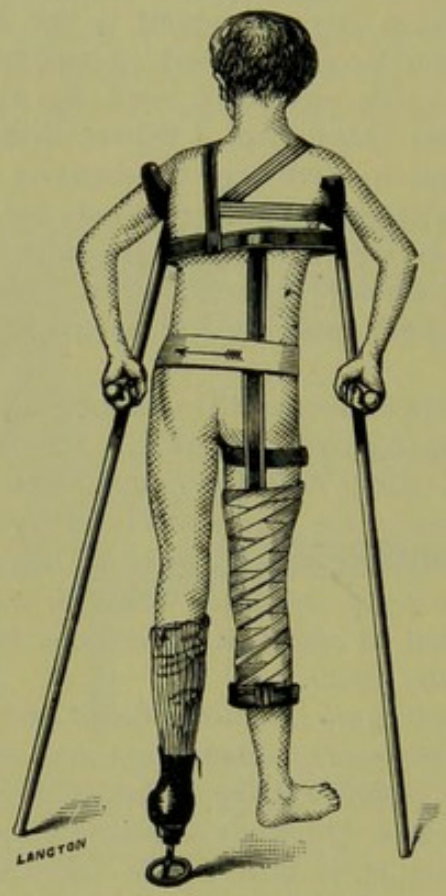


Fig. 181.—Thomas's Hip Splint, applied. Slightly altered from Mr. Thomas's work on the 'Hip, Knee, and Ankle.'

Fig. 182.—Thomas's Hip Splint adjusted for a case with no deformity.

out, to be looked upon rather as an ordinary operation for necrosed bone than anything more formidable; and that this is the state of the joint even in cases often spoken of as those of early disease, is the fact upon which we should like to lay stress.

While we advise excision in all cases in which the disease *progresses in spite of adequate treatment*, we have come to the belief that modern methods of abscess treatment and efficient use of splints have enabled us to reduce the number of excisions. Thus in seven years, 1886-1893, 83 excisions were performed, while in five years, 1894-1898, 31 excisions of the hip were done at the Children's Hospital by the writer.

It is necessary of course to distinguish sharply between abscess the result of progressive disease and residual abscess ; it is in the former that the question of excision arises. Where the disease is quiescent, abscesses may well be dealt with by the method already described, of thorough cleaning out and closure after injection of iodoform emulsion. We are not disposed to think that mere injection of iodoform into tuberculous joints without removal of the original focus of disease will be successful to any great extent. It is undoubtedly useful in some cases to deal with the abscess first, and, when that has healed, to remove the diseased bone by a second operation under more favourable conditions. The operation of excision is discredited because it is put off until disease is so far advanced that no mode of treatment can have more than a small proportion of good results ; while timely excision cuts short the disease, saves pain, lessens the time of treatment, and gives a better limb.

We have in the last edition of this book considerably modified our statements in former editions as to excision. We do not perform excision now as frequently as we did in former years. Cases of hip disease are brought, we think, earlier than they formerly were, the treatment of them has been more efficient before they are brought to hospital, and the treatment in hospital is also better. Probably a no less important factor in the reduction of excision operations is the great advance in the treatment of 'abscess.' The modern method of thoroughly cleaning out the cavity with removal of all detritus and closing it again completely by suture reduces a certain number of these cases to a condition nearly corresponding to early disease. Hence we have reduced, and hope still further to reduce, the number of cases of disease in all joints which require radical operations. While thus recording with satisfaction our belief in the important advance made of late years in the treatment of joint disease, we still urge the importance of excision in every case in which in spite of good treatment the disease is progressive, and not only this, but excision before the disease has gone too far. If we leave it as a last resort we shall diminish the number of excisions, but increase the roll of amputations and deaths. Excision must of course always be necessary where pelvic or extensive femoral necrosis exists.

Modes of Excision.—Various incisions for removal of the upper end of the femur have been advocated. Of these the incision over the middle of the trochanter and slightly concave forward is the one we usually adopt. We see no advantage in most of the others over the one extending downwards for about three inches, more or less according to age and the extent of the disease, along the middle of the trochanter. Where, however, it is proposed to remove a large part of the pelvic wall, a flap operation is desirable, and we have frequently used it ; the flap incision has the advantage of freely exposing the diseased area and allowing thorough cleaning of the soft parts, and by chiselling off and turning up the trochanter with its muscles attached the power to move the limb subsequently is likely to be greater.

Next, if a flap is not made, the soft parts should be divided vertically above the trochanter and the capsule opened freely, if this has not been done by the first incision. The joint should then be explored with the finger.

The next step is to separate the soft tissues from the bone on the inner side, stripping back the periosteum as far as it exists as such. The finger

should then be used to pass round the bone and feel that the upper end is free ; next, still using the finger as a guard at the inner side of the bone, the femur should be sawn through just below the trochanteric margin with a keyhole- or finger-saw. Some part of the trochanteric epiphysis is usually left behind. The upper extremity of the bone is then prised out with the finger or raspatory. The acetabulum should be then examined and any sequestra removed. If there is a large carious surface, it may be gouged or scraped with a Volkmann's spoon or left alone. It is well to remove any rough or semi-necrosed bone, but we doubt the possibility of being able to remove all the disease without greatly adding to the severity of the operation where there is extensive inflammation without necrosis, nor is such treatment desirable.

The upper end of the femur should be examined to see if the whole disease has been removed ; if not, a further section should be made, and this may be carried a considerable distance down the shaft ; six inches have been removed with a good result, and but little shortening, by an American surgeon.

Here it is well to point out the danger of the practice of thrusting the head of the femur forcibly out of the wound before sawing it through, instead of dividing it *in situ*. Several cases of fracture of the shaft of the atrophied fatty bone have occurred. An additional objection to this practice is the ease with which the periosteum may be thus stripped oft the inner aspect of the shaft, and so necrosis may occur.

The operation is much more easily and safely done in the way described, and involves less violence to and less division of the soft parts. The finger is quite as good a guide as the eye to the condition of the bone.

Usually no vessels require ligatures, though there is sometimes free oozing of blood. If the wound can be made aseptic, it should be carefully cleaned and closed by sutures after injection of iodoform emulsion ; if the case is one with old-standing sinuses, we prefer to leave it quite open, and in that case a large drainage tube should be passed deep into the cavity of the joint. Any sinuses or abscess cavities should then be thoroughly scraped out and well cleaned before applying the dressing. We sponge over the cavity freely with pure turpentine before closing it. It will often be found that a distinct membranous layer of lymph lines the cavity of the articulation, but there is rarely anything like the thickness of granulation tissue so often seen in the knee and other joints. It is well to remove any masses of pulpy granulations should they exist, but anything like the elaborate dissection required in erasion of the knee is impracticable.

In many cases we make our section through the neck of the femur, but in some cases the head of the femur is so far destroyed that it would be impossible to do less than take away the trochanter, while the trochanter if left in cases that require drainage tends to block up the orifice of the wound and prevents the free escape of discharge and *débris* of bone, and thus interferes with one of the main objects of the operation. This argument does not, of course, apply where it is possible to close the wound entirely. The Clinical Society's Committee advised that the trochanter should be left unless diseased, or unless there is extensive pelvic disease, and where the flap operation is employed it must be left.

Where intrapelvic abscess exists the acetabulum should be perforated. Examination per rectum enables the diagnosis to be made if this condition is suspected.

The most convenient form of dressing afterwards is a thick pad of wood-wool wadding, over a thin layer of wet gauze. Iodoform should be freely dusted into the wound before applying the dressings, or iodoform emulsion injected. We have used iodoform less and turpentine more in recent years.

Messrs. Barker and Pollard, in December 1888, brought before the Medical and Chirurgical Society of London a method of managing the operation of excision of the hip. The method consists in clearing away all disease of the soft parts by scraping or excision; scraping out abscess cavities, and by means of thorough and careful asepticism getting the wound clean. The novelty is in their mode of carefully drying out the wound and closing it entirely after removal of all tuberculous material as far as possible, so that primary union is obtained. Messrs. Barker and Pollard showed cases in which this result had been obtained, and we have since then followed their plan in its main features with success. There is no doubt this is a most valuable improvement; it is, of course, applicable to cases of early excision chiefly, or only, and experience shows that even so there is some danger of relapse (pp. 748 and 751, note). For further details we must refer to the 'Medico-Chirurgical Transactions,' 1888; but we may reprint here Mr. Pollard's abstract of the essentials of the method:

1. The whole of the tuberculous growth must be removed.
2. Perfect asepsis must be assured.
3. Bleeding must be checked and the wound made as dry as possible.
4. Oozing must be checked by the even, elastic support of a wool dressing and a moderately tight bandage.
5. Absolute rest of the part must be maintained during the process of healing.

Following Sir H. Howse, we prefer to have the extension put on before the operation, so that the weights, or, better, Bryant's splint, can be applied at once before the patient is put to bed. The shock of the operation is sometimes somewhat severe, but usually soon passes off under the use of opium and stimulants. Rarely, however, much more severe and prolonged shock occurs.

The subsequent management of the case requires some special remarks. It is exceedingly difficult to keep the wound aseptic in cases where sinuses have previously existed or where there is widespread suppuration. It is, however, a great gain if the wounds can be kept clean even for a time, and with present methods primary union after excision may be expected in a large proportion of cases. (*Vide* note p. 751.)

The after-treatment of cases of excision simply consists in dressing and in keeping the limb quiet and in good position. This may be done by various means, of which the best are simple extension by a weight (the weight may usually be reckoned at one pound for each year of the child's age from 2 to 6; six pounds is generally enough up to 12 years of age, after which more may be added), with or without a long splint on the opposite side, and a Bryant's double splint, which has many advantages in securing 'parallelism

of the two limbs,' and in the ease and comfort with which the patient can be moved. It is an invaluable apparatus, and we almost invariably use it.

The sooner excision cases are got up and about the better ; some cases may leave their beds in three weeks ; others, of course, are much longer in getting up, the difference depending mainly upon the state of the disease at the time of operation.

The period of convalescence after excision varies from the time mentioned to two years, while in some cases sinuses may remain open much longer if pelvic disease exists. We keep our patients usually in a Thomas's splint for from at least three to six months after excision ; after this the child, if old enough, should get about with a patten and crutches, allowing the limb to swing, and only after a year or more should he be allowed gradually to bear weight upon the leg. If, however, excision is done early, the limb is fit for walking sooner, sometimes in five or six months. If the affected leg is allowed to touch the ground too soon, it becomes pushed up upon the dorsum ilii, and much shortening results. On the other hand, if the limb is fixed too long, it becomes stiff. A very large proportion of cases of excision in the later stages of the disease remain with sinuses, but often these produce no ill result except the trouble of dressing them ; a certain number may be got to close by scraping, cautery, and the regular application of turpentine to the sinuses and cavities ; others are very intractable. In a certain number of cases the wound re-opens after having healed ; this is undoubtedly common, but is due to over-use, neglect, or violence, and with ordinary care and frequently repeated scrapings with closure of the wound after excision of tuberculous tracks and edges of skin, the wounds usually again close.

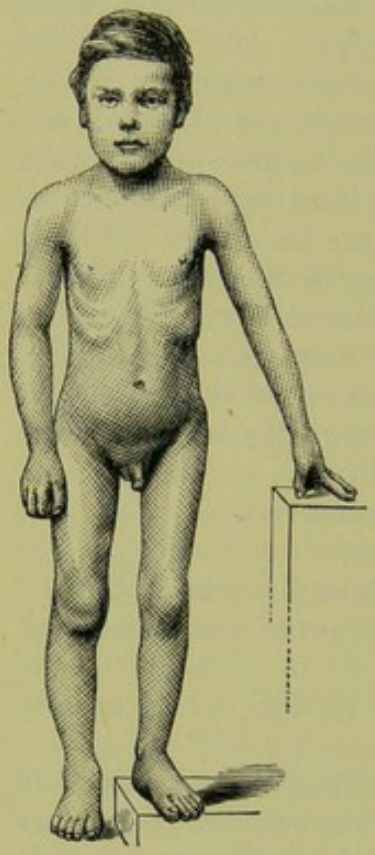


Fig. 183.—From a photograph showing a good average result after excision, when the leg has been walked upon, and the stump of the femur is thrust up upon the dorsum ilii.

It is interesting and important to note that in measuring the amount of shortening after excision the real shortening—as measured from the upper end of the femur to the malleolus on each side—is often trifling, and sometimes there is none, while the practical shortening as measured from the pelvis to the malleolus is considerable. Though some shortening will necessarily result, any large amount is due to weight being borne upon the limb prematurely. It has already been pointed out that growth in length of the femur takes place almost entirely at its lower epiphysial line : hence the loss of length or true shortening is only the distance from the line of section to the top of the head, coupled with such arrest of growth as may result from impaired nutrition, this last being, of course, a very inconstant quantity. Ollier estimates that during the first four years of life growth takes place about equally at each end of the femur ; after that time the lower end grows more rapidly.

The primary objects of the operation of excision of the hip are to save life and relieve pain ; the next most important question is that of the usefulness of the limb and the condition of the 'joint' after the operation. One of two results must occur after excision : either a freely movable limb, or one with varying degrees of stiffness, from some mobility to bony ankylosis. Bony ankylosis after excision is very rare. Close fibrous union, so that but little mobility remains, is very common ; movement through from 30° to 50° is perhaps the commonest result, and a smaller number have complete mobility.

It is not possible to estimate in figures the results to be expected from excision ; for details we must refer to the monograph mentioned at the beginning of the chapter.

Whether, then, we consider the pathology of the disease, the actual local condition, the relief of pain, the preservation of life, the duration of illness, the condition of the limb and its usefulness, or the dangers of secondary disease, on every ground, in our opinion, excision is the best course under the circumstances and with the limitations already stated.

Chronic Synovitis of Adolescents.—Occasionally in young rapidly growing lads or girls, usually from 12 to 17 years, a chronic synovitis of the hip occurs, often apparently due to strain or long standing. It causes pain, lameness, and some stiffness of the joint with effusion, but little or no swelling around the trochanter, though this may appear prominent. The softening of the ligaments by inflammation may lead to complete or partial dislocation of the head of the femur. We believe we have seen this condition associated with coxa vara. The treatment is prolonged rest, and the prospect of recovery is good, though some stiffness may remain for a long time.

CASE.—Hy. H. Ætat 16. Page boy. Twelve months ago the boy felt a sharp pain in the left hip. As this continued he was kept at home, and wore a Thomas's splint for six months, and afterwards he got about with crutches. A year later the left limb was shortened and wasted, with some rigidity of the hip and knee. Adhesions were broken down under an anæsthetic, and he finally got well and was able to work, though some stiffness and lameness remained. No abscess ever formed.

(For coxa vara, *vide* chapter on RICKETS.)

Conclusions.—1. The hip joint in childhood is commonly subject to two affections : (*a*) simple synovitis ; (*b*) tuberculous disease.

2. Simple synovitis is usually traumatic, very rarely suppurates, is amenable to ordinary treatment, and as a rule leaves behind no bad results.

3. Tuberculous disease, or common 'hip disease,' affects primarily the upper end of the femur, or occasionally the acetabulum, and produces necrosis or extensive caries.

4. In the earlier stages of hip disease, before caseation of bone or suppuration has taken place, proper treatment will, in a fair proportion of cases, result in recovery with a nearly perfect limb.

5. As soon as suppuration occurs, it is certain that recovery will not take place without destruction of the upper epiphysis of the femur more or less completely.

6. The process of removal of the diseased bone without operation is so slow, so exhausting, and so uncertain that it should be reserved for those cases where time and care can be fully devoted to it.

7. A case of hip disease, seen before suppuration has occurred, is best treated by the use of a Thomas's splint with or without previous straightening by extension.

8. Excision of the hip cuts short the disease, relieves pain, and gives a better limb than the average result obtained without operation in cases of equal severity; but the operation is less often required with modern methods of wound treatment, and more adequate care of the joint in the early stages of disease.

9. Excision should be looked upon as an ordinary operation for necrosis, and the operation itself is not necessarily attended by a higher mortality than sequestrotomy elsewhere.

10. Excision in old pelvic disease, or where the health is broken down, should usually be rejected in favour of amputation.

11. The presence of a sinus after operation, unless there is much discharge or evidence of extensive pelvic disease, does not imply failure of the operation.

12. The presence of an abscess after a long period of quiescence (residual abscess), without other evidence of relapse, is not to be looked upon as of serious import.

Amputation.—The question of amputation at the hip joint for disease is one of the highest importance. We must consider not only the unavoidable mortality and crippling caused by the disease, but also the interference with pleasure and education entailed by long confinement indoors. Where there is no reasonable prospect of recovery with a useful limb, amputation must not be too summarily set aside.

There is little doubt that, in cases of extensive disease where the femur is necrosed for a long distance and the powers of the patient are inadequate to repair it, in cases where descending osteomyelitis occurs, and in cases where profuse discharge and amyloid disease come on, amputation should be performed.

In cases of more advanced amyloid disease, unless the powers of the child are so enfeebled that the operation will prove fatal by shock, it ought also undoubtedly to be done.

In another class of cases the question is more difficult. Where there is disease of the pelvis, is amputation contra-indicated if other conditions require it? We should answer yes, if the pelvic disease extends so widely that there is no hope of removing it all, and the condition is one of caries and not necrosis. Where there is caries limited to the neighbourhood of the acetabulum, where there is necrosis, or where there is reason to think that the disease in the limb is preventing repair in the pelvis, amputation should be performed.

As to the question of saving life, amputation at the hip performed with due precautions as to hæmorrhage and shock, and special care during the first twenty-four hours, is by no means a fatal operation in children.

We have amputated in some fifteen cases in children. In nearly all excision had been previously performed. All of these recovered well from the operation except one who died from hæmorrhage. In this case nearly the whole of the ilium was removed at the same time.

The best plan is the oval incision of Furneaux Jordan; the excision wound should be utilised, and the line of section brought as far as possible from the anus and vulva.

Neither the various methods of operation nor the best means of controlling bleeding are questions suited for discussion here. Elevating the limb before operation, and digital pressure with the help of an elastic tourniquet in the early stages of the operation, are as efficient means of controlling the hæmorrhage as any; in several cases we have ligatured the femoral or external iliac as a preliminary, and think well of this plan.

If possible, it is, as pointed out by Mr. Shuter, well to preserve as much periosteum as possible, and it will be found that after excision the bone usually very readily separates from the periosteal sheath; a longer, firmer, and more or less mobile stump may be thus obtained.

Double Hip Disease is not a very rare condition, and we have more than once had cases in which the second joint has become diseased while the child was lying in bed for the treatment of the first joint. The management of these cases is that of the common condition, except that a double Thomas's splint is of course required. Double excision is occasionally called for, and we have had good results from it; in one case the child remained sound and well, and was able to walk without support.

Scissor-legged Deformity after Hip Disease.—Mr. Lucas, Dr. Tyson, of Folkestone, and others have recorded cases where, as a result of double hip disease, a peculiar 'cross-legged' or 'scissor-legged deformity' occurs; both legs are adducted, the one in front of the other, and progression takes place entirely by movement at the knee joint. It is easy to understand the condition by simply walking with the knees crossed over one another. It occurs, according to Mr. Lucas, in cases where disease has taken place first in one joint, resulting in adduction, and then subsequently in the other joint. Other deformities may result from the same condition.

Adduction after Subsidence of Hip Disease.—This is unfortunately a common and most troublesome cause of crippling after active disease has subsided. It results from inadequate treatment while the disease is active, or premature removal of splints; also very often from the bad habit these patients acquire of resting the foot of the affected limb upon the dorsum of the other foot. The deformity may in some cases be remedied by extension either direct or at right angles, but in severe and rigid cases it may be necessary to osteotomise the upper end of the femur with or without division of the adductors before the limb can be straightened.

Tuberculous embolism, or the rapid development of general miliary tuberculosis after an operation on a tuberculous focus, is especially likely to occur after excision of the hip, since the removal of the infective material is necessarily incomplete.

NOTE.—Our former Senior Resident, Dr. Carruthers, now of Congleton, went kindly over our records of excision of the hip from 1886 to 1893 performed by the writer. He reports that 83 operations have been done, of which in 31 instances the wound was sutured without drainage. Of these 22 healed at once, i.e. by primary union throughout, or with the exception of small superficial areas; 9 cases failed to unite at once, and 5 of the 22 which united broke down again after varying periods. These figures must be taken as approximate only, inasmuch as wounds may have reopened shortly after discharge, and in one or two cases of the 83 the result is doubtful.

CHAPTER XXXII

SPINAL DISEASE

Caries of the Spine, Angular Curvature, and **Pott's Disease** are terms which, as commonly used, include conditions of very varying severity affecting several different structures. This is so, since the spinal column is in each segment provided with several different articulations, and any of these, as well as the bone itself, may become the seat of disease. Thus the mischief may begin at the junction of a vertebral body and intervertebral disc, at the junction of a vertebral body with its epiphysis, in the centre of a body, or on its anterior, posterior, or lateral surfaces ; or again, the articular processes, or their joints, the transverse and spinous processes, may any of them be separately diseased. Again, the mode of connection between the skull and atlas, the atlas and axis, and the sacral joints implies necessarily varying conditions from those found in disease of the rest of the column.

Obviously the names given to disease of the spine are not equally applicable to all these affections ; disease of a spinous or an articular process does not give rise to angular curvature. It is, however, quite the exception to find in children disease of the spine affecting any part except the bodies and intervertebral discs ; we can only call to mind two cases of disease of a spinous process alone, one of which was the following :

CASE.—*Necrosis of the Cervical Spinous Processes.*—Edward H., age 4 years 5 months ; admitted July 21, 1882. Six weeks ago a hard lump was noticed at the back of the neck, he having, a fortnight before, fallen on the back of his head ; the swelling had gradually increased, but he had had neither pain nor tenderness. On admission he was well nourished ; there was a large fluctuating swelling in the middle of the back of the neck ; it was opened antiseptically, and about dr. iij of healthy pus escaped ; the tips of one or more spines were bare ; the dressing slipped the next day ; the abscess continued to discharge, and he was sent out on August 25 with a jurymast on and still unhealed sinus. In January 1883, at Out Patients', he was nearly well ; the movements of the neck were perfect and the thickening nearly gone, but there was still a small sinus. Subsequently a sequestrum consisting of the spinous process was removed, and he quite recovered (*vide* chapter on DISEASES OF THE BONES).

We have never verified a case of disease of a joint between the articular processes, and disease of the transverse processes is rare. The atlanto-axial and occipito-atlantoid joints are also very rarely affected in children in comparison with caries of the bodies.

The ordinary form of caries of the spine affecting the bodies or intervertebral discs or both structures is met with in all parts of the spinal column from the axis to the sacrum. In a hundred cases taken at random from our Out-Patient papers we found eighteen cases of cervical disease, forty-one

cases where the cervico-dorsal, upper, or mid-dorsal regions were involved, thirty-three instances of lower dorsal or dorso-lumbar disease, six of lumbar caries, and two of disease of the sacrum. R. W. Parker, as quoted by Erichsen, gives the following figures: Cervical nine, dorsal eighty-two, dorso-lumbar twenty-one, lumbar or lumbo-sacral thirty-seven, out of 149 cases. These figures are of some importance; for, in the first place, any attempt at removal of diseased bone can be only exceptionally made in the dorsal region, and also in the cervical part of the spine, while the treatment of the disease by apparatus becomes more troublesome as we ascend from the mid-dorsal region. Pus is more likely to point externally as lumbar or psoas abscess when the lower dorsal or lumbar vertebræ are attacked, though it is not rare for dorsal abscesses to track down the spine. Cervical abscesses point in the pharynx or side of the neck. Lastly, occasionally two foci of disease exist, as in fig. 184.

Fig. 184.—Caries of the Spine, showing two foci of disease.

Pathology.—It is probable that caries of the spine begins nearly always in the body of the vertebra, and not in the intervertebral disc itself; but it is difficult to be sure of the relative frequency of these sites, for the mischief soon spreads beyond the limits of a vertebra in most instances. Erichsen considers the epiphysial lines, the front of the bodies, and the centre of the bodies to be in this order the most frequent primary seats of disease. Wilks and Moxon apparently incline to the belief that the bones are the primary seat of 'scrofulous' disease in children, while disease beginning in the discs is a separate type of lesion—at all events in some cases the result simply of injury; probably the seat of disease varies. In most cases the lesion is an ordinary tuberculous disease of bone, rarefying ostitis being found in some parts, while in others caries necrotica or more extensive necrosis exists. Although a large number of patients, the subject of caries of the spine, never develop external abscesses, it by no means follows that no suppuration takes place; large collections of pus may form beneath the anterior common ligament in the dorsal region without ever discharging, and may, like abscesses elsewhere, dry up and remain as cheesy or calcareous masses. More rarely the abscess may empty itself into the lung or intestine; the latter result we have seen in a case of lumbar caries and in sacral disease, and it is probably more common than is supposed, the pus in the motions

being overlooked or put down to enteritis. In other instances caries of the spine, like caries elsewhere, may be throughout unattended with any pus formation (caries sicca).

There is often a discharge of small sequestra from spinal abscesses, and sometimes fair-sized pieces of dead bone come away or are extracted, as in the well-known instances of the odontoid process coming away entire through the pharynx ; but this is not common.

Pus from a lesion in one part of the spine may track downwards and give rise to a second focus of disease lower down, but sometimes, as in fig. 184, the two foci are quite independent and isolated from each other ; in the case from which the figure was taken the lower patch of disease developed first.

In some instances disease may begin as a simple non-tuberculous inflammation, the result of injury as already mentioned ; this is not, however, common in children in our experience, since in them the disease usually runs the course of tuberculous lesions generally. In the worst cases there is a mixed infection of tubercle bacilli with some other pyogenic organism such as a staphylococcus or the bacillus coli. These mixed infections are apt to occur when an 'abscess' so-called has been inefficiently dealt with. Cases of spinal curvature, due to the lesions of congenital syphilis, are also described.

Abscess.—Pus in connection with spinal caries usually burrows along certain definite lines determined by muscular and fascial barriers ; thus in the neck, abscesses are either prævertebral, bulging forwards into the pharynx, as in atlanto-axial disease, or point at the side in the posterior triangle, just behind the sterno-mastoid, sometimes on both sides.

In the lower cervical and upper dorsal regions the abscesses, if they exist, rarely point externally, but, if they do so, either track down the spine and appear as lumbar or psoas abscesses, or perforate an intercostal or intertransverse space and appear in the back. Abscess in upper dorsal caries comparatively rarely points externally. Dorsal and lumbar caries commonly gives rise to psoas abscess, the pus getting into the sheath of the muscle at its upper attachment and burrowing down within it, often entirely destroying the muscle itself ; it then may either pass outwards into the iliac fossa, beneath the iliac fascia, and form a swelling there (iliac abscess), or, travelling on beneath Poupart's ligament, bulge in the thigh on the outer side of the femoral sheath as a psoas abscess. Often, however, though forming a collection in front, the matter does not point there, but, passing on behind the vessels towards the lesser trochanter, appears at the back of the thigh as a gluteal abscess. In other instances the pus finds its way round the edge of the quadratus lumborum and through the transversalis aponeurosis, perhaps in the course of a branch of a lumbar artery, and points in the back (lumbar abscess). Again, the pus may gravitate backwards into the pelvis and escape through the sciatic notch, appearing as another form of gluteal abscess. We have seen an abscess bulging at both sciatic foramina, so that fluctuation could be felt across the cavity of the pelvis. Less often the abscess descends over the iliac crest on its outer aspect, or burrows forwards between the layers of the abdominal wall. Once it has reached the thigh, matter may track down it for an indefinite distance.

Deformity.—In most cases caries of the spine sooner or later gives rise to angular deformity (kyphosis). This is, of course, due to destruction of the bodies of one or more vertebræ, and consequent collapse of the column ; or possibly, to a certain extent, is caused by muscular contraction drawing together the adjacent bodies, the spines being thereby made to project posteriorly. The amount of deformity in such cases varies from a mere faint prominence of one vertebral spine, only to be recognised by careful observation, to a great prominent 'knuckle' involving six or eight vertebræ. When the disease is in the dorsal region, the falling together of the vertebral bodies produces a corresponding chest deformity ; the ribs are brought close together, the shoulders are raised, and the head looks sunken between them, the antero-posterior diameter of the chest being increased at the expense of the vertical.

In the cervical region the deformity is usually much less marked ; sometimes, however, there is a prominent angular curvature, and the head is drooped forwards with the chin upon the sternum ; or the head and upper cervical vertebræ are poked forwards with a projection backwards at the root of the neck.

It must be remembered, however, that these deformities occur only in an advanced stage of destruction, and only when the whole breadth of a vertebra is eaten away ; thus, disease of one side or the posterior part of a body may exist without any angular deformity, and in some instances the spine is recurved, so that the convexity is forwards instead of backwards ; this is most commonly seen in the cervical region : we have, however, seen it in the lumbar vertebræ too. In such cases the bending is never sharply angular, but is due to spasm of the posterior spinal muscles ; it can rarely, if ever, be due to destruction of bone, for, to produce such result, not only the bodies but the arches of the vertebræ would have to be destroyed : the condition is generally merely an exaggeration of the normal curves.

Since there is a physiological curve with its convexity forwards in the cervical and lumbar regions, a certain amount of destruction of the vertebral bodies has the effect of merely straightening these curves, and it is only when considerable erosion has taken place that a curve with its convexity backwards is produced.

Extensive disease of the posterior parts of the bodies may, of course, exist without any curvature, and in such cases the inflammatory material poured out may produce pressure on the cord or nerves, or inflammation by extension ; hence the old saying, 'The less the deformity, the more the paralysis.'[1] Paralysis in such cases is probably hardly ever due to bony pressure, since the spinal canal is not encroached upon ; this is only likely to occur where a sequestrum is pushed into the canal.[2] Lateral curvature sometimes results from destruction of the sides of the bodies and consequent collapse ; more often, however, any lateral curvature that does exist is a result of ligamentous and muscular weakness, and as such is a true lateral curvature.

[1] It is also a matter of frequent observation that paraplegia and abscess are rarely associated.

[2] Paraplegia is commoner in cervical and upper dorsal caries than in disease lower down.

Before there is any permanent deformity from loss of material, certain characteristic attitudes are assumed by the subjects of spinal disease. In caries of the cervical spine the child often supports his head with his hands, to lighten the pressure upon the diseased spot and prevent any sudden jar, and is slow and careful in turning round and stooping. When the dorsal or lumbar regions are involved, instead of bending the spine to reach any object upon the floor, the child bends the knees and hips, and so brings down the hands, and at every opportunity assumes the resting position shown in fig. 185.

It is most important to distinguish angular curvature from lateral curvature and from rickety spine. It is only in the very early and very late stages of disease that there is likely to be any doubt whether a case is one of lateral or angular curvature; in ordinary well-marked cases the distinction is clear enough. In some old cases of lateral curvature very sharp bends in the spine are much like angular deformity; and again, we have more than once seen cases where there was an early lateral curve and no symptoms pointing to caries, yet in a few months undoubted caries appeared. Careful and repeated observations are, therefore, necessary if there is any possibility of doubt, and it must be remembered that the two affections may co-exist. Ordinarily a diagnosis is readily made by the presence in the one of a lateral curve and of rotation, and by the fact that the curve in caries is abrupt, in lateral curvature gradual, as well as by the presence or absence of the other symptoms of caries mentioned.

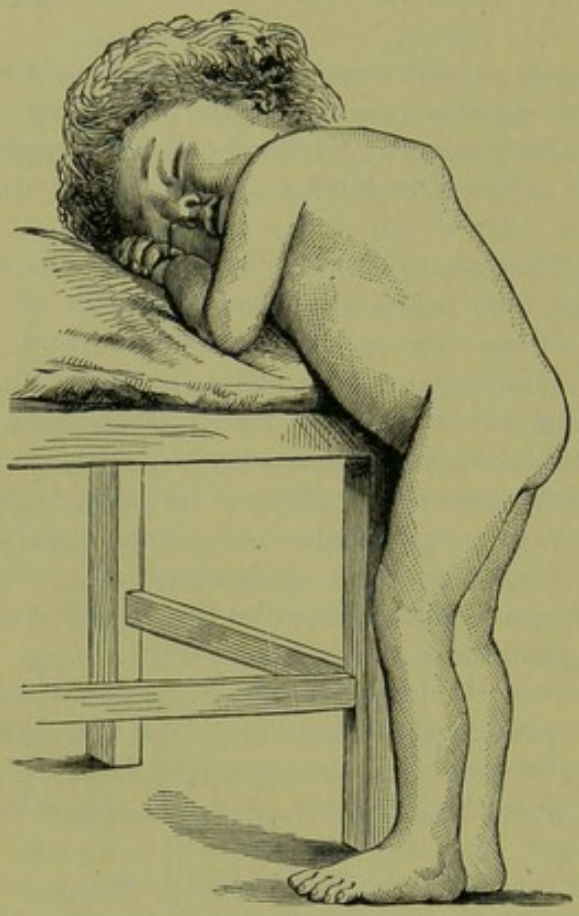


Fig. 185.—Caries of the Spine, showing a characteristic resting attitude, which should be contrasted with the rickety spine seen in fig. 41.

The rickety spine is distinguished by its being a general rounded curve, by the absence of rigidity, by the disappearance of the curve when the child is held so that the weight comes upon the spine, by the evidences of rickets elsewhere, and the absence of the characteristics of caries. Caries also is very rare in the first two years of life, rickety spine much more common during that period.

With these exceptions, and the possible ones of an old fracture or dislocation, or congenital undue prominence of certain spines, or the development of bursæ over the spines, the result of friction or pressure, angular deformity may be taken as pathognomonic of caries either present or pre-existing.

Abscess is not by itself a certain indication, since it may be due to many other causes than spinal caries; still, the presence of a lumbar, gluteal, iliac,

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psoas, post-pharyngeal, or cervical abscess should always lead to a careful examination of the spine. It must be remembered that pelvic disease, glandular, perityphlitic, perisigmoid, and perinephritic abscesses, empyema, carious ribs, sacro-iliac and hip disease, &c., may give rise to suppuration, which may point in positions identical with those in which spinal abscesses may find outlet.

Rigidity is a most important sign of spinal disease, important all the more because it is an early one ; the stiffness is due to spasm of the spinal muscles, just as in disease of any other joint. Rigidity is best tested by stripping the child and putting some object upon the floor for him to pick up ; by watching carefully it will be seen whether the whole spine bends as in health, or whether it is held stiff and immovable in any part. Healthy children freely bend their spines, but in order to test fully the mobility of the column the child should be told to keep its knees straight. Absence of flexibility is, taken alone, the most valuable sign of caries except deformity.

In the cervical region, muscular spasm may give rise to wry-neck, inability to nod or to turn the head round, according to the part involved.

Besides contraction of the posterior spinal muscles, there may be rigidity of the ilio-psoas, causing flexion of, and inability to straighten, one or both legs ; this usually means that a psoas abscess is beginning to form, and the muscles are rigid in consequence of irritation, or kept voluntarily contracted to prevent pressure upon the abscess. Local rigidity of the lumbar muscles or of certain of the posterior spinal muscles will sometimes be found ; thus the erector spinæ may be seen tightly contracted and standing out prominently just above the sacrum.

The test of bending the body backwards is more applicable to adults than to children, in whom it is difficult to estimate amounts of pain ; it should, however, always be employed.

Muscular wasting occurs in spinal as in other joint diseases, but is rarely well marked, except when the disease is far advanced, and hence it is not of great value alone as a symptom.

Dysphagia may result from pressure by an abscess upon the pharynx or œsophagus, or *dyspnœa* from pressure upon the trachea or lungs or upon the recurrent laryngeal nerves in disease lower down ; so, too, possibly, extensive abscess in the chest may give rise to physical signs, dulness, &c. This is, however, more likely to be due to enlarged mediastinal glands. We have had a case in which severe and progressive dyspnœa came on in a boy with acute caries of the upper dorsal spine : the disease was only of about seven weeks' standing, but there was a well-marked angular curvature. There was no paraplegia. Slight dulness was found on the right side near the spine, but no evidence of actual lung mischief sufficient to account for the dyspnœa. A portion of rib opposite the most prominent part of the curvature was excised and the head and proximal part of the rib, which were carious, removed. A considerable 'abscess' was found in front of the spine, and all the pressure symptoms were at once relieved when it was emptied.

Large abdominal abscesses may produce pressure effects upon vessels and viscera, but these are rare results. Abdominal distension from flatulence may be due either to pressure upon nerves or to failure of the digestive

powers in later stages, or to coincident tuberculous disease of the intestines, mesenteric glands, &c.

The *subjective symptoms* of spinal caries are pain and loss of sensation. Pain may be acute or nothing more than a feeling of tiredness or aching : it is usually an early and prominent symptom ; it may, however, be entirely absent, just as in some instances of chronic joint disease elsewhere. Usually there is pain over the affected spot, increased by pressure or jarring of the spine, such as may occur in jumping, or suddenly stepping down from a height ; in caries of the cervical spine, pressure upon the top of the head often causes suffering, and in any part of the column flexion or rotation movements may be painful.

Further, there is usually pain in the course of the nerves passing out from the diseased area ; thus, in dorsal caries there is pain at the sternum or in the side ; in dorso-lumbar disease there is abdominal pain ('girdle pain' ; so called 'dry belly ache'). Pains in the limbs, shooting down the legs over the distribution of the sacral and lumbar plexuses, and similarly in the arms, may be met with. Any obscure pain should always be carefully traced to its source by searching along the whole course of the affected nerve up to its origin. Thus, pain in the back of the head, so-called 'headache,' may be due to pressure upon the occipital nerves, and so on.[1]

The anæsthesia and paræsthesia due to spinal caries are either the result of pressure upon the theca or nerves or of inflammation spreading from the bone to the meninges or cord, and will be found described at page 605.

Pain in the spine is sometimes increased by the application of warmth, e.g. a hot sponge applied over the diseased part, but the symptom is not constant nor of any great value. In some instances we have found herpes zoster occurring in connection with caries of the spine, and it is worth while to examine the spine in cases of shingles, since the eruption may be a result of lesions starting in the spinal column.

The conditions most likely to be confounded with spinal disease are, in the neck, sprains or stiff neck from cold, reflex irritation, &c., glandular inflammation, and cervical cellulitis. The 'vertebra prominens' should be remembered, and the ease with which the cervical transverse processes can be felt ; there is often a deceptive feeling of thickening about the cervical vertebræ which is apt to mislead unless comparison is made with a healthy neck. In caries thickening will be felt. In glandular abscess the glands themselves can usually be felt to be enlarged, and generally the pain is most marked or only exists on one side, whereas in caries there is usually tenderness on pressure on both sides. This, with the other symptoms already mentioned, will serve to distinguish between the two conditions. Prævertebral abscess, though often due to spinal disease, may be the result of several other lesions (*vide* p. 79).

Caries of the dorsal and lumbar spine has already had its distinguishing features pointed out ; it is only necessary to add that in all cases search should be made for evidence of abscess deep in the abdomen, since large collections of matter sometimes form very insidiously.

[1] For illustrations of these peripheral pains the reader is referred to Mr. Hilton's admirable book, *Rest and Pain*, edited by Mr. Jacobson.

Complications.—In addition to the troubles arising directly from the spinal lesions other complications may arise ; thus the vertebral disease may be only a part of a general tuberculosis in which viscera or bones and joints other than the spine may be involved. Sometimes a psoas abscess in tracking down gives rise to disease of the sacro-iliac or hip joints (*vide* HIP DISEASE). As a result of pressure upon or inflammation of the spinal cord and its membranes cystitis or paralysis of the bladder may result ; bedsores may form, both as a consequence of pressure and from the nerve lesions. Exhaustion, hectic, lardaceous disease, and general tuberculosis are the most common causes of death, though it must not be forgotten that sudden death may occur from displacement, the result of softened ligaments, in the upper cervical spine, or from bursting of an abscess into the air passages, or ulceration into a large vessel. In other instances pyæmia or other intercurrent disease cuts life short.

Paraplegia may occur in the course of spinal disease as a result of pressure from inflammatory exudation poured out into the spinal canal, from effusion pressing upon the nerve roots, an occurrence met with in the cervical region ('cervical paraplegia' of Gull), from necrosis and projection of a sequestrum into the canal, or rarely from the angular bending of the spinal column. Paraplegia occurs most frequently in cases of caries of some part above the lower dorsal spine, more rarely in lumbar disease. The degree of paralysis varies from mere weakness with paræsthesia to complete paralysis of the lower limbs, the bladder, and the rectum ; or in rare cases the paraplegia may be complete below the lower cervical region. There are loss of power, diminished sensibility, exaggeration of the reflexes, more or less contraction of the limbs, and, in cases where the cervical or lumbar enlargement of the cord is involved, actual muscular degeneration. Pain may or may not be present. For details, *vide* chapter on NERVOUS DISEASES ; *Paraplegia*, p. 605.

Mode of Repair.—Repair in the spine takes place just as in other joints ; the carious or necrotic process ceases, and the tissue injured beyond recovery is either absorbed or is thrown off and comes away in the discharge, or it is encysted and remains quiescent, giving rise to no more irritation. The granulation tissue either develops into fibrous tissue or ossifies, and the adjacent bone surfaces are welded together ; in addition to this bony splints and buttresses are developed around the diseased spot and further strengthen it.

It is possible in very early stages for the inflammation to subside, and the parts to return to their original healthy condition ; but once there is loss of substance the curvature is never lost, though the spine may appear straighter from development of compensatory curves, or from straightening out of other mere transitory yieldings due to muscular and ligamentous weakness.

Treatment.—Disease of the spine requires treatment on exactly the same principles as disease of other joints, viz. rest and general hygienic measures, with such management of abscesses as each case may demand.

The general treatment need not be specified here further than to say that nutritious and careful diet, iron, and cod-liver oil, together with good air—sea air if possible—are the desiderata. The difficulties arise in

obtaining rest and in the treatment of abscesses. Rest implies absolute fixation of the diseased part: this requires different arrangements in caries of the upper and lower parts of the spine. In cervical caries the best plan of treatment is to put the child on a hard mattress, with a small pillow to fit in between the shoulders and occiput so as just to support the spine without straining it: a ring air or water cushion for the head answers very well. Sandbags not too tightly filled are then laid along each side of the neck, packed well in, and secured by one placed across above the top of the head; a folded handkerchief should be carried across the forehead and fastened to the sandbags at the side to prevent any possible lifting of the head. Arrangements should be made for defæcation, &c., without disturbing the child, by providing a hole in the mattress or a separate part in the middle that can be slid out. We know no better plan than this, as advised by Mr. Hilton, where it can be carried out rigidly, but it is difficult to manage for a sufficient time. Extension by means of a head sling and weights may be applied in cases of cervical and high dorsal caries (*vide* Schapps, 'Year-Book of Treatment,' 1895, p. 276). As soon as repair has fairly advanced, as evidenced by absence of pain for some months previously, loss of tenderness, and diminution of thickening, with drying up of any abscesses that may have formed, the child should have on a stiff leather or poroplastic collar moulded carefully to the neck and occiput, and shaped to the shoulders below; he may then begin gently and carefully to get about for a short time daily, but on the least sign of pain or swelling the original plan must be reverted to.

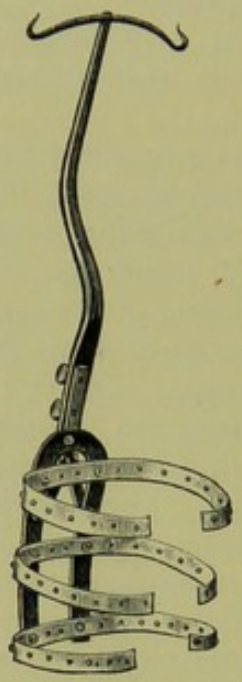

Fig. 185.—A Jurymast for Cervical or Upper Dorsal Caries. The altered shape of the upright makes it easier to fit, and it is not necessary to have it of steel; it also prevents falling forward of the head without making absolutely vertical traction. The spring of the steel is replaced by elastic cords in the straps, which have been omitted from the figure for the sake of clearness.

Or a jurymast may be applied with a plaster or felt jacket, either the original form devised by Sayre, or a shape we prefer as less troublesome, and we think more efficient, as shown in fig. 186; this form has the advantage of providing elastic support, of not requiring to be made of steel, and of not tending to press upon the vertex. The jurymast must be carefully modelled to the particular case, and never removed, but the straps kept just taut. Failing the treatment in bed, the jurymast is, we think, as good a plan as any, though it is troublesome to manage, and we seldom use it. Various other methods, such as inflatable rubber collars, sawdust collars, &c., are used with advantage in suitable cases, i.e. when the disease is subsiding. Extension of the head by weights, the trunk being fixed, is sometimes usefully employed, but requires care not to overstretch the softening ligaments.

Caries in the upper and mid-dorsal regions requires as absolute recumbency as cervical disease, but it may be either in the prone or supine position, and sandbags are not required; the child should be fastened down by the simple plan shown in fig. 180 if he cannot be trusted to lie still. The jury-

mast plan is applicable, of course, to these cases as well, and must be used in any case where the ordinary jacket cannot be so applied as to carry the weight of the upper part of the body.

The ordinary plaster-of-Paris Sayre's jacket is a useful appliance for spinal

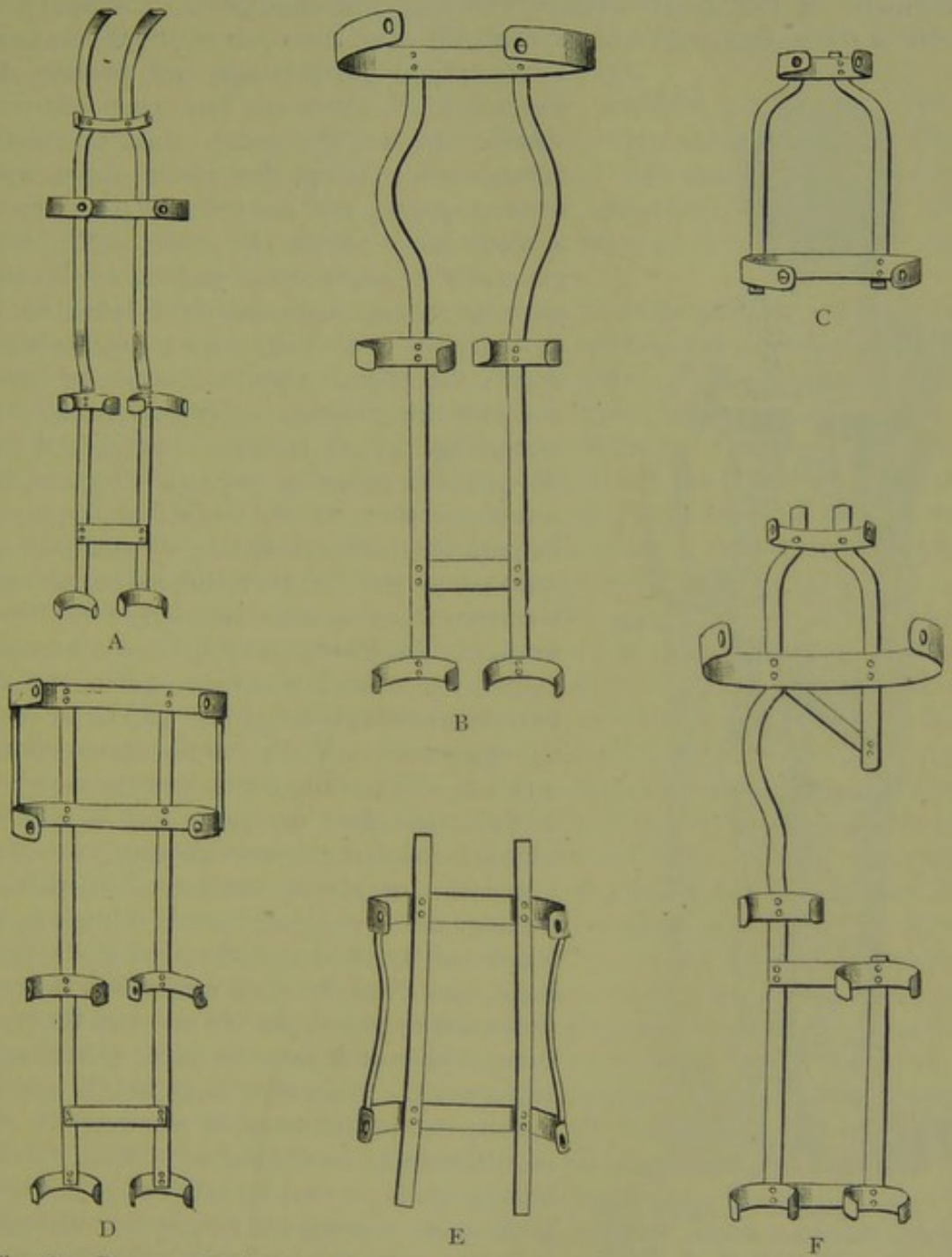

Fig. 187.—Patterns of Splints for Spinal Caries, Laminectomy, &c. A, for fixing head, trunk, and lower limbs; B, for dorso-lumbar caries; C, for upper dorsal; D, for dorsal disease; E, for dorso-lumbar laminectomy; F, for fixing whole trunk and lower limbs in a case of lumbar or gluteal abscess, &c. These appliances are all Thomas's splints or modifications of them.

caries in the lower dorsal and lumbar regions. In acute and rapidly progressing cases a period of recumbency should be insisted on, either with or without the jacket. Certain points are essential in the use of this appliance. 1. Any sharply projecting spines must be protected by padding round them

and by careful moulding of the plaster to avoid pressure. 2. The jacket must reach well up to the root of the neck in front and behind, being shaped out in the axillæ ; this may be done by carrying the bandages crosswise over the shoulders and cutting out the cervical part afterwards, or by careful adjustment of the turns without crossing the shoulders. 3. The lower border of the jacket must come down well over the crest of the ilium, so as to distribute the pressure and prevent the formation of sores on the crest and iliac spines. In fact, the jacket must be closely fitting and envelop the whole spine from neck to pelvis, and not be, as it too often is, a mere wisp round the waist. We used generally to apply these jackets in the out-patients' room, with the child lying on its face across two chairs with a gap between them ; the tripod may, of course, be used, but with the greatest caution, to prevent any stretching, and it must be remembered that the point in applying the jacket is to fix the spine and prevent any further pressure, not to pull the surfaces apart—it would be as rational to put on powerful extension and counter-extension after excision of the knee, dragging the bones away from one another, as to try to extend a carious spine. Of the various modifications of the jacket we have no experience. With careful management a jacket will last from nine months to a year if the child does not grow out of it, but usually hospital patients require new ones every two or three months. The plan of putting on two jerseys and changing the inner one by tacking a new one to its lower edge, and then drawing it upwards beneath the jacket by pulling the old one over the head, is ingenious and saves frequent changing in some cases. Pain after a jacket is put on usually means pressure at some point, and should lead to careful examination : if at the hips or axillæ, it may be relieved by judicious packing or cutting out ; if in the back, the jacket must be removed, or it will cause sores. Free dusting between the jersey and the skin with powdered boric acid, or, in dirty people, with pulv. hyd. ammon., is useful. From six to eight bandages are usually required for a jacket in a child ; they should be applied in spirals so as to cross and strengthen one another, and care must taken not to allow the edges to be thin and weak. 'Dinner pads' are not necessary if the bandages are put on judiciously ; a soft patch in the jacket over the abdomen does not demand a re-application

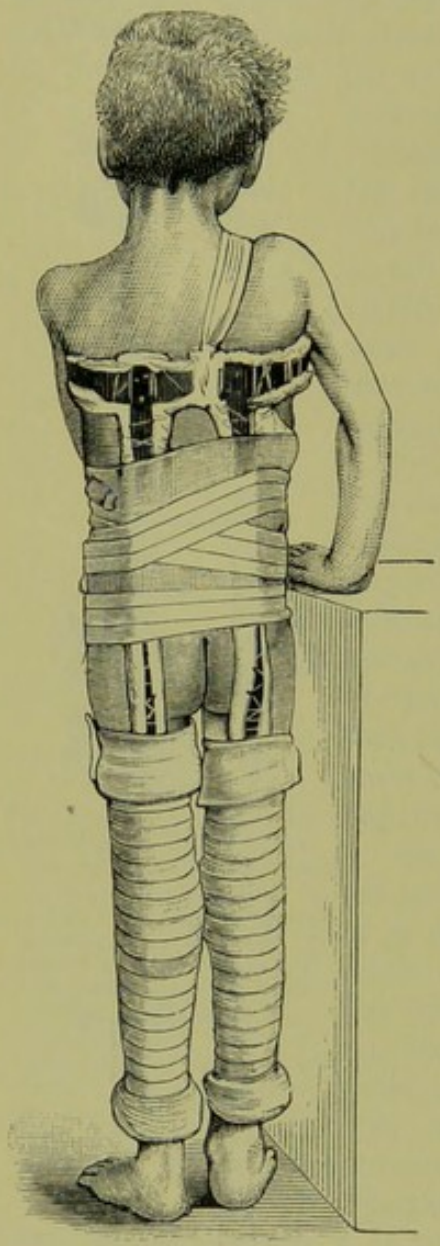

Fig. 188.—Caries of the Spine, with double ilio-lumbar abscess, treated by the application of a double Thomas's splint.

so long as the rest of the jacket is firm. In some cases, where, from the presence of abscesses in the back, or co-existent hip disease, or flexion of the legs from psoas abscess, a jacket is inapplicable, we use a double Thomas's hip splint and find it very useful ; it ensures recumbency, keeps the spine at rest, extends the legs, and does not interfere with dressings nor require removal (figs. 187, 188). Should the child be fit to be on its legs, it can get about, with crutches, in a double Thomas's splint.

Poroplastic and other jackets have only doubtful advantages over the original Sayre's, and have many drawbacks ; they are rather applicable as protections after consolidation has taken place than as a mode of treatment for active disease. Of the various special apparatus we can only speak in the same terms, but not from actual experience of them : we have never been tempted to try them.

While we have described the management of Sayre's jackets and the jury-mast we have personally almost entirely given up their use in favour of absolute recumbency with or without a Thomas's spine splint. We believe no treatment is so good as absolute confinement to a recumbent posture ; but it must be absolute ; there must be no raising of the body for washing or feeding or emptying the bowels. The best plan is to keep the child on a blanket-covered board on which he can be carried to and from bed and his day-room or spinal carriage. From this board he should never be raised, though he may be occasionally rolled over on to his side to sponge the back.

If it were possible to reach and remove the source of suppuration in all cases, the management of spinal abscess would be that of all other abscesses in connection with bone disease, but the question is not a simple one, and each case has to be judged for itself. In cervical disease, as a rule, all abscesses should be opened as soon as they develop, for they are apt to track widely down the neck or, pointing in the pharynx, to become septic or a source of danger from pressure. Hence antiseptic incision, by dissection at the posterior border of the sterno-mastoid, is the best treatment. In one case where the disease was of the spinous process alone, we opened the abscess, and later removed the necrosed spine ; and this, perhaps, might sometimes be done in necrosis of the bodies as proposed by Sir F. Treves more especially for lumbar necrosis. Opening of the abscess in the pharynx is not a good plan, and should only be done in an emergency where the pressure is threatening suffocation ; even then we should prefer to do tracheotomy and then open the abscess in the neck at leisure, allowing the tracheotomy wound to close.

Abscess due to upper dorsal caries does not usually come to the surface, though no doubt it often exists hidden in the posterior mediastinum ; where if it gives rise to symptoms it may be recognised, as in the case related on p. 757. Abscess pointing in the lumbar, iliac, or psoas area is the condition most commonly met with ; as to its treatment, our opinion is that if the abscess is on the point of bursting, or gives rise to much pain, or is increasing, it should be opened at once with full antiseptic precautions—the opening being made in the loin if there is any cavity there of sufficient size, or, if not, in some cases it is a good plan to pass a long probe from the lower opening, iliac, psoas, or gluteal, as the case may be, and cut down upon it in the loin. Where the abscess is small, chronic, and stationary, and where no adequate treatment has been hitherto adopted and there is not much pain, it is

justifiable to wait. The pus may be absorbed, there may be no sequestra to keep up irritation, and the caries may subside with rest, while we cannot remove the disease if it does not subside. When once opened there is always the possibility of dressings slipping and the wound getting foul, with the usual result of slowly progressive or acute septic poisoning. But if the conditions mentioned above exist, or if the abscess is large or does not subside after a few weeks of absolute rest in bed, it is better emptied. All spinal abscesses, when opened, should be dealt with by the method already mentioned as suitable for chronic abscesses elsewhere—i.e. they should be opened freely, all their contents thoroughly wiped and washed out ; the wall of the abscess being thoroughly cleaned, and the wound closed without drainage. Should there be subsequent evidence of sepsis from imperfect management of the wound, it must be opened and drained, but this must be looked upon as a serious disaster. If, however, the wound heals without fever, but the abscess gradually refills, the failure is due merely to incomplete removal of the diseased material, and the operation must be repeated as often as fluid re-collects. By this method excellent results will be obtained if—and this is the whole question—sepsis is avoided. As to lumbar exploration and removal of sequestra, the plan introduced by Sir F. Treves, we confess we rather agree with Mr. Owen that, while opening the abscess as near the seat of disease as possible is of course good, it is but rarely that we can hope to make out the exact condition of parts or find the sequestra *in situ*, and the method is, as already pointed out, only applicable to lumbar disease. Nevertheless the abscess should be explored with the finger in order to ascertain the size, shape, and relations of the cavity, as well as to reach, if possible, the original seat of the disease and remove any sequestra and wash or sponge out any caseous lymph lying loose in the abscess cavity. This is, of course, quite a different matter from cutting down upon vertebral bodies. It is not wise to scrape these abscesses or to use any strong antiseptic lotion, since anything more than gentle wiping out is apt to lead to bleeding from the wall of the cavity, and any strong lotion may be imperfectly emptied out of the cavity, and so may give rise to poisoning.

Where paraplegia occurs strict recumbency in bed is the only treatment, with very careful general management and the utmost watchfulness to avoid bedsores. All discharges must be carefully cleaned away and the parts kept dry and powdered with boric acid. Occasional washings with strong spirit tend to harden the skin and prevent pressure sores. Any contractures of the limbs should be prevented as far as possible by suitable appliances. The internal administration of large doses of iodide of potassium is highly recommended by our friend Dr. Gibney, of New York, but it has failed in our own hands. Mercury may be tried with advantage in some cases. Counter-irritation in the form of blisters or the actual cautery is sometimes of service. Where the paraplegia resists all treatment for a long time, the question of 'laminectomy' and removal of the source of pressure is to be considered. In one case in which we operated we removed a thick layer of lymph from within the spinal canal, and a paraplegia of six months' standing, which had resisted all other modes of treatment, at once began to improve, but the benefit was only temporary. In two of our cases complete recovery of power of walking followed the operation, but we limit

its application to cases in which paraplegia has persisted after at least six months' absolute recumbency. In cases where paraplegia has come on rapidly, and is due to pressure of an abscess, the operation should no doubt be done earlier (*vide* Thorburn, 'Brit. Med. Jour.,' June 30, 1894). Sufficient success has been obtained by laminectomy to fully justify it in cases where paraplegia does not improve by long-continued rest. The cord may be compressed by sequestra or by an extradural abscess, or possibly by distortion of the spine, but most commonly the pressure is due to effusion of thick tough lymph on the surface of the theca. For details of the operation we must refer to the special works on operative surgery. After the operation some such apparatus as that figured (fig. 187, A, C, or E) should be applied until the parts have consolidated. Our own experience is that the operation is seldom called for, and that the great majority of cases of compression paraplegia improve by continuous rest in bed.

Disease of the sacrum, with abscess pointing into the rectum, is a desperate condition. The abscess is certain to be septic, and can only be reached through the rectum unless it has burrowed down to the sciatic notch, or points at the back, as it may do. In one case we tried to remove the disease, but in consequence of patency of the theca below its normal point it was wounded, and the child died of meningitis; the *post-mortem* showed that any such operation would have been exceedingly difficult, and probably impracticable.

The prognosis in spinal disease depends upon the stage to which the mischief has advanced, the presence of other tuberculous lesions, and the amount of care that can be bestowed upon the case. It is not necessarily bad, and under favourable circumstances is decidedly good; but from one to three years' treatment or even more is required.

Atlanto-axial disease is, as already remarked, rare in children; it is essentially the same disease as tuberculosis of any other joint, but its importance depends upon the effects liable to follow softening of the ligaments and sudden displacement of the odontoid process, viz. sudden death from pressure upon the upper cervical cord. Occipital pain, rigidity and thickening of the neck, with perhaps paresis, are the general symptoms; there may be special difficulty in rotating the head. The general rules for cervical caries apply in other respects to this locality.

Disease of the **costo-vertebral** articulations sometimes occurs, either alone, or as a result of extension from disease of the spine or a rib. Pain, which may be radiating, and formation of abscess, are usually the only symptoms by which the disease can be recognised. The abscess may point either in the back or lumbar region; possibly some cases of psoas abscess depend upon this lesion. It is likely to be mistaken for spinal caries, but the absence of curvature, the slight, if any, rigidity, and the unilateral pain and suppuration, as well as the results of exploration, will probably enable the difficulty to be cleared up. Fixation in a plaster jacket with, if necessary, a window for discharge, or, better still, one of the appliances figured (fig. 187) is the best treatment if the disease is intractable.

Calot's operation.—The revival of the practice of forcibly reducing the deformity resulting from destruction of the vertebral bodies by tuberculous disease must be briefly noticed, as the method has been to some extent

employed in this country, and more largely upon the Continent and in America.

The plan consists in straightening out an angular curvature by combined traction and pressure forcibly applied. That it is possible to reduce the deformity by this means in cases where active disease is going on, and even in some instances where repair has taken place, there is no doubt. Whether the treatment is reasonable and justifiable is quite another question. When active disease is going on it can hardly be considered desirable to tear and bruise tissues already damaged by the attacks of tuberculosis, and run the risk of adding septic infection to the existing tuberculous lesion, nor must the dangers of causing tuberculous embolism be forgotten. But, further than this, a wide gap is necessarily made in the spine, and we have to consider how this is to be filled. The gap is lined with lacerated tuberculous tissue, and is filled with caseous material, recent blood clot, and probably fragments of carious or necrotic bone. These are not tissues likely to be effectual in satisfactorily filling up the chasm, yet they are, apart from a recurrence of the deformity and coaptation of the walls of the gap, the only material available for repair.

Other objections to be raised against the plan are the dangers of injury to the spinal cord, of rupturing 'abscesses' or collections of caseous material, of complete severance of the spinal column, and of lighting up a fresh outbreak of the local tuberculosis. Such are the objections in theory to the operation. In practice the record of mortality and bad results, though very serious, is not hitherto so bad as might have been expected, but so far as we are aware no evidence is yet forthcoming that any repair or filling up of the gap by new bone takes place, and therefore we have no ground for believing that the restoration of shape will be permanent.

The strongest argument in favour of the practice is that it is said to have been successful in some cases of paraplegia in relieving the pressure, but from what we know of the causes of paraplegia in spinal caries we cannot expect that this relief will be anything but exceptional.

On the whole the practice is to be looked upon as wrong in principle, and too dangerous and uncertain to justify any further resort to it until it can be shown by a record of the cases already operated upon not only that the immediate and remote dangers are not great, but also that the improvement in position is permanent and the subsequent union of the bone secure. Mr. R. W. Murray, of Liverpool, in 1897, published reports of two cases in which this procedure had been adopted. He gives *post-mortem* reports showing absence of repair two or three months after the straightening. He does not attribute the deaths to the manipulation. We have never been tempted to try the method, and it appears that the practice has been wisely abandoned.

CHAPTER XXXIII

CLUB-FOOT, DEFORMITIES OF LIMBS, ETC.

THE deformity known as club-foot or talipes may be congenital or acquired. The varieties of the congenital affection are named as follows :

Talipes varus „ valgus „ equinus „ calcaneus	the simple forms.
Talipes equino-varus „ calcaneo-valgus	the compound forms.

Talipes cavus may be simple or associated with equino-varus or equinus.

The only common form of club-foot is equino-varus ; this deformity is sometimes called simply varus, but inasmuch as the distortion is a compound one in almost all cases, we shall consider it under the more accurate title—and this is the more necessary, since its successful treatment largely depends upon recognition of this complexity. Calcaneo-valgus is the next most common form ; the others are only occasionally met with, and as great rarities anomalous forms such as calcaneo-varus and equino-valgus are seen.

The general appearance of congenital **equino-varus** is seen in the figures. The heel is drawn up (equinus) and the anterior half of the foot is adducted and rotated inwards upon an antero-posterior axis, the adduction and rotation taking place at the transverse tarsal joint. Considering this deformity more in detail, it will be found that abnormalities exist in the muscles, ligaments, bones, and fasciæ of the foot, and, though the subject has long been under investigation, we owe to Mr. Parker and Mr. Shattock much of our information upon the share taken by these several structures in the maintenance of the malposition. We use the word 'maintenance' to show that we believe that the deformity is due to persistent fixation of the foot in a distorted attitude rather than to any active displacement caused by muscular or ligamentous contraction. In describing the anatomy of talipes we acknowledge freely our indebtedness to Mr. Parker's work.[1]

In talipes equino-varus the posterior ligament of the ankle joint, the anterior part of the internal lateral ligament, and the astragalo-scaphoid and inferior calcaneo-scaphoid[2] ligaments are those which are especially tight. In addition to these the plantar ligaments and plantar fascia help to maintain the concavity of the sole of the foot which co-exists with the equino-varus.

[1] *Congenital Club-foot*, 1887.

[2] Constituting the 'astragalo-scaphoid capsule' of Parker.

In severe cases the whole of the ligaments on the inner side of the foot are shortened, and there may be adventitious fibrous bands.

Besides the ligamentous structures, the tibialis posticus and anticus, as well as the flexors of the toes, the short muscles of the sole, and the muscles of the calf acting upon the tendo Achillis, contribute to the maintenance of the deformity, though it has been shown that, with the exception of the tendo Achillis, all the rest may be divided, and yet, unless the ligaments are also cut, but little effect can be produced upon the malposition. This is, however, not always the case, and it is probable that the share taken by the different factors in talipes is not always the same. Mr. Parker places the resisting structures in equino-varus in early life in the following order of importance :

(1) The astragalo-scaphoid capsule. (2) The tendo Achillis. (3) The skin of the inner border of the foot. (4) The bony framework of the foot. (5) The other ligaments and muscles.

As to the bones, the trochlear surface of the astragalus is increased posteriorly and diminished in front, and the neck of the astragalus is lengthened and directed more obliquely inwards than normal ; the articular surface on the head lies further inwards than usual. The ' calcaneum lies in a position of exaggerated rotation inwards beneath the astragalus, and in one case was found fused with the navicular.' The lower ends of the tibia and fibula are rotated inwards. The exact form of the astragalus appears to vary with the severity of the case.

The drawing up of the os calcis tends to throw the head of the astragalus downwards, and the front of the foot is inverted at the transverse tarsal joint, and so the scaphoid slips partially off the astragalus and comes to articulate with the tibia. The cuboid, cuneiform, and metatarsals are also rotated inwards, and further retracted by the long and short muscles so as to contract the sole of the foot, thus producing cavus. In some cases all the tarsal bones show a tendency to curvature with the concavity inwards, and the direction of their articular surfaces is altered. The fibula may lie entirely behind the tibia, and the tendo Achillis, being brought close to the inner ankle, may lie nearer the posterior tibial artery than in the normal foot. In a case we dissected the flexor longus digitorum lay directly over the tibialis posticus. Bursæ are found over the prominences of the foot, and may exist even in intra-uterine life.

In early stages and slight cases it appears that the astragalus is natural in appearance, in more severe deformity it is wasted and the neck deviates ; there is not, however, any constant relation between deviation of the neck and deformity. In one or two cases that we have seen the deviation of the foot inwards was, we thought, at the scapho-cuneiform, not at the transverse tarsal joint. The ordinary result of these changes is adduction and rotation inwards of the front half of the foot, with elevation of the heel (figs. 189, 190).

In **valgus** the whole foot is everted at the ankle or the subastragaloid joint, as well as rotated outwards at the transverse tarsal joint ;[1] and, further, the sole is flattened, or in infants oftener convex downwards, the tibialis posticus and calcaneo-scaphoid ligaments being stretched and the peronei shortened.

[1] So that valgus is not the exact opposite of varus.

In **equinus** the tendo Achillis and posterior ligament of the ankle joint are shortened and the astragalus is drawn back, so that only the front of the trochlea is between the malleoli; there are other less important displacements of other tendons.[1] Talipes equinus is said to be an exceedingly rare condition as a congenital deformity; we have seen a very pure example in which intra-uterine pressure marks upon the knees and shoulders were obvious. In **calcaneus** the chief contracted structures are the extensors of the great and lesser toes, the tibialis anticus, and the anterior ligament of the ankle joint; thus the foot is flexed upon the leg and the patient walks upon the heel; the front of the foot may be much atrophied. The trochlear surface of the astragalus is prolonged forwards as far as the navicular facet, and the inner malleolar surface is prolonged forwards (Parker and Shattock).

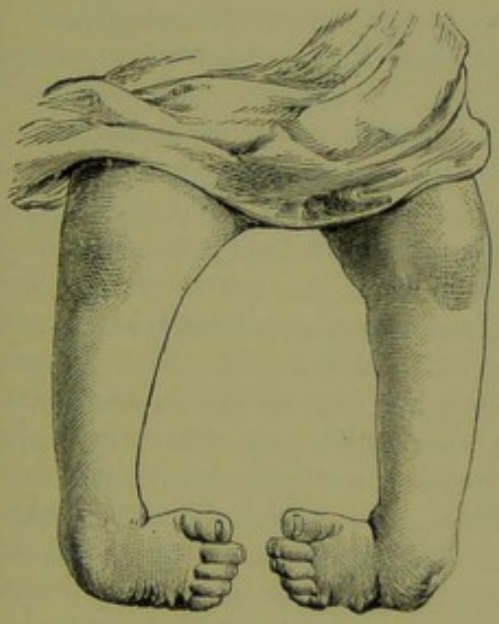

Fig. 189.—Severe Talipes Equino-Varus.

Fig. 190.—Very severe Talipes Equino-Varus.

We have noticed extreme projection backwards of the os calcis in congenital calcaneus, as if the foot were partially dislocated backwards at the ankle, a deep depression existing over the front of the joint. Hollow club-foot (**cavus**) depends upon shortening of the muscles of the sole of the foot and the plantar ligaments, as well as the flexors of the toes, the tendo Achillis, and tibialis posticus. By the arching of the foot and the drawing up of the heel the extensors of the toes are put upon the stretch, and hence the toes are drawn up in hyper-extension, so that the deformity known as 'hollow claw-foot' is usually produced.

The compound forms of talipes need no special description, as they consist of combinations of the simple varieties.[2]

[1] *Vide* Mr. Parker's book.

[2] Holmes Coote, in *St. Barth.'s Reports*, vol. ii. 1866, described a form of talipes consisting in rigidity of the tendo Achillis with subsequent development of flat-foot, of which

Etiology.—Many theories have been proposed to account for the occurrence of club-foot, and it is possible that most of them are true in certain cases ; we do not think any one cause alone will explain all cases of club-foot, though the great majority are due to malposition *in utero.*

Central and peripheral nerve lesions, causing spasm or paralysis of muscles, may account for some cases, where, for instance, spina bifida or absence of brain (anencephale) is associated with talipes ; on the other hand, Parker and Shattock found both cord and nerves perfect in a case they examined. In opposition to them, however, we must point out that the nutrition of the talipedic limbs is often impaired, and they are fat, flabby, and toneless ;[1] the muscles may, however, react normally to electricity. Intra-uterine pressure associated with deficient amniotic fluid (Cruveilhier) is no doubt the cause in some children. We have found talipes associated with intra-uterine constrictions and amputations from amniotic bands,[2] and in another case, alluded to above, the deformity co-existed with pressure marks ; but the distortion is also found where the liquor amnii is abundant, and such explanation hardly accounts for single talipes as the only malformation.

A persistence of the natural early fœtal position (Eschricht) explains some cases (of equino-varus and, later, calcaneus) ; in others, again, deficient development of parts is the cause, as in cases where congenital absence of the fibula has produced valgus, and this may be compared with fig. 204, of absence of the radius producing club-hand.[3] Hueter supposed that obliquity of the neck of the astragalus was a cause, but, as shown by Parker, this may occur without talipes, and talipes may exist without it. Intra-uterine joint disease possibly explains some cases, and adhesions are found in certain instances in the joints. Cruveilhier, Förster,[4] Parker and Shattock, and Silcock have pointed out that where the limbs are interlocked in abnormal positions they will exert pressure on each other quite independently of the amount of fluid ; we have frequently seen cases where clearly the feet had interlocked : the one foot, being in a position of extreme calcaneo-valgus, was received into the concavity of the other, which had severe equino-varus.[5] For further discussion of the subject we must refer to the admirable works, so often quoted, of Messrs. Parker and Shattock, and, in acknowledging our indebtedness to them, we can confirm many of their observations by our own ; we think that nearly, but not quite, all of the cases can be explained mechanically by pressure or position *in utero*, bad packing as it were, and so-called 'club-hand' is, we believe, due to the same cause. One of the strongest proofs, to our mind, is the tendency seen in children to assume, long after birth, the position they occupy *in utero*, with the feet or hands

it appears to be an early stage ; he called it 'rectangular talipes equinus,' the foot being kept at a right angle with the leg.

[1] Possibly this may be explained by the absence of natural exercise *in utero*, when the feet are interlocked or misplaced.

[2] Parker and Shattock also mention a case of theirs.

[3] Club-hand is, however, probably the result of pressure causing arrest of development of the præ-axial border of the limb.

[4] *Missbildungen des Menschen*, Taf. xxvi. fig. i., from Cruveilhier ; the figure is copied in Bodenhamer, as the subject had also imperforate anus.

[5] Confirmation of this view of the causation of talipes is found in the other deformities similarly produced, such as 'genu recurvatum, &c.' *Vide* figs. 206, 207.

locked in the talipedal attitude (fig. 191). The result of habitual positions in producing curved bones in rickety children is interesting also in this relation (*vide* fig. 44).

It is sometimes said that talipes is merely an arrest of development, a 'failure to unwind' the foot from its earlier or later fœtal position: we think this hardly fully expresses the truth, there is something more; an actual pressure and squeezing together of the parts in an abnormal position is certainly what has occurred—in most of the more severe cases at any rate.

As to the degree of deformity, we cannot do better than quote Mr. Parker's words: 'When the cause begins to act very early in, and continues throughout, intra-uterine life, the deformity will be a very fundamental one; whereas, if the cause begins to act at a later period, or if it be continued for a short time only, the resulting deformity will be less severe.'—'Brit. Med. Jour.,' October 27, 1888.

The *treatment* of all cases of club-foot in children can be successfully carried out without any but the most simple apparatus, except in the instances where, from neglect, old cases may require tarsectomy; we shall, therefore, confine ourselves to description of the methods we have found most useful, and omit all reference to costly and complicated appliances. The general principles of management are the same for the different forms of club-foot, so that we may take an ordinary case of equino-varus as a type. Several questions have to be considered, such as (1) When is treatment to be begun? (2) Is a cutting operation to be performed; if so, what structures should be divided, and at what age? (3) When operation is required should all the tense structures be divided at the same time, and should reduction of the deformity follow immediately on the operation or be delayed? (4) What is the best apparatus to apply? (5) How long is treatment to be continued?

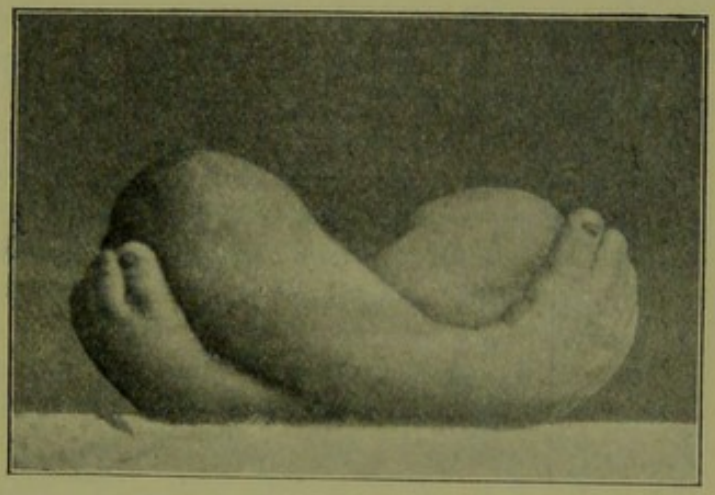

Fig. 191.—Showing how Talipes is produced by 'bad packing.' (From a photograph by Mr. C. S. Ashe.)

(1) It might be thought unnecessary to insist upon the treatment of club-foot being begun immediately after birth, but we have more than once had cases, several months or more old, brought for relief, in which not only had nothing been attempted, but the friends had been told the child was not old enough for any treatment yet. Of course with a child a few days old more can be done in a week than is possible in a month with an older child. Treatment should be begun without a day's delay. (2) The question of tenotomy has been allowed to become largely one of fashion, some surgeons advising it in nearly every case, and others insisting not only on its needlessness, but upon the harm resulting from it. The rules we follow on this point are: If the child is seen within the first few weeks of life, operation is very rarely,

if ever, necessary. During the next two or three years two points have to be considered: first, what amount of care can be expended upon the case; and secondly, how rigid are the resisting structures, i.e. can the deformity be reduced by moderate force? If the child can be thoroughly well looked after, and its splints applied regularly and intelligently, operation is not *necessary* in most cases under two years old, although it undoubtedly shortens the time required for reduction, and is sometimes desirable—certainly so where there is much rigidity, and any doubt about the efficiency of the care and management. Where the rigidity is so great in a child over three months old or thereabouts that the deformity cannot be completely reduced by reasonable force, operation should at once be performed; such cases are, however, comparatively rare. We see no advantage in forcible 'redressement' over a cutting operation. (3) In equino-varus, if all the resisting structures are to be divided, those which maintain the varus part of the deformity as opposed to the equinus may be cut at the same time, and before there is any attempt to remedy the equinus, or both may be done at the one sitting. The plantar fascia rarely requires division except in neglected cases. Authorities differ as to the risks of immediate reduction after tenotomy. We do not think the matter is one of great importance, and generally settle the question by the interval that is to elapse before the next visit; if more than two days, we usually correct the deformity at once. (4) As to the question of apparatus, we may say at once that we have never used, or seen the advantage of, the more complicated instruments—shoes modified in various ways from Scarpa's, taliverts, and so on; they are too expensive for the hospital class, and in all classes we are quite satisfied with the results to be obtained by much more simple means.

Practically we find one of three appliances will meet almost every case; two are of Dr. Little's invention, and the third is a slight modification of Barwell's artificial muscle plan. To take a case of equino-varus in which the varus is to be remedied first. The first appliance is adapted only to infants or children a few months old. It is simply a strip of thick block-tin long enough to reach from the knee to just beyond the end of the toes when the foot is pointed (fig. 192). This is bent to fit the foot along its outer side in its full equino-varus position. It is then bandaged on, no attempt being made to remedy the equinus or varus; when it is securely fixed to the leg and foot, the front of the foot (i.e. the part beyond the transverse tarsal joint), together with the tin, is gently bent outwards so as to slightly improve the varus, leaving the equinus unaltered. The foot is left in this position till the next day, or longer if absolutely necessary, when the bandage is re-applied and a little further correction employed, and so on till the varus is somewhat over-reduced. The equinus is then dealt with in the same way, the splint being applied to the back of the limb. The second appliance (fig. 194) is simply Dr. Little's tin splint. It may be used with the foot-piece fixed at a right angle with the leg-piece, or better movable, so as to remedy the varus alone first. This splint is applicable to older and more rigid cases, as it is a much more powerful appliance than the last. It is useful sometimes to have a slit cut in the metal at the angle between the leg and foot pieces running a little distance along the edge of the sole; through this slit the bandage is carried, and so the heel is more securely

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fixed down. The third apparatus is Barwell's artificial muscle, somewhat modified. The way of applying the muscle is that shown in fig. 193. The principle of the elastic traction method, which we owe to Mr. Barwell, is of the utmost value in orthopædic work. In talipes the continuous traction and the possibility of taking off the apparatus and moulding and massaging the limb are of the greatest importance. The continual play of the elastic tends to develop the action of the muscles as well as to correct the deformity, and, combined with massage, helps to improve the defective development of the limb which so often co-exists with talipes. The plan we adopt usually is to use one or other of the tin splints, generally the first, until the deformity is so far corrected that the muscle can be efficiently applied ; the latter is then worn till the cure is complete.

As to the duration of treatment no hard-and-fast rule can be laid down ; it varies in each case with the rigidity of the parts, the age of the patient, and the care expended upon it. If the case is seen early, or if operation is decided upon, an artificial muscle can usually be applied in a few days. As soon as this can be used the drudgery of the task is over, but the case cannot

Fig. 192.—Little's plain Tin Splint.

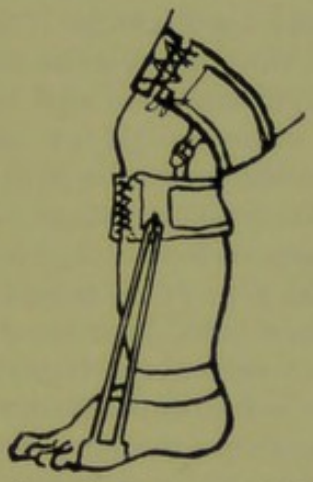


Fig. 193.—Artificial Muscle applied to correct Equino-varus. The felt band is kept well over the balls of the toes. (Drawn by H. Irving, M.B.)

Fig. 194.—Little's Tin Talipes Shoe, which may have a joint at the junction of the sole and leg pieces.

be considered cured ; hence the answer to the fifth point, that of the duration of treatment, can only be general. As Dr. Little pointed out, no case is safe from relapse until the patient is old enough to watch himself and correct the earliest sign of return of the deformity, although by the use of the artificial muscle another dictum of his, that there must be no walking till the deformity is remedied, may be set aside. Great care is required, in applying the splints, not to be deceived by the rotation of the limb, and until the artificial muscle can be applied so as to slightly over-correct the deformity no walking is to be allowed ; after this point is reached it does no harm, but rather good. The essence of the matter is largely in the amount of trouble taken with each case by the surgeon and the friends.

Some other points in management must be also considered. Manipulation, i.e. firmly holding the foot in a slightly over-corrected position, is exceedingly useful, and should be daily employed each time the splints are removed—or if, unfortunately, from pressure sores or other causes, the apparatus has to be left off, frequent manipulation prevents time from being

lost. The leg should be firmly grasped in one hand, in such position that the patella looks directly forwards, and then the other hand should be used to slowly turn the foot into position, bearing in mind, in each case, the seat of the deformity ; thus in varus the ankle joint must be steadied and the rotation made at the transverse tarsal joint.

Pressure sores are to be avoided by regular daily renewal of apparatus, and avoidance of rucking up of plaster or bandages ; though, perhaps, strapping is more apt to cause sores than webbing,[1] it is easier to keep on in the early stages of treatment ; we, however, generally use thin saddler's felt or webbing for the foot-strap, and carry it round the ankle and foot in the fashion shown in fig. 193.

Should it be decided that tenotomy is required in a given case, the rules for its performance are as follows. To divide the tibialis posticus the limb is laid upon its outer side upon a firm pillow, the posterior border of the tibia is felt for, and the tenotome passed in two fingers' breadth (in an infant) above the inner malleolus, in such position that its point just hits the edge of the bone ; the knife is then slipped close to the bone, between it and the tendon, and its edge turned towards the tendon ; the foot is then held so as to correct the deformity, and by a gentle levering motion the tendon is divided, cutting towards the skin ; as soon as the tendon is felt to snap, the knife is withdrawn and a collodion pad and bandage applied. Occasionally bleeding is free, but readily stops on pressure, and no bad result follows. If the edge of the tibia cannot be felt, a point midway between the front and back of the limb marks its position. The better plan is to divide the tibialis posticus, together with the ligaments, through one puncture opposite the transverse tarsal joint in the posterior crease of the sole.

The tibialis anticus is best divided upon the dorsum of the foot, just before its insertion into the inner cuneiform ; it is easily felt, and the knife passed beneath it, and division effected as in the posterior tendon.

The tendo Achillis is perhaps the simplest of all. It should be cut about ¾ inch above its insertion, at its narrowest part, the knife being passed well beneath it (i.e. nearer the tibia), from the inner side while the limb lies on its anterior surface. Personally we prefer to pass in the knife while the tendons are held tense and can be plainly felt ; others prefer to tighten only after the tenotome is beneath the muscle.

We are much in favour, in suitable cases, of Mr. Parker's plan of dividing all rigid structures at the transverse tarsal joint, and not limiting the section to the tendons or fascia. The tubercle of the scaphoid should be felt for and the knife passed in at the inner border of the foot, just behind the bone ; the edge is then turned towards the joint and made to cut well into it, dividing everything until the foot readily yields ; by thus severing the ligaments subsequent reduction is rendered much easier. Where this plan is adopted, the tibialis posticus and anticus are divided at the same time as the rest of the rigid structures ; the internal plantar artery is necessarily cut, and we have once seen a traumatic aneurism result, but no serious ill effect need be feared, even if bleeding is free at the time.[2] The anterior

[1] *Vide* Golding Bird, *Guy's Hospital Reports*, 1882.

[2] Other cases of aneurism following division of the plantar fascia are on record—*vide* Walsham, *Lancet*, January 28, 1888.

and posterior ligaments of the ankle joint require division in some cases of calcaneus and equinus respectively.

It should be remembered that in second tenotomies the characteristic snap is often not felt.

We are not satisfied with the results of fixing feet in plaster of Paris, either with or without tenotomy, but much prefer an arrangement where the pressure may be altered frequently.

Where the artificial muscle plan is being employed, if tenotomy is required at all, it is usually the tendo Achillis that needs division, since the plaster is apt to slip up towards the heel in such cases. Where the other splints are used, it is better, if the varus is corrected first, to divide the tibial tendons, &c., three or four weeks before the tendo Achillis ; some surgeons prefer always to divide the Achilles tendon first. The peronei rarely require division (we have never seen a case suitable for peroneal tenotomy) ; if they do, the section is made two fingers' breadth above the outer malleolus. The extensor longus digitorum and proprius hallucis may be divided just below the annular ligament, but we have never found the operation necessary.

Congenital valgus is best treated by a muscle applied so as to exert pressure in the opposite way to varus ; it is, however, not so readily corrected. The rare equinus requires muscles on both sides to draw up the toes, usually after tenotomy. Calcaneus is best treated by the tin strip (fig. 192) or the jointed form of the splint (fig. 194).

Talipes cavus is often remedied by division of the tendo Achillis only ; in other instances the resisting structures in the sole may require section. Where there is much cavus with equinus it is sometimes necessary to attach the 'muscle' to a thin metal plate moulded to the balls of the toes, to prevent the foot strap from slipping into the hollow of the sole.

There is no doubt that tenotomy alone is in many cases inadequate, and has been, with the exception of division of the tendo Achillis, largely given up in favour of the more complete and scientific operation of 'syndesmotomy' (division of ligaments) described by Parker. Of 'open division' (Phelps' operation) of all the resisting structures, including the skin, we have little experience ; we have, however, had one or two cases in which after 'syndesmotomy' at the transverse tarsal joint the skin has given way under the strain of forcible reduction of the deformity. The only harm resulting has been delay in the healing of the wound and some little increase in difficulty in the application of the 'muscle.' The principle of the plan does not commend itself to us.

Excision of one or more bones of the tarsus for inveterate club-foot, as employed by Davies Colley, Davy, Lund, and others, is an operation to be reserved for severe cases in older children, and only employed when there is no hope of remedying the deformity by other means.

The operation we prefer consists in making a ⊥-shaped or oval incision on the outer side of the foot, the horizontal limb running along the outer border, and the vertical part passing across the centre of the cuboid. The flaps are reflected, the bones exposed, the tendons being drawn aside, and a wedge of bone is removed entire or piecemeal from the outer side of the foot ; a chisel or osteotome is the most convenient instrument for the purpose. Various lines of section are employed, but the general rule is to remove the cuboid always,

and as much of the adjacent bones as the individual case may require ; the cuneiforms, head of the astragalus, bases of the metatarsal bones, and front of the os calcis may all require to be taken away.[1] After the operation the foot should come readily into position ; all bleeding having been stopped, and the dressings applied, the limb is at first fixed lightly on a back splint. The wound often heals somewhat slowly, and until it is superficial we prefer not to use forcible corrective apparatus ; usually in about a fortnight the muscle may be applied. It is a good plan to take away an oval piece of the thick callous skin and the underlying bursa from the dorsum of the foot. We look upon the operation as a very valuable one in suitable cases—for instance, where the patient walks upon the dorsum of the foot and pressure sores are prone to develop, while all the structures are rigid (*vide* fig. 190).

Excision of the astragalus alone, we think, is best adapted for paralytic cases—in such instances we have removed the bone with excellent results ; it may be done without division of any important structure, by an incision over the ankle joint, carried from the tibialis posticus to the tibialis anticus, and another one at right angles to this, along the inner border of the latter tendon. By a little careful dissection the bone can be got out, the only difficulty being with the interosseous ligament. After the operation a shapely foot with a good arch still remains. Other incisions may be used.

The most common forms of **paralytic** (**acquired**) **Talipes** are equino-varus and valgus ; these, so far as the deformity goes, are usually readily treated by the artificial muscle method, and the effect is generally immediate and to a certain extent satisfactory ; it does not, of course, remove the weakness and flabbiness of the foot, but it prevents actual turning outwards or inwards, and makes walking much steadier and more sightly. Where, however, from long neglect the deformity is irremediable by these means, the method of excising the astragalus already described may be required. In very severe cases of infantile paralysis, where the foot is perfectly powerless, and especially where the paralysis extends above the knee, and the knee joint is flexed, the limb being flail-like, short, and useless, amputation may be required ; this, however, should never be done in childhood, since there is a possibility of improvement. The attempt to convert the flail-like distorted limb into a stiff stable support by resection of the knee and ankle joints ('arthrodesis') gives very satisfactory results. In a case we operated on in 1884 there was very considerable improvement—this was, we believe, the first case operated upon in this country. Further experience has proved to us the great value of this operation in suitable cases. Walsham practised shortening the tendons by excision of a part and suture of the divided ends, thus correcting the deformity and allowing the lax muscles to act ; we also tried the plan, with fair results in two or three cases. It is sometimes of much value. Nicoladoni, Eve, Goldthwait and others introduced the method of attaching healthy muscles to the tendons of paralysed ones so as to restore

[1] The principal modes of tarsectomy are :
1. Excision of a wedge of bone, irrespective of joint lines (Davies Colley).
2. ,, ,, cuboid (Little).
3. ,, ,, astragalus (Lund) (chiefly, we think, applicable to acquired talipes).
4. ,, ,, astragalus, cuboid and scaphoid (West).
5. ,, ,, wedge from the neck of the astragalus (Heuter).
6. Linear osteotomy of the tarsus or of the leg above the ankle joint (Hahn).
7. Excision of a wedge from the transverse tarsal joint, &c. (Rydygier) : *vide* Rydygier, *Berlin. Klin. Woch.* February 5, 1883.

flexor longus hallucis is a very important factor in tying together the pillars of the arch of the foot ('Lancet,' February 9, 1884). In slight cases it is often sufficient to thicken the inner side of the boot, both sole and heel, so as to throw the foot into a varus position. This of course in addition to the exercises.

No operation is ever required for acquired flat-foot in children.

A form of distortion in which there is adduction of the foot, or rather rotation inwards, in which the deformity depends upon a rotation of the whole leg, is sometimes met with. It gives rise to the condition popularly known as 'duck-toes.' The unsightly gait may be due to congenital malposition or to rickets; it has been proposed to call the deformity 'club-leg,' and to remedy it by osteotomy of the femur (*vide supra*, chapter on RICKETY DEFORMITIES; also Parker, 'British Medical Journal,' Oct. 27, 1888).

Fig. 190.—Congenital Wry-neck.

Wry-neck or **Torticollis** is a fairly common affection in childhood, and may be due to any of the following conditions:

1. It may be congenital, probably due to malposition *in utero*—sometimes to mal-development, as in a case of our own, in which wry-neck, deficient development of the external ear, mastoid region, and lower jaw co-existed with cleft palate and mental deficiency.[1]

2. It may result from injuries at birth, lacerations of muscles, &c. Volkmann has found the sterno-mastoid represented by a band of cicatricial tissue. Sterno-mastoid tumour (p. 25) is sometimes followed by torticollis, the injured muscle subsequently becoming contracted. We have had several cases in which there was a history of sterno-mastoid tumour in infancy. (See D'Arcy Power, 'Med. Chir. Trans.' vol. lxxvi. 1894.) Petersen, however, thinks the hæmatoma is a result of injury to the previously shortened muscle.

3. It may be spasmodic, due to central or peripheral nerve lesions or reflex irritation.

4. It may result from suppuration in the neck, due to either glandular abscesses or cervical caries, causing matting together of the parts and contracture of the muscles.

5. Burns or other injuries may, of course, produce cicatricial torticollis.

In its most simple form wry-neck is due to contraction limited to one sterno-mastoid, which is felt as a hard tight cord in the neck; the head in

[1] Intercalations of more or less developed vertebral bodies may produce wry-neck of one kind, as it may lateral curvature.

such cases is drawn towards the shoulder, and the face turned towards the opposite side (fig. 199).

Golding Bird[1] is inclined to consider the condition due to a cerebral lesion analogous to the cord lesions in infantile paralysis.

In other instances the sterno-mastoid is not alone affected, but the scalenes, trapezius, and cervical fascia contribute to the deformity.

Treatment.—In slight cases in quite young children regular daily stretching and manipulation of the rigid muscles may suffice to get rid of the deformity. In the severer forms of the affection tenotomy is the only effectual treatment. The sterno-mastoid, and possibly the trapezius, require division. We always now divide the muscle through an open incision, in preference to the old subcutaneous plan, and where the cervical fascia is also tightly contracted it is necessary to divide it, and in such cases it is certainly safer to make an incision over the muscle and gradually dissect through the rigid parts in an open wound. Some surgeons prefer to divide the muscle at its middle. Two days after the tenotomy the apparatus (fig. 200) recommended by Mr. Southam should be applied. The following case is characteristic :

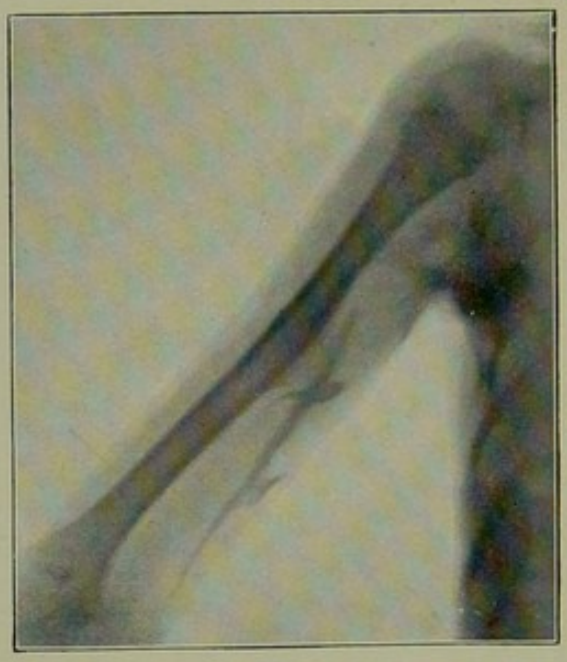
Fig. 200.—Artificial Muscle applied for Wry-neck after division of the Sterno-mastoid. A Sayre's or felt jacket is applied to the trunk, and traction made from a poroplastic cap or ring of strapping.

Case.—*Torticollis.*—John Wm. G., age 5 years ; admitted August 5, 1885. A neurotic family history ; the child has never been strong ; the deformity is congenital, but has been getting worse lately, and is increased when the child is not well ; has lately had toothache on the left side. On admission the left sterno-mastoid is contracted in its whole extent, forming a firm prominent band ; the interval between the tendons is deeply marked, the sternal tendon being the most prominent. The chin is rotated 1½ inch from the middle line downwards and to the right ; the platysma is also prominent. August 13, tenotomy of both heads through the interval ; the cervical fascia was also partially divided. Antiseptic operation and wood-wool dressing. 14th, no pain ; the head was packed in sand-bags. 17th, a plaster-of-Paris jacket was put on with hooks fixed in it, and a rubber muscle was applied parallel to the right sterno-mastoid, attached to the head by circular bands of strapping. 20th, another muscle was applied in a corresponding position at the back. 22nd, made out-patient. He was seen subsequently, and hardly any visible deformity remained. November 10, 1885, quite well.

Spasmodic torticollis, if it does not yield to medical treatment, may require stretching or resection of the spinal accessory nerve—all causes of

[1] *Guy's Reports*, 1890 ; *vide* also Murray, *Liverpool Med. Chir. Jour.* July 1892.

PLATE II.



Skiagram of the arm and chest wall in a case of Myositis ossificans, showing the bony spines and plates in the muscles.

reflex irritation, carious teeth, worms, otorrhœa, enlarged glands, &c., having been previously removed.

The other forms of wry-neck require treatment on general principles, or are irremediable ; special care must, of course, be taken not to overlook the presence of cervical caries.

In all cases of wry-neck, where manipulation is admissible, steady and regular attempts should be made to remedy the distortion ; friction and steady stretching of the neck with the hands should be tried, and the child made to practise, before a looking-glass, trying to hold the head straight. To supplement these means, various apparatus, collars, &c., may be used ; the one we have found most efficient is that figured for use after tenotomy. In quite young children, of course, no voluntary help from the child can be obtained, but the friends must be instructed what to do, and in older patients it is a good plan, as Mr. Roth has pointed out, to get the child familiar with the exercises before the tenotomy is performed, so that no time may be wasted afterwards.

Congenital cases, where the sterno-mastoid alone is involved, are usually completely curable ; many of the spasmodic cases get well either spontaneously or after removal of some source of irritation. In cases where the scaleni are involved there is more difficulty, and section of cervical nerves or of these muscles may be desirable, provided a suitable case occur. In many of these patients the face is undeveloped, or distorted on the affected side ; secondary lateral curvature of the spine may also result.

It is certain that the condition already described as sterno-mastoid tumour sometimes leads to subsequent development of torticollis from cicatricial contracture of the muscle ; in the many cases we have seen, such result has followed in several instances, and D'Arcy Power has collected a number of other cases. *Op. cit.*

No treatment is required for the sterno-mastoid tumour except that watch should be kept for the slightest sign of onset of the torticollis, and suitable preventive exercises employed.

Congenital Deficiencies and Malformations of Muscles are often slight, and interesting from an anatomical rather than a surgical point of view ; in other instances, such as those where the pectoral muscles are absent, in association with arrest of development of the chest-wall, the malformations are irremediable ; in others, again, some help may be obtained by elastic cords ('artificial muscles'), or possibly by the transplantation of muscle flaps ; for the most part, however, these conditions are beyond the present reach of surgery.

We must just mention the very rare condition known as *myositis ossificans*, of which a remarkable instance was some time ago under our care. The patient was a child of 6 years old ; the affection began about a year before and was steadily progressing ; cervical, pectoral, brachial, abdominal, intercostal, and femoral muscles were many of them more or less affected, without any disturbance of health so far. No cause is known for the disease, and no treatment seems to be of any avail ; the subjects of it usually die from interference with the respiratory movements or some intercurrent illness, though they may live for years (Plate II.).

Tenosynovitis is an affection common in, but by no means peculiar to, childhood. Tuberculous tenosynovitis is, however, not rare as a secondary condition to joint disease, but occasionally occurring alone; its existence is to be suspected when swelling and suppuration occur in the course of a tendon in a tuberculous subject, and its treatment must be on general principles—rest and constitutional measures in the early stages, and careful scraping if necessary later. We have once or twice seen suppuration in the large palmar sheath, and in one instance it occurred in a premature child only a few weeks old, coming on without assignable cause; secondary pyæmic abscesses elsewhere followed, but the child ultimately got quite well.

Bursæ in children are not usually very well developed. Patellar bursitis is, however, not very rare, and we have seen it lead to disease of the knee-joint; the olecranon bursa is also occasionally enlarged, while effusion into the semi-membranosus bursa is not uncommon. Ganglion is most common in the radial extensor tendons and in those of the thumb; in recent cases the fluid may be dispersed by pressure, in others it should be punctured with a grooved needle and the clear gelatinous contents let out; a pad with firm pressure should be kept on for three weeks afterwards, or the sac is likely to refill. In obstinate cases the sac should be laid open and as much of it as possible dissected away.

Malformations.—Other congenital malformations may be conveniently considered as (1) those due to errors of growth in the embryo itself—inherent errors [1]—and (2) those due to abnormal intra-uterine surroundings—acquired errors; or they may be classified as deformities by excess, deformities by deficiency, and deformities by distortion. In either case it is somewhat difficult to assign to their proper place all the malformations met with, and fortunately it is of little practical importance, as far as treatment goes, that we should do so.

Among inherent errors may be classed supernumerary fingers and toes—polydactylism; some cases of webbed fingers and toes—syndactylism; tripodism; congenital tumours of the dermoid class—with which might be put the cases of so-called fœtal inclusion. Possibly certain less-marked malformations, such as those affecting only some of the structures of a limb, congenital varices, venous and lymphatic, congenital muscular abnormalities, &c., should be placed here, though these, in so far as they are of surgical importance, are more conveniently considered under the organs to which they belong. Many instances of inherent errors are better seen in the head and trunk, such as a failure of closure of the dorsal and ventral laminæ and of the visceral arches of the head, meningocele, spina bifida, hare-lip, extroversion of the bladder, &c.

Among acquired errors are all those due to intra-uterine pressure, either by the walls of the uterus itself, by amniotic bands (Gurlt),[2] by pressure or violence applied to the uterus from without, or by mere malposition of the fœtus *in utero*, at whatever period of gestation they arise.

[1] 'Vices of conformation.'

[2] Or, as Montgomery has pointed out, by bands of lymph stretching from one part of the fœtus to another; *cf.* Intra-uterine Amputation, p. 787, and *vide* Todd's *Encyclopædia* and Ballantyne's *Antenatal Pathology*.

In considering what malformations should be placed in this group, we must remember that it is probable that pressure or violence acting in a very early stage of development leaves much less obvious signs of injury than if it is inflicted at a later period ; thus constriction or pressure during the later months of pregnancy may leave distinct cicatrices, while the same forces applied earlier may cause deficiencies without any marks of violence or scars.[1]

In this group will be placed deficiency of limbs, fingers, &c. (**intra-uterine amputation**), as examples of the highest degree of deformity ; also congenital constrictions and dimples, together with congenital synostoses or deficiencies of parts or the whole of a limb, such as absence of one or more of the carpal or tarsal bones,[2] of the lower end of the radius or ulna, causing club-hand ; or mere faults of position such as are found in club-foot, flexed or hyper-extended joints, &c.

The proof that some of these deformities are the result of errors of the embryo, and others of abnormalities of the environment (intra-uterine pressure, &c.), is in many cases easy, in others impossible. Thus polydactylism and congenital tumours cannot be the result of intra-uterine pressure, while congenital deficiency of limbs is shown to be at least sometimes due to constriction by the fact that the amputated limb has been found lying loose *in utero*, and in other instances the limb has been found incompletely severed, or even an unhealed stump has been present. On the other hand, the absence of the amputated limb, and the smooth scarless appearance of the stump sometimes met with, may be explained by the fact that the limb may become disintegrated by maceration *in utero*, and if the separation took place at a very early stage the scar might disappear during growth or become indistinguishable from its small size. Pressure, again, might well produce entire arrest of growth of a limb without amputation, and thus no scar would be left, while in other cases pressure might produce fusion of parts together, as in web fingers.[3] Evidence in favour of this is afforded by the co-existence of amputations with webbed fingers (both, in such cases, the result of pressure, though even here the webbed condition may have been due to mere retarded development from constriction).

Case.—*Web Fingers and Toes, &c.*—Albert B., age 9 months ; admitted November 2, 1885. No history of deformity or maternal impression. Left hand, second and third fingers are united as far as the first interphalangeal joint ; there is no nail on the first finger, a very imperfect nail on the second. Right hand, the first finger has a deep constriction around the last phalanx, with a bulbous enlargement of the end of the finger ; the second finger has a similar constriction, but the part beyond is small and almost without nail. There is a very deep constriction round the right leg, about one inch above the ankle, almost reaching to the bone. The child can stand on the leg and moves the foot freely. Left foot, there is only one phalanx in the great toe, and no nail ; the nail of the second toe is very rudimentary, and there is a small outgrowth on the fourth toe. Right foot,

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[1] Vide *Med. Chir. Trans.* 1877 for a case of complete absence of both upper limbs without any scar ; this was supposed not to be due to amputation.

[2] Bryant (*Diseases of Children*) records a case of congenital absence of the fibula, os calcis, cuboid, and three outer toes ; and this is not a very rare malformation.

[3] Web fingers are, however, no doubt in most cases due to mere persistence of the fœtal spade-like condition of the hands.

toes perfect, but the foot is hypertrophied and flat. November 5, Didot's operation on the hand. 7th, healing well. 12th, stitches removed; flaps have united largely, but there is some granulating surface. Sent home on November 13. The flaps subsequently gave way partially, but were again nearly healed, when the child died at home of broncho-pneumonia.

Suppression of an intermediate segment of a limb, as where fingers are found springing from a stump of the upper arm, is probably due to pressure.

Again, inherent and acquired errors may co-exist, and would be likely to do so. A local overgrowth of the embryo might well disturb the relation between the uterus and its contents, and lead to deformity by pressure.[1]

Lastly, reversion, atavism, and so on, must not be left out of sight in considering these questions, which cannot, however, be further discussed here.[2]

Whether double monsters, dermoid cysts of the ovary and testis, and congenital tumours of various kinds are the result of fœtal inclusion, parthenogenesis, or gemmation, is a question that cannot be entered upon here; it will be sufficient to say that some cases are certainly the result of 'fused'[3] embryos—e.g. double monsters, adherent twins, and so on—while some congenital tumours are equally certainly mere errors in the closing in of the folds of the blastoderm or of the local involutions by which certain organs are formed.[4] We have had a remarkable case of abdominal tumour in a child three months old which proved to be an included fœtus lying in the lesser cavity of the peritoneum.

Supernumerary digits are found attached in various ways; thus, a mere little fleshy outgrowth with or without a nail, and with no bony support, may be attached to a more or less normal finger, or the end of a finger may be bifid, with two nails. In other instances a supernumerary thumb with two phalanges may spring from the joint between the 'metacarpal' bone and the first phalanx, a common joint existing for the two thumbs, or the extra one may be attached to the side of the proper one. It is sometimes not easy to make out which is the supernumerary and which the natural digit; in such cases the most useful one should, of course, be left.

In any case of supernumerary fingers the additional one should be removed in infancy, so as to allow the other as far as possible to be trained into its proper position. Where a joint is common to the two fingers care must be taken not to injure the articulation nor to allow it to suppurate, for fear of a stiff joint resulting. Supernumerary toes should be removed if they cause distortion of the foot or are likely to lead to trouble in wearing ordinary boots.

For figures and details of the different forms of polydactylism we must refer to Annandale's work on 'Diseases of the Fingers and Toes.'

[1] Deficient development of one half of the body, with facial paralysis, has been met with (Barker, *Clin. Soc. Trans.* 1884).

[2] *Vide* Bland Sutton's Lecture, *Lancet*, 1887–8; also Ballantyne's *Antenatal Pathology*, the standard authority on this question.

[3] 'If during development the medullary fold remains cleft, two complete fœtuses are formed from a single ovum,' and every degree of combination from twins to very rudimentary 'parasitic' fœtuses may result. (Bland Sutton, *Lancet*, February 11, 1888.)

[4] Numerous figures and references will be found in Förster's *Missbildungen des Menschen*.

Occasionally cases are met with where more or less of a limb is deficient, and the member ends in a pointed or truncated extremity like an amputation stump ; this may occur at any point in the length of a limb. Sometimes only parts of one or more digits are deficient, sometimes the amputation has been incomplete, and a deep sulcus round the finger or limb, with often a bulbous expansion on the distal side of it, marks the seat of pressure. This constriction in some cases is so tight that there appears to be little left undivided except the bone, and this condition we have met with associated with talipes ; the movements of the limbs were, however, good, and evidently the deeper structures, though compressed, were not divided. We have also seen these constrictions associated with dimpled depressions over the knees and shoulders, and rigidity of the joints, also the result of intra-uterine pressure ; in one instance there was also microcephalus. Most of the cases of intra-uterine amputations, and of these constrictions, are the result of pressure by amniotic bands or fœtal adhesions, as already pointed out ; but it is undoubtedly occasionally true that pressure by the umbilical cord, so gradually exerted as not to interfere with its own circulation, may

Fig. 201.—Double Thumb.

Fig. 202.—Intra-uterine Amputation of Fingers.

produce the same effect.[1] We have not seen a case of constriction requiring any operation, though it has been suggested by Mr. Edmund Owen to pare the adjacent surfaces and unite them so as to obliterate the groove.

Nothing, of course, can be done for congenital amputation except the use of prothetic appliances, and it is wonderful what use these patients can make of their stumps. As already pointed out, in some instances there is a distinct scar, in others a smooth unbroken cutaneous surface, and sometimes rudimentary digits remain attached to the end of a stump containing only the humerus or femur ; this is rather an arrest of growth by pressure than a true amputation. So, too, sometimes the femur or humerus is congenitally very short or deficient (fig. 203).

Club-hand, so called, is a somewhat rare affection, resulting from arrest of development of more or less of the radius or ulna, with consequent abduction or adduction of the hand (Plate III.). The whole præ-axial border of the limb may be more or less completely suppressed. It is not in any sense really comparable to the ordinary forms of club-foot, and is little amenable to

[1] *Vide* Neville, *Brit. Med. Jour.* 1883, p. 209.

treatment. Something, however, may be done by manipulation to remedy the deformity and possibly encourage growth of the shortened bone by friction and removal of pressure. Less often the hand is fixed in flexion or hyper-extension, and in these cases sometimes tenotomy may be required. Similar deformities may, of course, result from cicatricial contraction after injury. In one instance the radius was entirely deficient on both sides, and the ulna was fractured and repaired, probably *in utero*. At the suggestion of one of our Resident Medical Officers, Mr. J. H. Thompson, we transplanted some bone from another child into an incision between the muscles of the forearm. The wound healed perfectly, and the bone was growing at the time of the child's death from an independent cause two or three weeks later; the position of the hand was much improved. Careful bandaging and the use of splints will do good in some cases if treatment is begun early. In some instances it is worth while considering the question of shortening the bone on the sound side, so as to bring the hand into position, after the fashion applicable to cases of arrest of growth from epiphysial injuries (*vide* chapter on that subject).

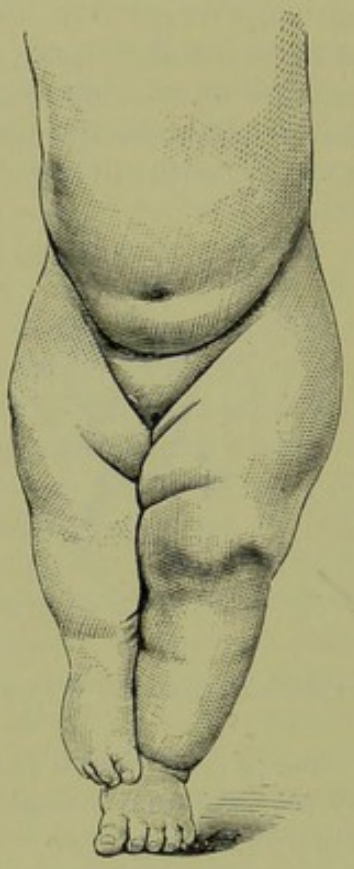


Fig. 203.—Congenital Arrest of Development of one Lower Limb.

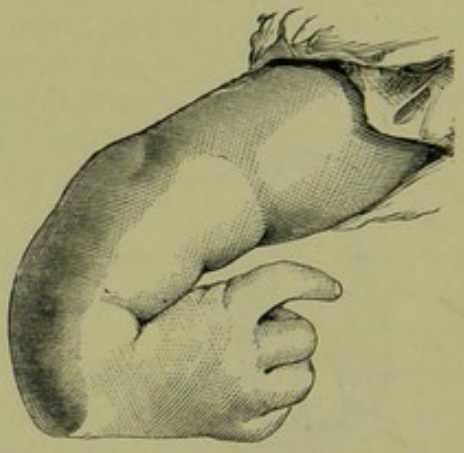


Fig. 204.—'Club-hand,' so called. There is absence of the radius and thumb with abduction of the hand.

Web Fingers.—Various degrees of this deformity are met with: thus there may be a mere extension of the normal web forwards to the first interphalangeal joint. In other instances metacarpal bones and phalanges may be fused together, or bound in very close contact throughout the whole length of the digit; occasionally the union is only at the distal ends[1] (*vide antea*). The deformity is usually more or less perfectly symmetrical, and often associated with a similar condition in the feet or with some other deformity.

Where there is complete bony fusion of two adjacent digits no attempt should be made to separate them; where, however, only skin and sub-

[1] This could hardly be the result of failure of the natural differentiation of the fingers in fœtal life, which results from the phalanges outgrowing the webs.

PLATE III.

Skiagram of a case of Club Hand with arrest of development of the radial (præaxial) border of the limb.

cutaneous tissue unite the two fingers, they should be separated. Simple division of the web is of little use, since the wound granulates up from the bottom and more or less reunion occurs.

Several plans have been devised to meet this difficulty, such as applying an elastic cord between the fingers and fastening it round the wrist after division of the web ; perforating the base of the web and putting a thread or wire through the orifice and allowing it to heal, and then dividing the web. Another mode consists in dividing the web and then bringing a flap of skin from the dorsum or palm across between the fingers so as to interpose a bridge of skin at the base (Norton). The best plans are the last-mentioned and that advocated by Didot, in which a dorsal flap from one finger and the web, and a palmar flap from the other finger and the palmar aspect of the web, are cut ; the rest of the web is then divided, and the flaps are wrapped

Fig. 205.—Double Club-hand.

round the raw surface of the finger, to which they remain attached. In doing this operation, however, it will be found that there is not sufficient skin to cover both fingers, and one has to heal by granulation. Web toes do not require treatment.

Congenital Rigidity of Joints and Contractions.—As already stated, children are sometimes born with joints, chiefly the knees, elbows, and shoulders, which are stiff, or, on the other hand, unduly lax ; and sometimes these joints are fixed in flexion, sometimes hyper-extended, or at least hyper-extensible. In such cases there are not rarely marks of pressure about the joints—depressions and adhesions of the skin. Probably the conditions determining such deformities are like those causing talipes, viz. intra-uterine pressure or malposition ; thus the 'genu recurvatum' sometimes seen results from the limbs being packed in hyper-extension

along the ventral surface of the body (figs. 206, 207); it is sometimes described as congenital dislocation of the knee. In these patients the patella is usually either absent or very small; it, however, develops as the position and mobility of the knee are improved by treatment. The rigidity and hyper-extension of the joint may be almost perfectly overcome by suitable exercises and apparatus. Failure of developmental rotation accounts for other deformities.

Diligent friction and passive movement, together with the application of splints, as the individual deformity may require, will sometimes effect great improvement;[1] in other instances little success attends treatment.

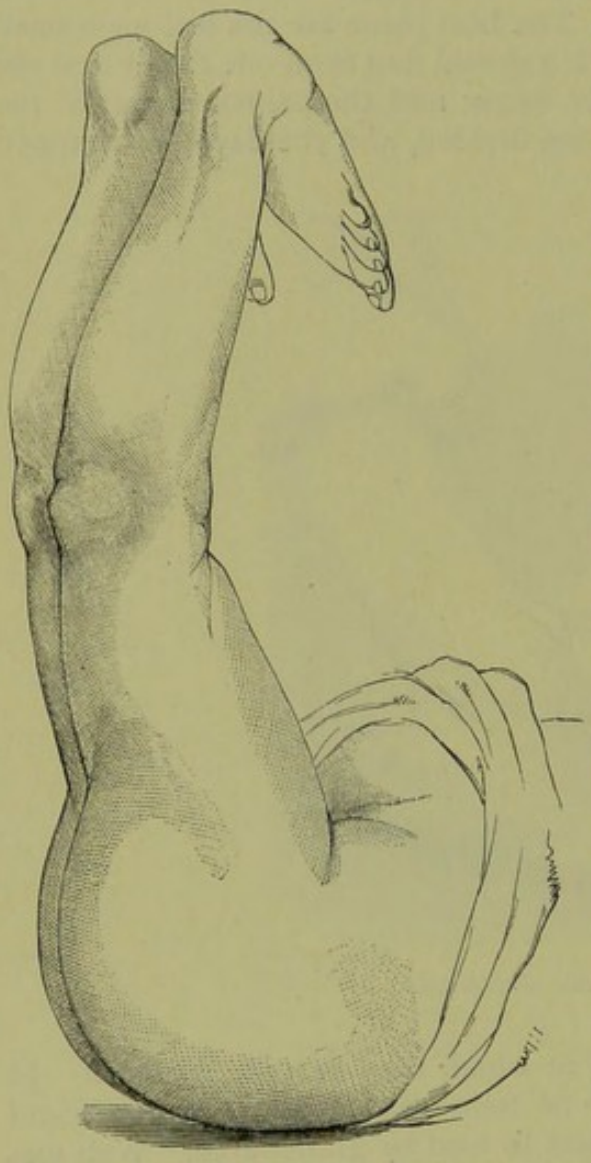


Fig. 206.—Genu recurvatum and Talipes calcaneus. (From sketch by the late Mr. C. F. Sutton.)

One or more of the fingers or toes may be congenitally contracted either in flexion or extension; the contraction, often slight at first, tends to increase as the child grows. Hammer-toe is a result of this condition. In most instances it has been shown that contraction of the ligaments of the inter-phalangeal joints is the cause of the deformity.

We have met with a non-congenital form of contraction of the terminal joints of the index and middle fingers. The skin and fascia were the structures affected, just as in Dupuytren's contraction. According to Adams, the little finger is more often affected, and the deformity is said to be markedly hereditary, and to be commonly associated with a history of 'hammer-toe.'[2]

Stretching and simple splints, in ordinary cases, is the treatment required. If neglected, troublesome corns or bunions and distortion of the nails may result from pressure of boots. Division of the lateral ligaments, or in some cases resection of a joint or part of the shaft of a phalanx, or even amputation, may be the best treatment for hammer-toe.

'Hallux flexus,' first described by Mr. Davies Colley, is defined as a

[1] Berkeley Hill records a good case in which there was so much rotation that the heels looked directly forwards. By the use of apparatus and tenotomy an almost perfect result was obtained.—*Brit. Med. Jour.* July 12, 1884; *vide* also 1883.

[2] Adams, *Lancet*, December 13, 1890, also 1891; and Anderson's Lectures, *Lancet*, August 1891.

'progressive diminution in the normal range of extension of the great toe.' It causes lameness, is pathologically closely allied to hammer-toe, and requires treatment by rest followed by manipulation and friction, and in severe cases by division of the lateral ligaments or osteotomy. (*Vide* also 'Metatarsalgia,' p. 780.) Hallux valgus and other deviations of the toes are rarely serious in children, and are usually amenable to treatment by splints, or wearing of boots and socks with stalls for the toes. So-called 'toe-post' boots are very useful for these cases.

It must be remembered that some of these patients with distorted limbs are cases of cerebral deficiency, and for them of course little can be done.

Congenital Dislocations, so called, of almost any joint may be met with: thus the temporo-maxillary, elbow, and wrist joints, the joints of the spine, toes, &c., have been found displaced, though such deformities are by far most frequently met with in the hip. These conditions have been variously explained: injury *in utero* or at birth, intra-uterine inflammations, convulsions, pressure, nervous, bony, and muscular lesions have all been assigned, as in club-foot, as causes of congenital dislocations. It is most probable that, as in club-foot, intra-uterine pressure from malposition is the most frequent cause, though not the only one. In all cases more or less deformity of the bony articular surfaces is found, and this is of the utmost importance, since it largely prevents the possibility of anything like complete reduction.

Fig. 207.—Abnormal position *in utero*, causing genu recurvatum and talipes calcaneus, &c. (From sketch by the late Mr. C. F. Sutton.)

In 'congenital dislocation' of the lower jaw the condyle and glenoid cavity, as well as much of the bony framework of that side of the skull, have been found stunted. Occipito-atlantoid dislocation, both backward and forward, has been described; in the former the head is flexed, in the latter hyper-extended.

Dislocations of the clavicle in the varieties met with in later life are also mentioned by Guérin.

The humerus may be displaced downwards, forwards (subcoracoid) or backwards (subspinous), with arrest of growth of muscle and bone, and

deviation from the normal shape of the articular surfaces.[1] Displacements of the elbow and wrist have also been met with.[2] The most important of all these malformations is **Congenital Dislocation of the Hip,** since it is by far the most frequent, and sometimes seriously incapacitates the subject of it. In these cases the acetabulum is small, shallow, triangular in shape, and may be filled with fat or 'webbed over'; the head of the femur may be nearly normal or much stunted. A more or less perfect capsule may be present, and this may be thickened and constricted in such a way as to be interposed between the head of the femur and the imperfect cavity of the acetabulum—an important point in regard to treatment. An adventitious capsule and pouching of the synovial membrane is found in some instances. The head of the femur is also altered and imperfectly developed in varying degree. We have noticed in skiagrams of unilateral cases that the epiphysis is later in ossifying on the distorted side. The axis of the neck may be altered both as regards the angle it makes with the shaft, and the direction in which the convexity of the head faces. The neck is also shortened. The form of the head changes with growth and use of the limb, and the acetabulum tends to become shallower, though a new one may form. The ligamentum teres is atrophied, the muscles around the joint are wasted. The affection may be unilateral or less often bilateral. It is much more common in girls than in boys. The femur is usually freely movable and slides up and down upon the dorsum ilii to an extent of sometimes 2 inches or more (Plates IV., V.).

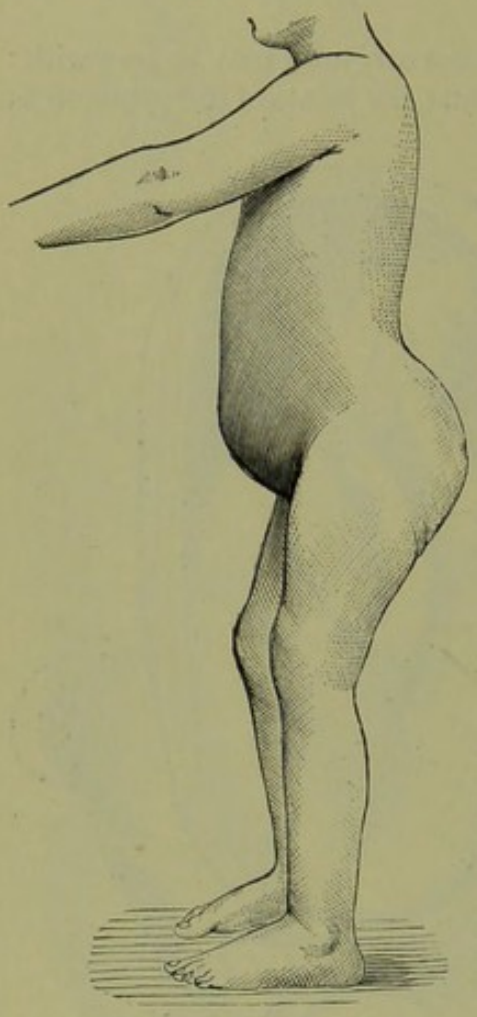


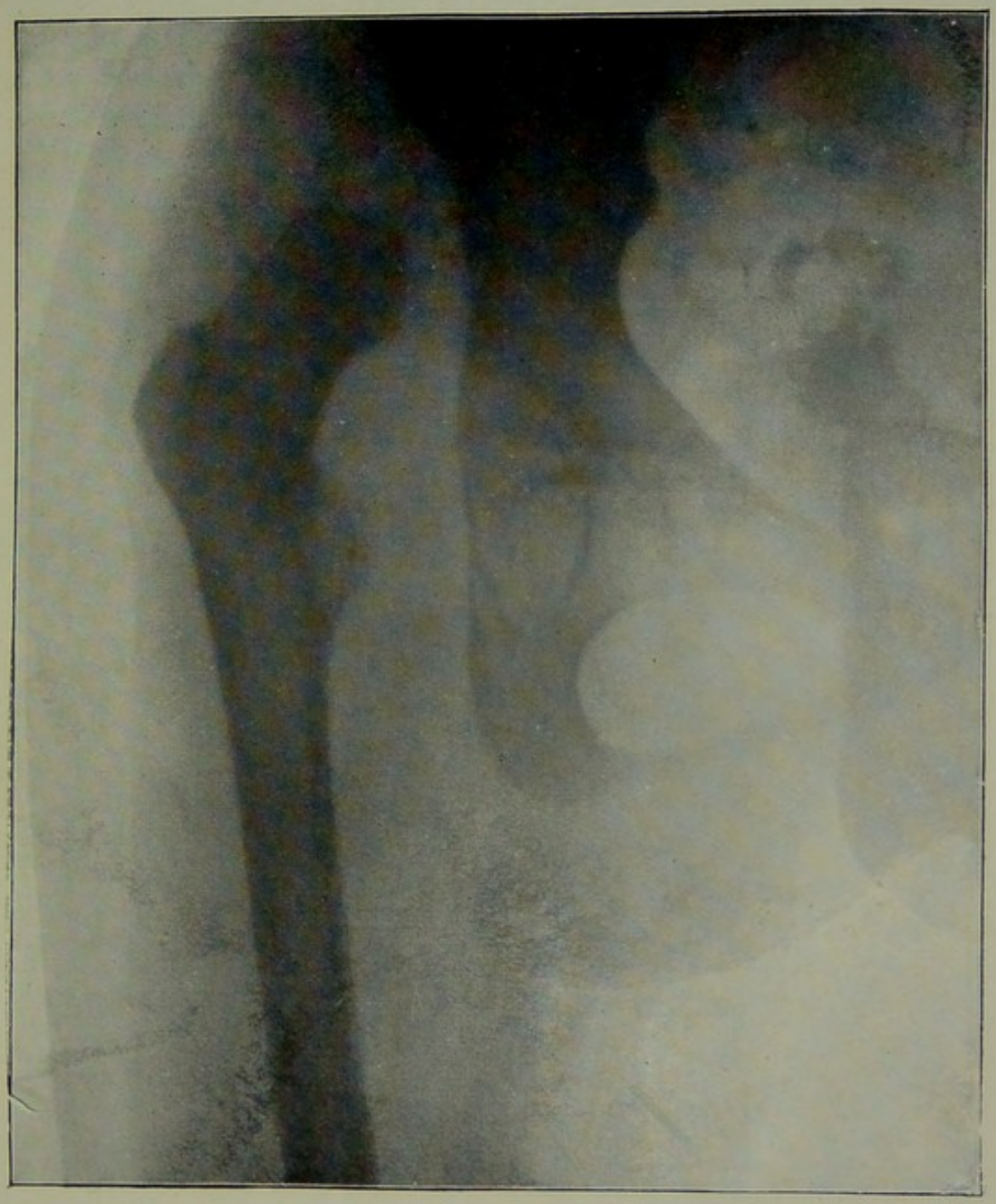
Fig. 208.—'Congenital Dislocation' of both Hips. Not a severe case.

The affected limb or limbs are usually imperfectly developed throughout. There is always a good deal of lameness in severe cases, though we have met with slight degrees of this deformity in which the joint was not very much altered. The deformity increases with age and use up to a certain point. There are marked lordosis and a peculiar 'waddling' way of walking which is very characteristic. Usually the displacement is upwards and backwards, but it may be in almost any direction; the limbs are sometimes adducted markedly.

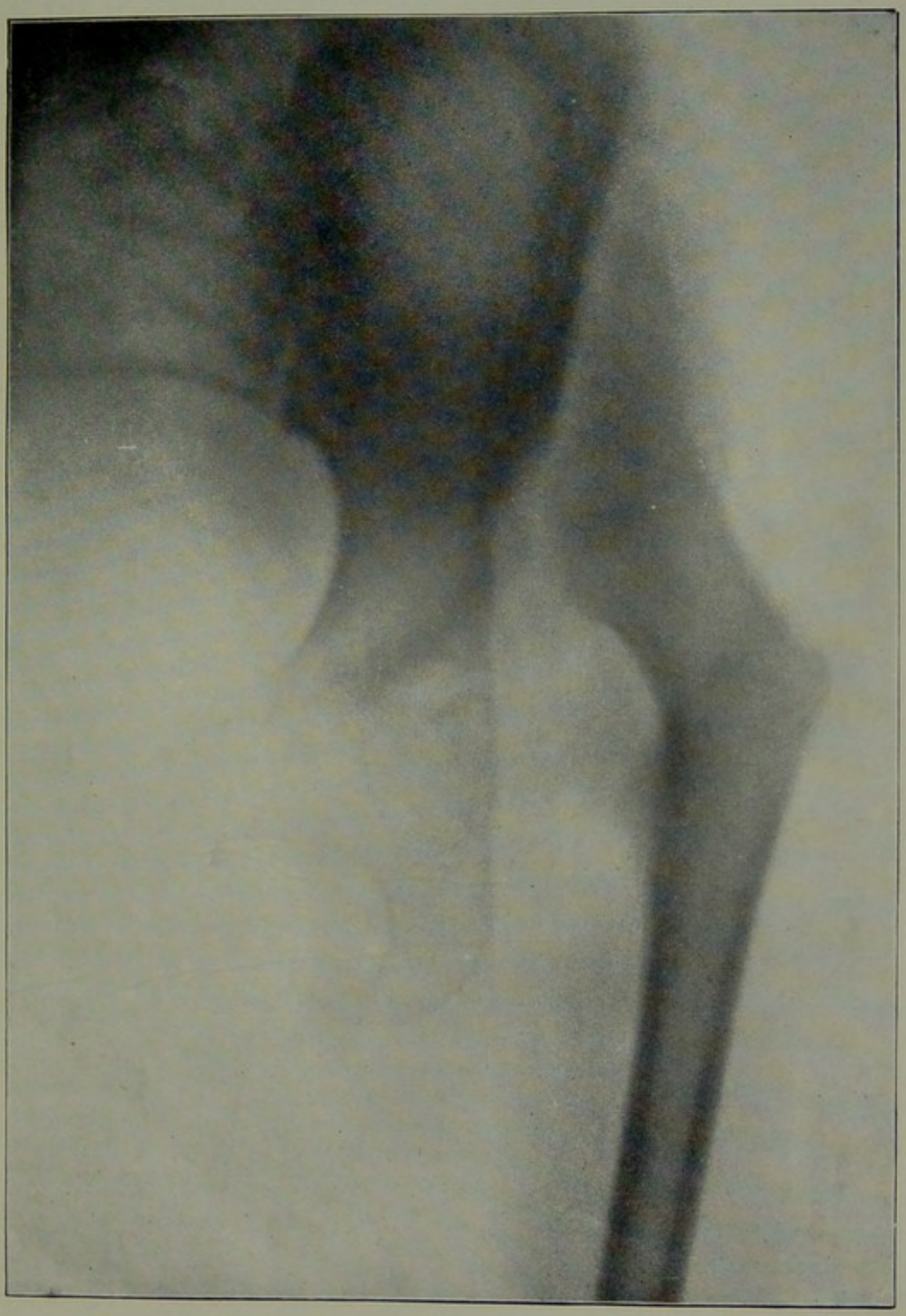
Besides the ungainliness of the walk, it is possible that the deformity of the pelvis may, as Adams suggested, be important from an obstetric point of

[1] Dislocation of the humerus appears to be often associated with other conditions of malformation; in a case shown us by our friend Mr. C. E. Richmond there were subspinous dislocation of the shoulder and dislocation of both hips. See Chapter on INJURIES.

[2] See Hamilton's work on *Fractures and Dislocations.*



'Congenital Dislocation,' of the hip. The acetabulum is seen far below the head of the femur.



'Congenital Dislocation' of the hip, the fellow to Plate IV.

view. The history of the case, the absence of pain and rigidity, and the peculiar gait distinguish the affection from hip disease. Rickety lordosis sometimes closely resembles congenital dislocation, but careful examination of the relative positions of the trochanters and iliac spines will prevent a mistake. A similar condition may result from infantile paralysis, so much so that it has been thought that many of the cases considered as congenital dislocations are really due to such paralysis (Keetley's 'Orthopædic Surgery,' in which will be found a full discussion of the pathology and history of the subject). The affection is by no means rare. (See also Coxa Vara, p. 224.)

The treatment of congenital dislocation of the hip is one of the thorny subjects of orthopædic surgery. In slight single cases, undoubtedly nothing is required beyond perhaps thickening of the sole of the boot on the affected side. In more marked instances various modes of treatment have been advocated, ranging from prolonged extension to excision. Of prolonged extension we can say we have seen it do harm, it is irksome to carry out, and though good results have been reported, it is difficult to believe that this would stand the test of walking for any length of time. Of apparatus it has been well said that it does not seem likely that a satisfactory appliance could be designed.

As to operations, the open operation of Hoffa, with gouging of the acetabulum and modelling the neck, is to be condemned on the grounds that if the head of the bone remains in the new position there is likely to be ankylosis, as well as on account of its risks and the impossibility of making a satisfactory articulation.

It is clearly impossible to 'reduce' a dislocated joint where no structurally complete joint exists ; hence a 'perfect' result can only occur when the case is one of true traumatic 'dislocation' at or before birth, or in infancy, and not an arrest of development. Where there is an arrest of development the head of the bone may be placed in the imperfect acetabulum and kept there, and the functional improvement may be most satisfactory ; but a 'perfect' result cannot be claimed when the structure remains imperfect, and we do not yet know how far the 'cures' claimed will last. As regards other methods, it is clear that in some cases it is, from the condition of the capsule, impossible to get the head of the bone inside the acetabulum and inside the capsule, i.e. even if the bone lies over the acetabulum some part of the capsule must be folded in between them. In such cases the risk of relapse must be considerable, and this is perhaps the strongest argument in favour of an open operation with division of the capsule, such as is practised by Mr. Burghard. Of the 'bloodless' method of Lorenz it is difficult in these days to see why such a crude proceeding as rupture of muscles and other resisting structures should be preferred to a carefully carried out tenotomy by open incision. There can be no doubt that by either method improvement in position and in functional result is obtained, at any rate for a time ; and we should select, as the most hopeful method, tenotomy of the adductors, with division of rigid fascial bands, perhaps of the ilio-psoas by open incision, followed by manipulations of abduction, traction with the femur flexed upon the trunk, extension and fixation in such position as will best keep the head of the bone opposite the acetabulum. This poistion will usually be abduction with rotation either

outwards or inwards. The 'reduction' must be tested by skiagrams from time to time. If this method is employed, fixation for six months at least, and probably more, is required in the abducted position. If this method fails and anything further is to be done, the method of laying open the capsule, placing the head in the acetabulum and shortening or tightening the capsule, as carried out by Mr. Burghard, is probably the most reasonable operation. Manipulation is more likely to be followed by improvement the younger the child, and up to 3 or 4 years of age is said to be the hopeful time. No justification exists for statements that there is no danger in these modes of treatment, or that they are by any means certain; failures, fractures, nerve and other injuries are by no means unknown, and some methods have caused loss of life.

In some cases division of the adductors without any formal attempt at 'replacement' causes much improvement in gait and position.

So-called **Congenital Dislocation of the Knee** has been already mentioned as 'genu recurvatum'; this joint is also occasionally found with partial backward or lateral displacement. If seen in quite early infancy, these deformities are fairly amenable to treatment by manipulation and splints, and we have been able to completely remedy the deformity of 'recurved knee' by these means (*vide* figs. 206, 207).

Besides the deformities already described, it is necessary just to mention the occurrence of cases of **Congenital Fissure of the Sternum** from non-union of the different centres of ossification, or rather non-closure of the ventral laminæ, sometimes associated with ectopia cordis. Cases of deficiency of the ribs over a larger or smaller area, and lack of development of the muscles of the chest-wall and of the mammary glands, may be met with; we have seen hernia of the lung through a gap of this sort. (*Vide* Thompson, 'Teratologia,' January 1895.)

Congenital Deficiency of one or both Clavicles or of the Scapula may also be occasionally seen. A suprascapula has been met with, attaching the scapula to the vertebræ, and requiring removal (Willett and Walsham, 'Med. Chir. Trans.' 1883). Deficiency or imperfect development of the patella sometimes occurs; it is usually absent in cases of genu recurvatum. Many other abnormal conditions may occur—some deficiencies, some excesses, as in the common cases of supernumerary mammæ, which are doubtless instances of reversion, and so on; but these cannot be discussed here. Many require no treatment; others must be dealt with on general rules. Occasionally protective shields may be required for such cases as thoracic hernia. The works of Ballantyne, Keetley, Tubby, and Jones should be consulted for accounts of these malformations, as well as papers by many American surgeons in the 'Annals of Surgery,' and elsewhere.

CHAPTER XXXIV

ANOMALIES OF GROWTH

THE general question of natural growth of the infant has been considered in the first chapter of this book, and the effect of rickets or of injuries to the growing line of bones in producing arrest of development in the limbs is discussed under those headings. Cretinism and myxœdema, and certain forms of idiocy associated with stunted growth, are also dealt with, but a short account must be given of certain anomalies in general growth which are less easily explained. Incidental mention has been made of cases in which absence of adult sexual characters is found, and it appears that two forms of this 'Infantilism,' so called, may be recognised. In one the physical and mental characters of early childhood persist into the time of youth, or even into later life ; in the other the arrest of development occurs later, and the individual lives on, with the attributes of adolescence, into the years of adult life. The former type has been called 'Infantilism' ; the latter might be called 'Juvenilism.'

These cases are quite distinct from the dwarfs with cerebral deficiency. Mentally they are quite bright and well developed, though in Infantilism the tastes and ideas may be like the body form, those of a little child. In Infantilism there is the roundness and plumpness of face, limb, and body, usual in a healthy child ; while in Juvenilism there is often the thin, drawn-out frame and long thin limbs of the rapidly growing youth. The two forms have been called Infantilism of Brissaud and of Lorain, as described by those writers.

As to the cause of this arrest, it has been supposed to be due to defect in blood supply from cardiac or vascular insufficiency, but this does not appear an adequate explanation. On the one hand, there is no doubt that in some instances disease or deficiency of the thyroid gland is closely associated with the arrested growth, for not only has such disease been found, but the administration of thyroid extract has produced rapid and more or less complete development and growth (*vide* Apert in 'Mal. de l'Enfance,' by Grancher and Comby). On the other hand, in a case of Dr. J. Thomson's, a child of $4\frac{3}{4}$ years resembled one of 18 months, was unaffected by thyroid treatment, and after death was found to have a normal thyroid and a large persistent thymus (*vide* 'Scottish Med. and Surg. Jour.' March 1900). These conditions have also been described as Ateleiosis (imperfection), and two types distinguished, the Asexual and the Sexual. In the former, all the parts of the body are more or less arrested, but in varying degree, and the genital organs most backward of all. In the latter, at the time of puberty

the sexual organs develop and the body 'sets,' i.e. bones complete their ossification, &c., but the size and to some extent the form and proportions of a child are persistent. Of this type many of the show dwarfs are examples. They are capable of propagation, and their children may be normal, but show a tendency to be dwarfs of the asexual type (*vide* H. Gilford, 'Brit. Med. Jour.' October 8, 1904).

Mr. Gilford also describes, under the name of Progeria, cases of premature senility occurring in the subjects of Ateleiosis who died of senile disease at 18 and 17 years.

Besides these more serious and complete anomalies of growth many less severe conditions are commonly met with. They occur most frequently between 12 and 16 years of age, and chiefly in town dwellers (Comby).

Gigantic growth sometimes follows one of the acute fevers, and of course rapid growth under such conditions is a well-known occurrence. It has been attributed to posture with diminished pressure and hyperæmia of the growing lines of the long bones. This overgrowth appears to be specially likely to occur after typhoid.

'Growing Fever' has been mentioned under DISEASES OF THE BONES, and in addition to what has been there stated we may add that the development of exostoses is sometimes associated with the local hyperæmia occurring at epiphysial lines.

The various affections of the circulatory and cerebral and digestive apparatus specially occurring during active growth are elsewhere described (*vide* also Comby in 'Mal. de l'Enfance' for details of these troubles).

CHAPTER XXXV

DISEASES OF THE NOSE

THE orifices of the anterior nares are a favourite seat of eczema, lupus, and superficial tuberculous ulceration ; other cutaneous affections and nævi are also often met with upon the surface of the nose (*vide* Chapters XXXIX. and XIX.)

The nasal cavities in children are exceedingly often the seat of acute or chronic catarrh, the result of cold, or extension from the pharynx. Catarrh also commonly occurs in rickety, tuberculous, or syphilitic children.

Acute Catarrh is generally simply mucous ; it may, however, become purulent, or may be so from the first, especially if it is the result of inoculation, which may occur at birth or accidentally at a later period.

Chronic Nasal Catarrh is marked by discharge of muco-purulent material from the nose, swelling of the mucous membrane and of the skin of the anterior nares, with often some thickening of the upper lip from irritation ; the voice is nasal, respiration is impeded, deafness is often present, the child snores, and, in an infant, suckling is often difficult, sometimes impossible, from obstruction to breathing through the nose. Occasionally the inflammation extends to the antrum, nasal duct, or frontal sinuses. On examining the nose the interior is seen to be red and angry-looking, often slightly excoriated ; it easily bleeds, and there are frequently dried scabs on its surface, while stringy mucus is apt to collect upon the lips in neglected children and give rise to soreness. Where one nostril alone is affected, careful search must be made for one of three conditions : a foreign body, such as a button, a bit of slate pencil, or a date-stone, &c. ; a mucous polypus growing from the region of the inferior or middle turbinated bone—a somewhat rare condition in childhood ; or, thirdly, a deviated nasal septum.

Chronic catarrh, from whatever cause, is apt, if neglected, to give rise to ozæna from decomposition of the retained secretion, or from caries or necrosis of the bones of the fossæ ; where the bones are involved the fœtor is more intense than in other cases.

Should the inflammation extend to the cartilaginous and bony septum, the nose may lose its support, by softening of these structures, and become flattened and depressed. Where the outer walls are more especially attacked, a broad thickened nose results. In most cases these deformities occur in connection with congenital syphilis rather than in tuberculous or simple bone lesions. A probe will usually detect the presence of bare bone, and it must be remembered that in cases of apparently simple polypi a

patch of exposed bone will often be felt. Bleeding from the nose in these affections occurs often in small amounts, but rarely to any serious extent.

Diagnosis.—The existence of chronic nasal catarrh is obvious ; its cause requires looking for, and this should be done systematically. First, if unilateral, the causes already mentioned—foreign body, deviated septum, or polypus—are to be suspected. If double, the throat should be examined for enlarged tonsils, chronic pharyngitis, and post-nasal adenoid growths. Evidence of congenital syphilis or tuberculosis may be obtained, or sometimes simply carious teeth or eczema may be the source of the trouble.

Treatment.—If the cause is local, an anæsthetic should be given, and the foreign body, post-nasal growths, &c., removed. To remove a foreign body from the nose, a simple loop of silver wire is useful, or a pair of dressing forceps or a small scoop may be employed ; sometimes a finger passed from the mouth into the posterior nares is of service, and occasionally the simplest plan is to push the foreign body backwards into the pharynx and remove it from the mouth. In one of our cases the body, a button, escaped into the pharynx while the child was under chloroform, and was found in the vomit brought up by the child on its awaking. In syphilitic and tuberculous cases syringing out with warm alkaline lotions (sodii bicarb. gr. xx ; aq. ℥j), or in older children the nasal douche, is the most efficient means of clearing away the crusts ; this should be done three or four times daily, and subsequently powdered boric acid or tannic acid and iodoform in equal parts should be blown into the nose through a quill or insufflator, or the nasal cavity may be brushed over with glycerine of tannin or lead lotion. Sometimes a spray may be substituted for the syringing after the nose is once cleared. Solution of hydrochlorate of cocaine, 5 to 10 per cent., may be used as a spray or brushed on, before removing a foreign body. Cleanliness and care of the general health, with mercury or iodide of potassium, or both together, according to the child's age, are required in syphilitic cases.[1] Any sequestra should be removed as early as possible, and all foul crusts kept constantly cleared away. Cod-liver oil and iron, with the usual hygienic measures and careful cleansing of the nose, together with iodoform insufflation, is the best treatment for the tuberculous cases. Nitrate of silver, gr. x–xxx to ℥j, is sometimes used with advantage as an occasional application. In nearly all chronic cases the prognosis is somewhat uncertain, and the course of the disease tedious. Where the above-mentioned methods fail, and especially in tuberculous ulceration of the nasal mucous membrane, an anæsthetic should be given and the affected parts well scraped with a Volkmann's spoon, or cauterised with the wire cautery.

Nasal obstruction, apart from the causes just mentioned and those already described under Diseases of Tonsils, &c., may be due to deviation of the cartilaginous septum. This is sometimes congenital—more often it is the result of fracture of the septum, or dislocation from either the ethmoid or vomer, or from the nasal spine of the upper jaw ; or, again, it may be the result of a chronic perichondritis, following an injury, and resulting in soften-

[1] In infants mercury alone, in children over three or four years iodide of potassium alone or, failing a good result, combined with mercury, is, we find, the most successful plan.

ing and subsequent deviation of a local patch of the septum. If the whole cartilage is involved, there will be some flattening of the end of the nose; this, however, does not usually occur. Simple chronic perichondritis, causing thickening, hæmatoma of the septum, or abscess, or even ecchondrosis of the cartilage may also be met with. The treatment of deviated septum consists, with or without incision of the cartilage, in forcible straightening with a pair of guarded sequestrum forceps or with Adams's special instrument; and the subsequent wearing of a nasal plug, such as Walsham's or the one devised by one of the present writers, or, best of all, a piece of rubber drainage tube, is required. In some cases removal of the projecting mass is called for: in such circumstances the muco-perichondrium should be dissected up and laid down again after removal of the cartilage. Hæmatoma, if it does not subside, is best treated by incision—so also abscess; usually in both cases incision on one side will empty the sac on both sides, since the cartilage is perforated. Dislocation is best treated by the use of plugs. Lateral deviation of the nose visible externally ('crooked nose') sometimes requires the use of special appliances to be worn to correct the deformity.

Nasal Polypi are somewhat rarely met with in childhood; they spring from the region of the middle or inferior turbinated bones as soft, grey, semitransparent, rounded masses; occasionally they take origin higher up in the nasal cavity. Repeated removals with the use of astringents in the intervals is the treatment required.[1] The polypi should be taken away with forceps; in some cases the tendency to re-growth is so obstinate that it is necessary to take away the whole of the turbinated bone from which the growths arise.

Where there is nasal obstruction from chronic catarrh or cicatricial contraction, the use of nasal bougies or plugs smeared with any medicament desired, such as iodide of lead or iodoform ointment, is useful.

Superficial Ulceration of the mucous membrane of the nose often occurs in cases of chronic catarrh from any cause, and occasionally the ulcers are deeper and lead to perforation of the septum; this is especially likely to occur from pressure of foreign bodies. We have seen perforation of the septum occur in a child simply from picking the nose. Perforation of the septum from tuberculous ulceration is fairly common and very intractable. The ulceration may or may not be associated with lupus of the adjacent skin.

Chronic Dry Catarrh of the nose, accompanied by atrophy of the turbinated bones and their coverings, may be met with; it is often associated with ozæna. The treatment is similar to that of ordinary chronic catarrh, but according to Sir M. Mackenzie, the use of medicated plugs of wool relieves some cases. The disease is a very intractable one: painting with glycerine is occasionally useful.

Congenital Malformations of the nose are rare; closure of the anterior or posterior nares, adhesions between the walls of the nasal fossæ, perforation

[1] Acid. tannic., parts ii; cupri sulphat., part i; pulv. plumbi nitrat., part ½, will be found a good snuff for these cases if obstinate; the milder applications mentioned under CHRONIC CATARRH are, however, often sufficient. The occasional application of nitrate of silver fused on a wire is sometimes required.

of the septum, and cases of cleft or flattened nose, or even of entire deficiency of the organ, have been met with.[1]

Malignant Polypi of the nose and nasopharynx are occasionally seen in children ; early removal is the only treatment, but speedy recurrence is to be looked for.

Epistaxis occurs very frequently in children, sometimes as a result merely of cerebral congestion, the communication between the longitudinal sinus and the nasal veins remaining open in early childhood ; in other cases congestion from catarrh, or ulceration, injury, or foreign bodies, &c., may give rise to bleeding. Hæmophilic patients frequently bleed from the nose, and epistaxis is a complication often met with in some of the exanthems, &c.

Usually the bleeding ceases spontaneously in a short time ; if this is not so, bathing with cold water, or a little ice applied inside or over the nose, will usually stop the flow. Astringent powders or lotions, tannin, alum, solution of adrenalin, &c., may be blown into the nostrils. Sometimes pressure from outside is effectual ; in other cases making the child stand upright, with the arms above the head so as to expand the chest and relieve venous engorgement, will prove successful.

Occasionally the nose may require plugging.

Nasal Deformity.—Where there is destruction of the whole or part of the nose, plastic operations may be employed. These must be planned according to the individual requirements of the case. The method of paraffin injection in suitable cases is well worth employing ; it might have to be repeated as growth took place. We are rather of opinion that a good artificial nose is preferable to most of those obtained by plastic operations. Where, however, there is loss of only a small part of the nose, or where there is flattening without loss of substance, attempts should be made to improve the appearance of the child by filling up the gap or elevating the depressed part. It will be found that there is great difficulty in obtaining a good prominent nose by any method, and too much should not be promised. For details of the methods of operating we must refer to systematic works on Operative Surgery.

[1] For figs. of deformities *vide* Förster's *Missbildungen des Menschen.*

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CHAPTER XXXVI

DISEASES OF THE EAR

Diseases of the External Ear.—The auricle may be congenitally absent or crumpled and distorted: for the former condition an artificial ear may be fitted, for the latter usually nothing can be done.

In cases of deficient development of the pinna the ramus of the jaw may also be stunted—i.e. the first post-oral arch and its appendages may be ill developed.[1]

(For an account of supernumerary auricles and fistulæ, *vide* p. 190.)

Sometimes the ear is unduly large, and stands out prominently from the side of the head; the appearance may be improved by the use of an ear truss, or in extreme cases by removal of a triangular portion of the ear and careful closure of the gap by sutures, or excision of a portion of the skin and cartilage from the posterior surface of the pinna, or by suturing the ear to the skin covering the mastoid process.

The pinna is often the seat of eczema and chilblains, which require the treatment of the same affections elsewhere; eczema most commonly attacks the crease between the auricle and the side of the head, and chilblains the free edge of the ear.

Simple, lupous, or other tuberculous ulceration may also attack the ear, and we have seen the whole auricle rapidly slough away during an attack of whooping-cough.

The orifice of the external meatus is sometimes congenitally closed: in such cases, if the tuning-fork shows the labyrinth to be healthy, a careful dissection may be made at the site of the orifice, or the meatus may be reached by incision behind the auricle and the orifice afterwards opened upon a bent probe. Nothing should be attempted until the child is old enough to have the hearing power tested, unless there is evidence of retained secretion giving rise to abscess, when an opening must be at once made.

The common affections of the **external meatus**, which in children is proportionately shallower and broader in a horizontal direction than in adults, are eczema, boils, accumulations of wax or epidermis, and the presence of foreign bodies: the first are not peculiar to children; the last is, of course, commoner in them. If the foreign body has passed beyond the orifice of the meatus, it should be removed by gently syringing, or by means of a loop of silver wire, or by a probe coated with cobbler's-wax or glue. No violence

[1] As in a case of Canton's, *Path. Soc. Trans.* vol. xv. We have had similar cases under our own care.

should be used, and it is better to leave a foreign body where it is than to push it further in or lacerate the meatus or membrana tympani in attempts at its removal. Insects, &c., in the meatus are readily killed by a drop or two of oil.

Eczema, tuberculous sores, &c., may give rise to purulent discharge from the ear, but usually such discharge comes from the middle ear. In all cases the pus should be carefully soaked up with absorbent wool and the ear examined. Sometimes, however, the meatus is so swollen and the child so intractable that no examination can be made: under such conditions the case should be treated as one of otitis media until, either with or without anæsthesia, the ear can be examined.

The imperfect development of the tympanic bone and consequent shallowness of the meatus in children must be borne in mind; in young infants the membrane lies in a more horizontal plane than in adults.

Inflammation of the Middle Ear may be either acute or chronic. The causes of acute otitis are catarrh of the nasopharynx, usually associated with enlarged tonsils or post-nasal adenoid growths, cold, and the exanthems, especially scarlet fever; injuries also, by picking or roughly drying out the ear with corners of towels and so on, may rupture the membrane and set up otitis media.

Sir W. Dalby has pointed out that boxing the ears of children may give rise to nervous deafness without a rupture of the membrana tympani, such deafness being usually permanent and severe; or the membrane may be ruptured: in such case the rupture may heal or be followed by inflammation of the middle ear; or, lastly, acute otitis may be set up without rupture of the membrane.

In otitis the result of throat affections the disease may be caused either by Eustachian obstruction, and consequent retention of secretion, or by actual extension of the inflammation along the tube. The symptoms are pain in the ear and head, deafness, and some constitutional disturbance. In infants, who cannot indicate the seat of their trouble, otitis should be suspected if there are fretfulness and restlessness, with tossing about of the head without other assignable cause. If these cases are left to themselves, the membrane soon yields, and a purulent discharge escapes from the meatus, giving usually great relief; until discharge appears the condition is often overlooked in scarlet fever, where the attention is apt to be directed to other symptoms. If the membrane is examined in such cases, there will be seen all the signs of inflammation, redness and loss of lustre, and if pus is present it may perhaps be visible as a yellow discoloration of the lower part of the membrane. It must not be forgotten, however, that pain may be quite absent, and the first sign of mischief may be the appearance of discharge or feverishness. Persistence of high temperature after the escape of pus should, even in the absence of local symptoms, suggest the existence of mastoid or jugular inflammation. (*Vide* Kerley, whose paper, read before the American Pediatric Society, May 1904, shows the importance of this point in infants.)

Treatment.—The throat must be attended to, and antiseptic, sedative, or astringent applications used, according to circumstances; next, the Eustachian tube must be kept open by Politzer's method: the inflation can be performed

at the moment of the child's crying. Hot fomentations, with perhaps a leech behind and in front of the ear, and instillation of a drop of glycerine and laudanum, or glycerine and carbolic acid, into the meatus, should be employed. Failing relief by these means, the membrane should be carefully incised, either horizontally or vertically, behind the handle of the malleus, and the discharge allowed to escape—gentle washing out of the ear with warm boric lotion, or better, $\frac{1}{10000}$ biniodide of mercury, and inflation of the middle ear, being also used. As soon as the acute symptoms have passed off, powdered boric acid and iodoform should be blown into the ear after drying it carefully with absorbent wool two or three times daily, according to the amount of discharge.

The dangers of otitis media are manifold : first, deafness ; and secondly, extension of inflammation, which may reach the mastoid antrum or the mastoid cells, perforate the roof of the tympanum, or the sutura petro-mastoidea, which is still open in infancy, and so directly reach the brain. Cerebral abscess and meningitis are not remote dangers. Or the carotid artery may be opened by ulceration and fatal bleeding ensue ; or thrombosis of the lateral sinus and jugular vein and pyæmia may result. Extension of mischief to the temporo-maxillary joint may occur, with stiffness of the articulation. The amount of deafness depends rather upon the injury done to the labyrinth, upon interference with the mobility of the ossicles, or upon fixation of the stapes, than upon destruction of the membrana tympani.

The dangers to life are to be met by providing free drainage for discharge and keeping the cavity aseptic as far as possible. If there is any pain, swelling, or tenderness over the mastoid process, an incision should be at once made down upon it ; if no pus is reached and the symptoms are urgent, the bone must be carefully gouged away just behind and level with the roof of the meatus until the cavity of the antrum is reached. It must be remembered that in children the mastoid cells are not well developed and vary much in size, and that the lateral sinus descends less than half an inch behind the meatus. Swelling and tenderness over the mastoid process does not always mean inflammation of the mastoid antrum or cells, but may be the result of extension superficially of inflammation of the meatus or of irritation of the mastoid lymphatic gland. Even if pus is not reached at the time, relief may be given and an easier way for discharge made ; but the removal of bone should be free if the symptoms are definite, and, if possible, an opening should be made through which lotion can be syringed into the external meatus. In chronic cases it may be necessary to do a further operation for entire removal of the outer wall of the antrum, and thus obliteration of its cavity. In neglected cases extensive necrosis may occur, and the walls of the meatus, or even the greater part of the petrous bone, may come away as sequestra. It is common to find the lymphatic glands just below the ear inflamed, and they may cause much pain, or may suppurate and discharge through the walls of the meatus. In the early stages of glandular inflammation, hot belladonna fomentations will often arrest the mischief ; if suppuration occurs, the abscess should be early incised. Suppurative meningitis, if diffuse, is not amenable to treatment, but localised cerebral abscess, which may be either in the temporo-sphenoidal lobe or

cerebellum, should be treated by trephining the skull and opening the abscess.

Facial paralysis, which not uncommonly results from otitis media, is peripheral, and the result of pressure upon the nerve in the wall of the tympanum ; the paralysis usually disappears on subsidence of the otitis, but may be permanent. Chronic otitis media may be due to the same causes as the above, but is often tuberculous ; it may last for years, and give rise to occasional attacks of acute earache. Chronic otitis is always a source of danger, and should never be neglected ; the tympanic cavity should be carefully cleansed by gentle syringing, and then the mucous membrane got into a healthy state by insufflation daily of the iodoform and boric powder, or by the use of slight astringents, such as alum, gr. iij to ʒj, or sulphate of zinc, gr. j–ij to ʒj ; boric and carbolic lotions are perhaps the most generally useful. On examination of the ear in these cases the membrane is usually almost entirely gone, and the ossicles more or less completely destroyed ; the hearing power is impaired, but seldom entirely lost. The complications met with in the acute variety are also liable to occur at any time in the course of a chronic case. Small perforations of the membrane in children readily heal, but it is exceptional to meet with them.

In very chronic otorrhœa masses of granulation tissue, springing from the tympanic cavity, less often from the membrane or walls of the meatus, may appear, and form the commonest kind of aural polypus ; fibrous, mucous, and adenomatous polypi are much rarer. Polypi are to be treated by removal with forceps, or scraping away, and the application of some caustic, of which we prefer solid nitrate of silver fused on a loop of wire ; crystals of perchloride of iron or chromic acid may be used if preferred, and the ear should be washed out with a solution of rectified spirit as strong as can be borne without pain (usually 1 in 4 to 1 in 2 can be employed). Boric and tannic acid and iodoform insufflations should be used between times. It is often necessary to remove these polypi several times before they cease growing. All abscesses burrowing about the ear must be opened and well drained, and the general health, as well as the condition of the throat and nose, carefully looked after. Eustachian catheters require an anæsthetic in children, and should only be used when Politzer's method fails.

The general routine method, then, of treating otorrhœa ('otitis media suppurativa') may be given thus. (1) Dry out the ear with absorbent wool.[1] (2) Examine with a speculum, and through this puff a powder of equal parts of iodoform and boric acid, once, twice, or three times daily, according to the amount of discharge.[2] (3) Inflate the ear by Politzer's method once daily. (4) Watch for, and open early, any mastoid or glandular abscess. (5) Protect from cold, and take care of the general health.[3] (6) Never neglect the least earache. (7) See that the throat and naso-pharynx are healthy.

[1] Where hospital patients cannot be seen daily the friends should syringe out the ear with warm boric lotion.

[2] We prefer a simple speculum and the use of an aural reflecting mirror, but Brinton's 'otoscope' may be used.

[3] A clean plug of absorbent wool should be put into the meatus and changed two or three times daily or more, according to the amount of discharge.

It must be remembered that pain in the ear may be a result of carious teeth, cervical adenitis, or any source of pressure upon the nerves supplying the auricle or meatus, as well as of ear disease.[1]

Affections of the Labyrinth in children may be either congenital, or the result of injury, or of extension from otitis media, or of congenital syphilis. The latter form usually comes on about the seventh to twelfth year, increases rapidly, affects one ear first, and leads to severe or total deafness ; it is rarely remediable, though mercury and iodide of potassium should be tried. If the case comes under treatment in an early stage, there is some hope of recovery. Deafness in children should be seen to at once, and care should be taken, in those in whom restoration of hearing cannot be complete, to make them read and speak aloud to prevent the tendency to become mutes. Deaf-mutes should be taught the 'oral method.'

Intracranial Abscess.—Should there be evidence of intracranial abscess, as shown by fever, vomiting, otorrhœa, pain in the side of the head, convulsions, squint, hemiplegia, more or less loss of consciousness, and perhaps optic neuritis, the ear should be examined and well cleaned out, so as to avoid any further retention of pus in the tympanum ; a flap of soft parts should then be turned up by a curved incision, exposing the temporal bone above and behind the ear ; a circle of bone should then be gouged away, having its centre opposite the posterior superior quadrant of the meatus, and from ½ in. to ¾ in. from the meatus, according to the age of the patient.[2] Having removed the bone, if no sign of abscess appears, the dura mater should be incised and the brain punctured first directly inwards, then forwards and inwards, and finally backwards, so as to tap any abscess situated either in the cerebrum or cerebellum ; if pus is found, the opening should be enlarged, and the abscess drained and treated on general principles. The mastoid antrum and cells, if not previously cleaned out, should be dealt with at the same time. (*Vide* also p. 522.) Barker points out that a single rigor, followed by subnormal temperature, slow pulse, and 'sluggish, but perfect, cerebration,' may be met with in cerebral abscess. There appears to be no certain means of distinguishing temporo-sphenoidal from cerebellar abscess, but in the latter the pain is usually occipital, and there is retraction of the head ; the amount of paralysis in either case is inconstant. Temporo-sphenoidal abscess is about three times as common as cerebellar, according to Barker. He also believes that abscess in the brain is much rarer than meningeal or subdural suppuration.

Some time ago we had under the care of our colleague Dr. Hutton and ourselves, a boy 11 years old, suffering from double otitis after small-pox. On admission there was discharge from both ears, with pain in the left, and in the left temple. Shortly after entering the hospital he had a succession of rigors. The ears were full of thick discharge, and each contained a small polypus. The ears were cleaned out, the polypoid

[1] *Vide* Hilton's *Rest and Pain*.

[2] Barker gives ½ in. above and ½ in. behind the centre of the bony meatus for subdural abscess over the roof of the tympanum, and ½ in. directly behind the meatus for subdural abscess in the groove of the lateral sinus. By enlarging the opening upwards and backwards, and then puncturing the dura mater, avoiding the lateral sinus, any abscess in the brain would probably be reached.

granulations removed, and the acute symptoms disappeared. There was no mastoid trouble. A week later the boy became drowsy, with a subnormal temperature: there was no paralysis, no spasm, except possibly of the muscles of the left side of the face, but this was probably rather paresis of the right side. Slight cloudiness of the left optic disc was found; there was no apparent tenderness. The next day a circle of bone was removed from above and behind the meatus, the dura mater opened, and the brain explored systematically, but no abscess was found in the temporo-sphenoidal region. A second flap of skin was then turned upwards from the occiput, and a small aperture made in the skull; a trocar was then passed into the cerebellum, and offensive pus escaped; the cannula was left in, but the boy died, apparently of shock, six hours later. From examination of the head we should advise in such cases the removal of a circle of bone immediately above the external auditory meatus, at a distance from it varying from ½ in. to 1 in., according to age; the dura mater should then be stripped back until the roof of the tympanum is exposed, and any pus lying there evacuated. Next, the dura mater should be incised and the brain explored, first directly inwards, in the posterior part of the temporo-sphenoidal lobe, and, failing this, backwards, inwards, and downwards, and finally forwards. Either a temporo-sphenoidal or cerebellar abscess would probably be thus reached. If, however, the symptoms are fairly definite and no abscess is found in this way, the skull should be opened midway between the superior and inferior curved lines of the occipital bone, and the cerebellum explored. It is readily reached in this position.

It should be remembered that a cerebral abscess may be latent—i.e. may exist and give rise to few or almost no symptoms—and yet may cause sudden death, probably often by rupturing into the lateral ventricle.

In the above case there were no definite symptoms to point to cerebellar rather than to temporo-sphenoidal abscess, and it was only, failing the latter, that, feeling strongly that an abscess existed somewhere, we sought it in the cerebellum. (*Vide* also Cerebral Abscess.)

In cases of tuberculous otitis we have been in the habit of freely scraping out the middle ear with a Volkmann's spoon, removing all cheesy bone and granulation tissue with or without a mastoid incision, according to the extent of the disease. The scraping should be thorough, and should be repeated if necessary.

Where symptoms of septic absorption and thrombosis of the lateral sinus and internal jugular vein exist, the vein should be exposed and ligatured, and then together with the sinus laid open and cleaned out. Similar constitutional symptoms with orbital swelling and proptosis would indicate thrombosis of the cavernous sinus, which occasionally occurs, and might possibly be reached by operation through the orbit, though we are not aware that this has been hitherto attempted.

NOTE.—In examining the tympanic cavity *post mortem*, it should be remembered that the presence of a puriform fluid in the middle ear of infants is common, and apparently rather the result of the changes that take place after the entry of air into the tympanic cavity than a pathological condition.

CHAPTER XXXVII

TUMOUR GROWTH IN CHILDHOOD

Tumour Growth in Childhood.—As might be expected in a rapidly growing organism, the connective-tissue group of tumours is that almost exclusively met with in children. Sarcoma, myxoma, enchondroma, and osteoma are the common forms of new growth, and these are usually in an embryonic and therefore unstable and rapidly growing form. Soft (encephaloid) carcinoma is occasionally met with, it is said, especially in the eye, kidney, and testicle ; but it is probably that most, if not all, of the so-called carcinomata are really sarcomata.[1]

Fig. 209.—Sarcoma of the Lower Jaw and Eyeball in a child aged 19 months.

Sarcomata are not rare in children ; they are commonly of the small round-celled or mixed varieties, are most often seen as periosteal growths, and often follow injuries. They are met with in connection with the jaws, the skull, and the long bones, most commonly grow rapidly, early become generalised, and are speedily fatal ; we have met with rapidly growing sarcoma as a sequel of acute periostitis.

The eye[2] and the skin are not rarely the seat of sarcoma. Retinal sarcomata are said to be common in infants and unknown after 12 years (Warren and Gould). We have seen a melanotic spindle-celled growth in the skin of the dorsum of the foot. The kidney is sometimes the subject of congenital sarcoma (*vide* Diseases of the Kidney).

[1] These are also common sites for sarcomata in childhood.

[2] As in the following case, figured above (fig. 209) :

Sarcoma of Eye and Jaw, &c.—Walter W., aged 1 year 7 months ; admitted July 28, 1884. At birth, in the left eye it was noticed that the pupil was white ; three months ago the eye began to swell ; three weeks ago the right half of the lower jaw began to enlarge

Where sarcomata occur in the limbs, early amputation is the only treatment. Testicular tumours should be removed as soon as they are recognised, and growths in other situations must be treated as the individual case may require.

We have met with a **Neuroma** only once in a child, and the case is of sufficient interest to be worth recording in detail.

Neuroma of Posterior Tibial Nerve.—Alice M., age 11 years; admitted May 9, 1885. Healthy girl. Three years ago first complained of pain in the right ankle and walked with a limp. Has been getting worse lately, and the ankle has become more tender. On admission there is much tenderness along the inner side of the ankle, extending for about 4½ inches up the leg. There is swelling and some heat over the painful area, which seemed to correspond to the tendons of the tibialis posticus and flexor longus digitorum. The case was thought to be one of tenosynovitis, and the child was sent out in a plaster-of-Paris splint on May 20. Re-admitted November 5. Condition unaltered; much pain and tenderness. November 23, the limb was rendered bloodless and an incision made over the swelling in its whole extent, when a firm, pale, lobulated tumour was found connected with the posterior tibial nerve; the growth was encapsuled and turned out fairly freely; it reached from the middle of the leg to nearly the middle of the inner side of the foot, and was about the size of two average fingers. The nerve was inextricably involved and ran through it. The whole tumour and the nerve were removed, about 5 inches of the latter being taken away. No large vessel was injured, but there was troublesome bleeding from some small ones. She did not bear the operation well. For some days she had hyperæsthesia of the opposite limb. The wound healed well, but somewhat slowly. On December 2 it was noticed that ankle-clonus was well marked. On the 13th the whole sole of the foot nearly to the root of the toes was completely anæsthetic, as well as almost the whole of the plantar surface of the little toe. The sides of the foot, the ball

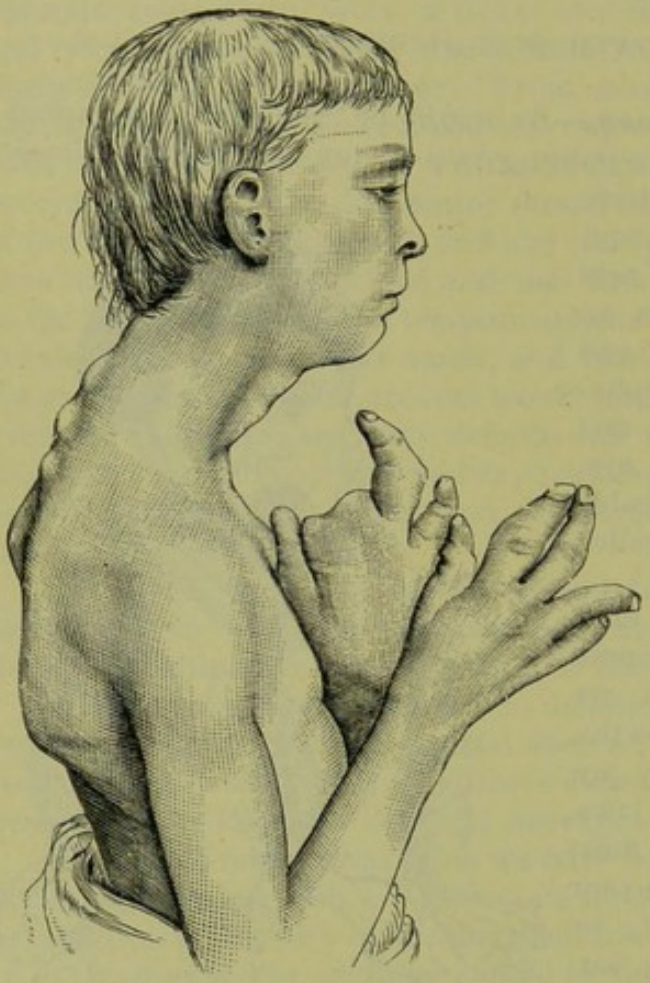

Fig. 210.—Enchondroma of Cervical Spine and Fingers.

painlessly and to grow rapidly in size. No cause known. On admission, well nourished. The left eyeball was enlarged and protruded; it was irregular in shape and reddened; the cornea was vascular. The lower part of the right side of face much enlarged; large veins on the surface, which was nodulated; swelling involved whole thickness of horizontal ramus of jaw, projecting outwards and into mouth, which could not be closed. Teeth displaced and loose; no ulceration; no disease elsewhere. August 1, swelling increasing rapidly, not much pain, losing flesh. Discharged August 12, and died at home a few weeks later.

of the great toe, and to a less extent the balls of the second, third, and fourth toes, together with the whole of their plantar surface, were partially anæsthetic. Sensation elsewhere normal. The calf muscles somewhat wasted. In January 1886 she was practically as on discharge, but could walk a little and move the foot freely without pain. Nutrition of foot good. Microscopically the tumour was a myxo-fibroma. Nerves could be traced for some distance in it and then became degenerated and lost. March 23, 1888, quite well; no return of sensation; foot warm; arch good; walks well; no pain or tenderness.

Of the more innocent growths the **Enchondromata** are the most common; they are usually multiple, occur on the fingers, and may be congenital; they tend to grow with more or less rapidity, and if they cause inconvenience may require amputation of one or more fingers. Removal of the growth alone is rarely satisfactory, since it has been shown that the tumour is very often central in origin, as in the following instance:

Multiple Enchondromata of the Fingers.—Samuel M., age 7 years 9 months; admitted January 28, 1885. When 5 months old swellings were noticed on the fore and middle

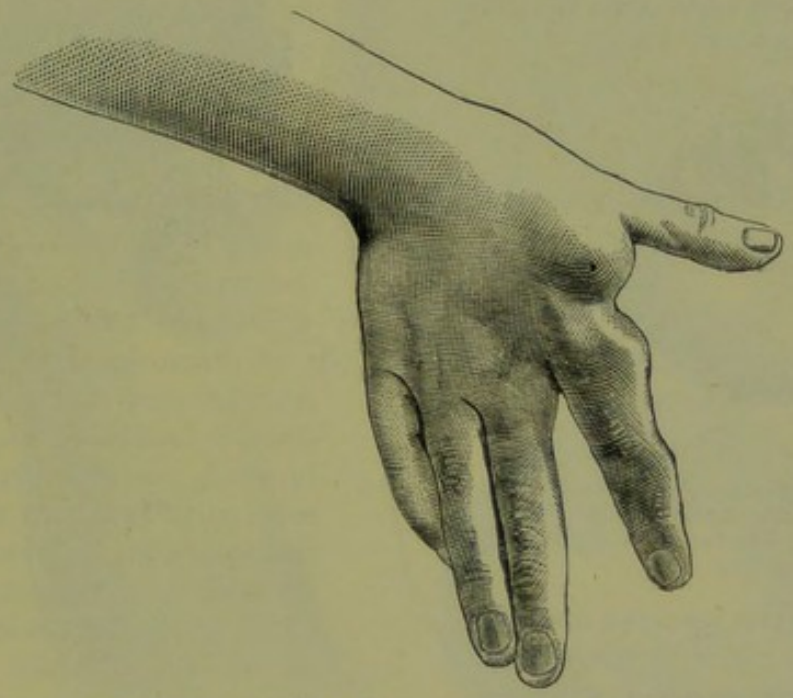

Fig. 211.—Multiple Enchondromata of the Forefinger.

fingers of the left hand; these have gradually increased, and give rise to much pain if injured; at other times they are painless. On admission, is a thin, unhealthy boy. Several cartilaginous masses are growing from all the fingers of both hands; the swellings vary in size from a pea to a small nut, the largest is in the flexor aspect of the left middle finger; this finger cannot be flexed. The fingers are large and distorted, with some lateral deflection of the second and third fingers of the right hand. The worst, the left middle finger, was amputated at the metacarpo-phalangeal joint, and the theca was stitched up with catgut (Treves). A section of the finger showed a cartilaginous tumour, the size of a small walnut, growing from the proximal end and from the central part of the epiphysial line of the second phalanx. The flexor tendon was stretched over the tumour. A smaller mass sprang from the distal end of the same phalanx. The wound soon healed. The other fingers were not touched, as they gave rise to no great inconvenience. The cervical vertebræ were similarly affected (*vide* fig. 210), and the feet in 1899 also became the seat of cartilaginous outgrowths.

Another case is shown in fig. 211. **Osteomata** are usually sessile, composed of cancellous tissue capped with soft cartilaginous or myxochondromatous tissue ; they most frequently spring from the neighbourhood of an epiphysial line, may be multiple, and are occasionally hereditary. These growths may require removal on account of their interference with the movements of a joint or of pain ; if chiselled or sawn through at the base, they do not recur. We have most often seen them at the upper end of the humerus, as in the case quoted.

Exostosis.—Sarah E. T., age 10 years 6 months ; admitted January 9, 1884. Tumour first noticed six weeks ago ; has grown slightly since ; no cause known. On admission an exostosis as large as a good-sized walnut was found on the posterior aspect of the humerus, 2 inches below the acromion ; the swelling was bilobed. Removed by chisel antiseptically on January 17 ; the surface was cartilaginous, the deeper part composed of cancellous tissue. Wound healed on January 22.

Fig. 212.—Hygroma of the Neck, associated with Macroglossia. Mr. Whitehead's case. The tongue is protruding. (*Vide* also Nævus.)

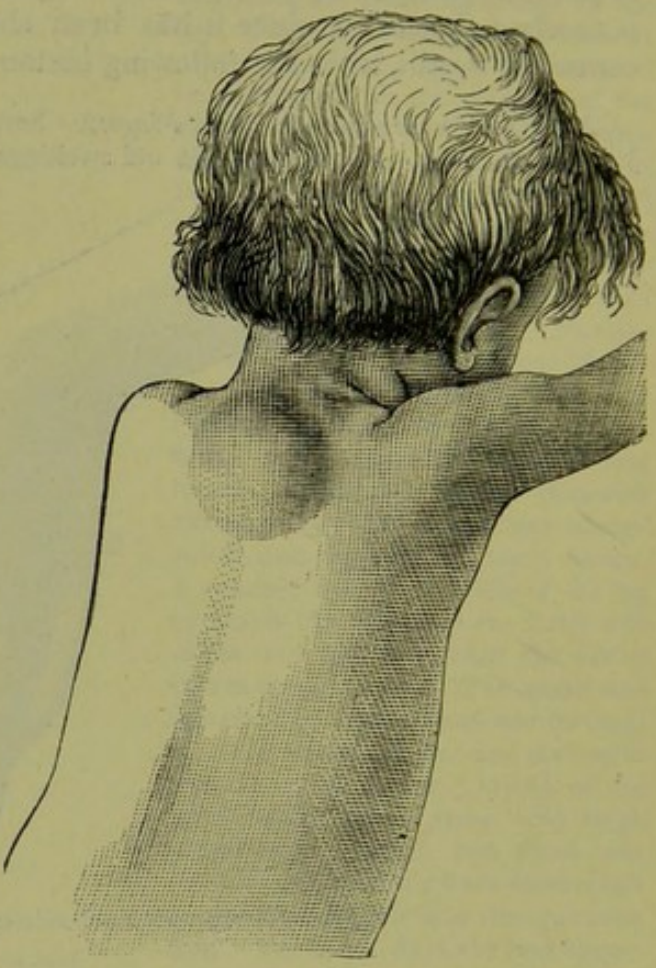

Fig. 213.—Congenital Serous Cyst of the Back.

Besides the growths already mentioned, there is the large group of **Congenital Fibrous and Cystic Tumours :** the former may occur in any part, the latter are said to be limited to the trunk and head ; we have, however, removed a multilocular cystic growth from the back of the thigh in a child. Cystic hygroma of the axilla is not very uncommon ; it usually extends up into the neck. The cystic tumours may be divided into several classes. A large proportion are really cavernous lymphangiomata (lymph nævi) (see Nævus) ; such are hygroma, hydrocele of the neck (a unilocular hygroma), the tumour mentioned above as removed from the thigh, and many others. In the second group are those cystic tumours resulting from degeneration of a blood nævus ; in these the fluid may be clear, or more or less stained by admixture of blood pigment. The third group includes cystic formations by degeneration in fibrous or teratomatous

growths ; and the last includes dermoid cysts, the result of involuted or 'dissociated' blastoderm.

These 'dermoid' cysts may be met with in the course of any of the lines of union of the embryo, e.g. along the median ventral and dorsal lines of the trunk, in the face, head, palate, neck, &c. These cysts are due to closing in of the tissues over a portion of epiblast ; hence the cyst wall is composed of more or less perfectly formed skin, with hairs, sebaceous glands, &c. ; lying in the cavity of the cyst will be found sebaceous matter and hairs, and epidermic scales. Perhaps the commonest sites for these tumours are the outer angle of the orbit (orbital fissure), the inner angle (lachrymal fissure), and the median ventral line. In the auricle they may result from inclusion of skin between the tubercles by fusion of which the auricle is formed. They are sometimes met with in the middle line of the nose, and cause much disfigurement by the growth of hair from their interior; in this position they may be due, as pointed out by Bland Sutton, to some irregular laying down of the skin. Or they may arise from imperfect closure of the internasal fissure. Possibly the growth of the nasal bones and lateral cartilages causes some inversion of the skin in some cases. The growth of hair seen upon the nose in later life suggests a possible similarity between the two conditions.

Fig. 214.—Hydrocele of Neck. (From photograph by J. Hepworth, M.R.C.S.)

Fig. 215.—Dermoid Cyst of Orbit.

Dermoid cysts differ from acquired sebaceous cysts in that they are congenital, that they lie deeper than the ordinary wen, being in the subcutaneous or even in the submuscular tissues, and in the case of the skull they may cause partial or complete absorption of the underlying bone. The skin over a dermoid cyst is usually of natural appearance and of normal thickness, not thinned and showing dilated

capillaries, as is often the case in sebaceous cysts. In sebaceous cysts the aperture of the gland is often visible as a black speck : no such mark is seen in a dermoid tumour. Should the dermoid cysts grow and become unsightly, they should be excised, but it must be remembered that their removal may be dangerous on account of their deep relations, and that, as they are lined with more or less perfect skin, complete removal is required, and it is not sufficient to lay open and scrape the cyst wall.

Mr. Bland Sutton, in his lectures delivered at the Royal College of Surgeons, classifies dermoid tumours as (1) Sequestration dermoids ; (2) Tubulo dermoids ; (3) Ovarian dermoids.

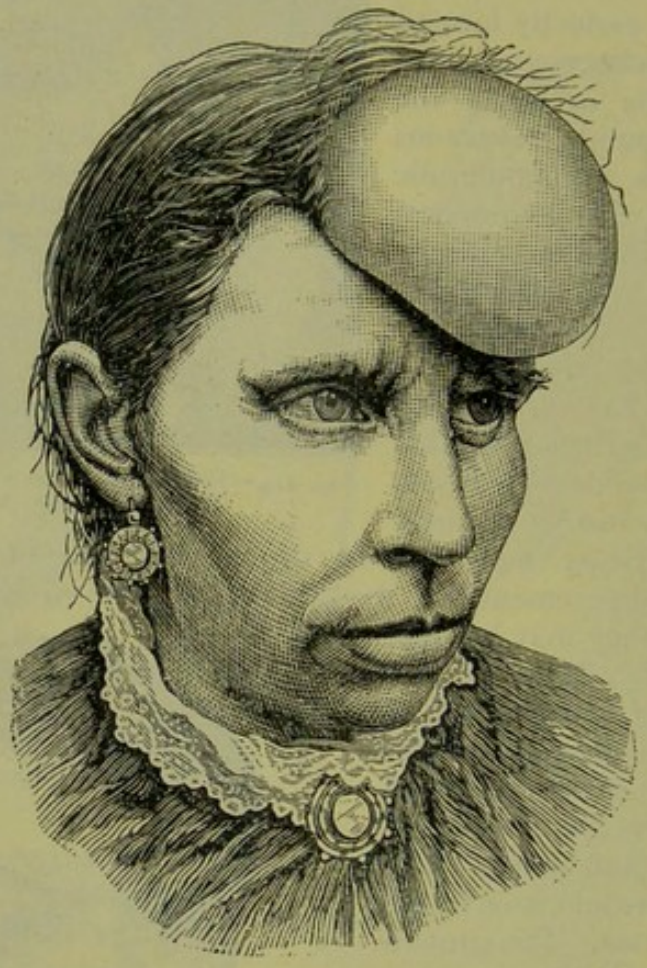

Fig. 216.—Dermoid Cyst of the Forehead. Mr. Hardie's case.

The first occur usually in the lines of union of the embryo, or are a result of accident ; a sort of subcutaneous grafting of dermal tissue.

Tubulo-dermoids arise in connection with 'obsolete canals' 'associated with the primitive alimentary canal.' They may exist as 'dermoid cysts,' 'dermoid tumours,' or as 'thyroid dermoids,' or 'congenital adenomata.' The first two varieties do not differ from sequestration dermoids, except that they are more complex. Mr. Sutton calls them thyroid dermoids because of their histological resemblance to the thyroid body. 'They present easily recognisable characters : (1) they arise in obsolete sections of the gut ; (2) resemble structurally the thyroid body ; (3) are frequently associated with striped or unstriped muscle fibre ; and (4) are usually congenital.' 'The most typical specimens occur in the neighbourhood of the coccyx, in the tongue, and in the neck.[1]

[1] *Vide* also Marshall, *Jour. Anat. and Phys.* vol. xxvi.

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After further details, for which we must refer to the 'British Medical Journal,' March 2, 1889, whence the above extracts are taken, Mr. Sutton concludes his most interesting account of these curious growths by remarking: 'It is an interesting fact that the six obsolete canals existing in the embryo of a mammal, namely, the infundibulum, neurenteric passage, post-anal gut, cranio-pharyngeal canal, thyreo-lingual duct, and the duct of the yolk sac, should all have direct relation with the alimentary canal, and each be directly associated with dermoids, often of considerable complexity, and with a peculiar form of tumour, identical in structure with the thyroid body.' Some time ago we met with a case of an infant, a twin three days old, who was the subject of a large unilocular cystic tumour growing from beneath the coccyx, and forming a somewhat pendulous mass hanging from the perinæum. The cyst was thin-walled, and about the size of the child's head. A day or two after admission the cyst burst, and gave exit to about half a pint of

Fig. 217.—Dermoid Cyst in the Lachrymal Fissure. A tooth is seen growing at the upper part of the tumour. Professor Young's case.

clear yellow fluid—practically serum. We removed the collapsed cyst by incision, and found a fine channel running up into the pelvis for about 1½ inch. The child did well, and was sent out with the wound nearly healed in March 1889. Sections of the wall of the cyst showed a distinctly villous lining, with a single layer of somewhat indistinct roundish cells.

(*Vide* also Malformation of the Digestive Apparatus.)

An important group of tumours in childhood is formed by the **fatty growths** often met with. There may be simple general obesity or hypertrophy of fat, a condition often met with in our experience in association with malformations such as club-foot, spina bifida, giant foot, &c.[1] Jacobi,[2] who has collected many of the cases on record of hypertrophy of the

[1] The cervical fatty growths met with in cretins are also noteworthy in this connection.

[2] *Archives of Pædiatrics*, February 1884. Jacobi's list contains obviously very different pathological conditions. Also Bland Sutton, *Brit. Med. Jour.* vol. i. 1890, p. 877.

extremities, attributes the condition to intra-uterine venous congestion[1] in early fœtal life ; if, however, this occurs before the first half of intra-uterine life, during which no fat is said to be formed, myxomatous tissue is developed ; if in the later stages, fatty tissue.

Lipoma may occur in any part of the body ; it is, however, rarely met

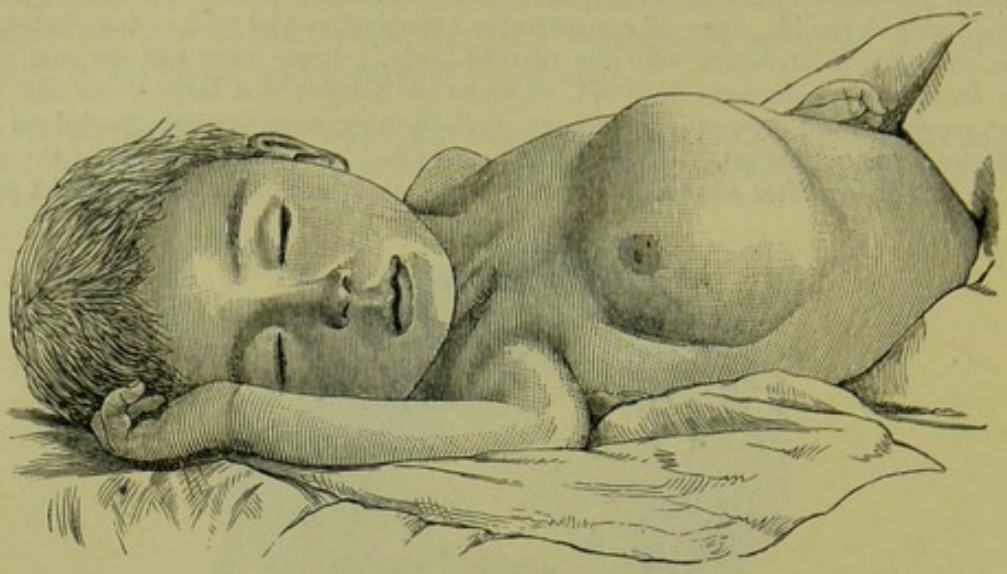

Fig. 218.—Congenital Myxo-lipoma of the Breast. The tumour was removed, and the child did well. We have seen a second similar case.

with in the head. Congenital lipomata are often not encapsuled ; they are sometimes associated with nævus, as in fig. 94 (nævus lipomatodes), or, as in one case of Jacobi's, with spina bifida. Congenital sacral tumours are often mainly fatty, as in one or two of our own cases ; but these, and indeed congenital lipomata elsewhere, are by no means always pure fatty growths ; fibrous, bony, or cartilaginous material may be mixed up with the fat, as well as nævus, muscular tissue, &c. ; these more complex tumours belong to the teratomatous class rather than to the ordinary lipomata. When occurring in the foot congenital lipoma forms one of the varieties of so-called 'giant foot,' of which fig. 219 is a specimen ; in some of these cases the growth is encapsuled ; in others it is diffuse, and after incomplete removal it shows a tendency to recurrence. In these cases of giant limb, which are usually unilateral, the rate of growth is variable, and all the constituents of the limb are overgrown in some cases, while in others the bones are enlarged, the vessels, muscles, and nerves being normal. (See also Nævus for an account of the lymphatic form of 'giant foot.')

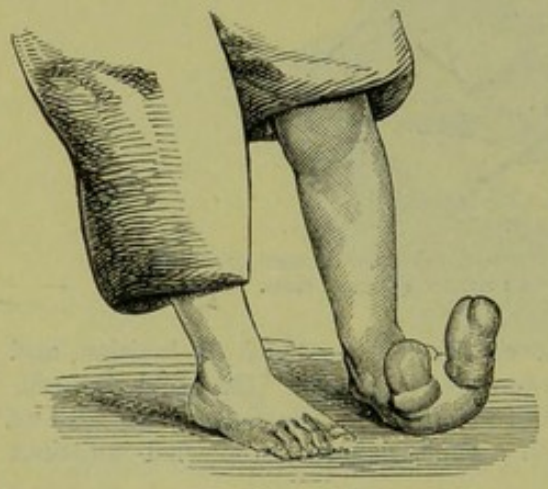

Fig. 219.—Giant Foot (the Fatty Variety), the growth affecting mainly the toes, but also to some extent the sole of the foot.

Fatty tumours of doubtful congenital origin are sometimes met with, and may be the seat of myxomatous change, as in the appended case.

[1] Busey attributes it to lymph stagnation.

CASE.—*Congenital (?) Myxo-lipoma of Thigh.*—William M., age 2 years; admitted November 2, 1885. Child began to walk last January, but was weak and soon tired; had a severe fall at that time. Four months ago a swelling was first noticed at the back of the left thigh; it has gradually increased in size, but has never been painful. Has been wearing splints for rickety deformity lately. No sores about the legs. On admission, a very rickety child. In the middle of the back of the left thigh is a soft movable swelling, not tender, not well defined, and indistinctly fluctuating (?). The swelling is about the size of a large walnut or larger. November 5, an incision was made over the swelling between the hamstrings; it was found to project on the inner side of the great sciatic nerve, and was, with some dissection, shelled out from its deeper attachments to the superficial layer of periosteum; it extended from the upper border of the popliteal space upwards for about 2½ inches. The whole growth was removed; it was fairly well encapsuled, soft, and gelatinous. Microscopically it proved to be a myxo-lipoma. On November 16 all stitches were removed and the wound was almost healed. Sent home.

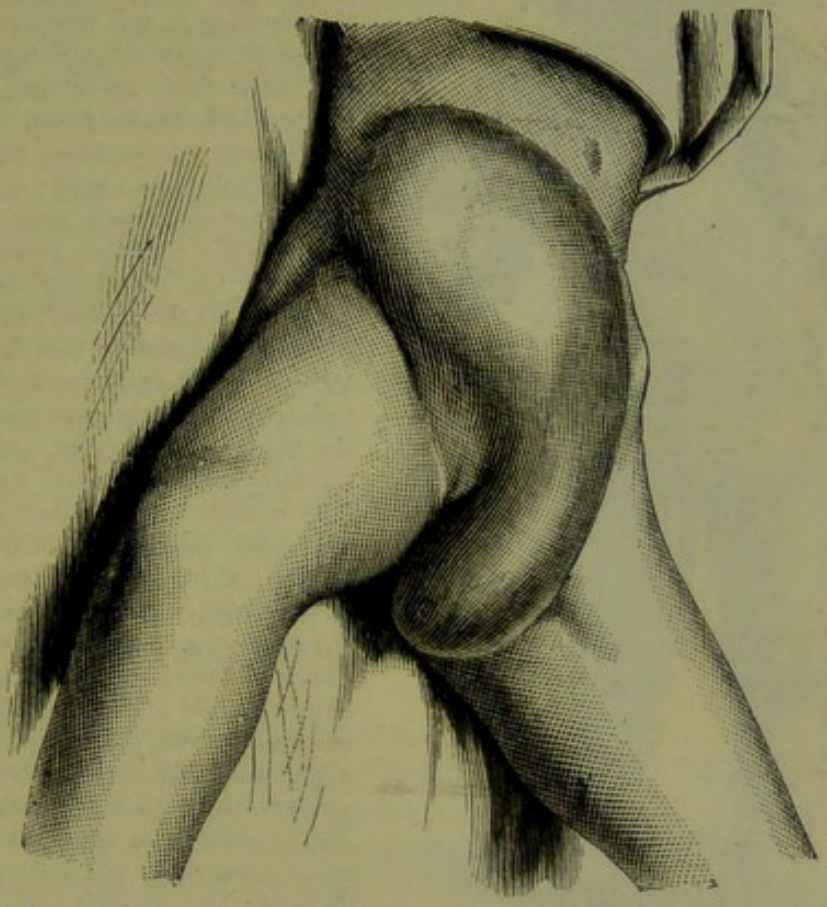

Fig. 220.—Congenital Cystic Tumour of the Groin. Mr. Hardie's case.

Compound Congenital Tumours occur most frequently about the sacral and lumbar regions; their origin is obscure, and has been accounted for on the view of included fœtation, gemmation, or inclusion of a portion of the outer layer of blastoderm, at the time of closure of the dorsal laminæ.[1] The tumours are often cystic, and may contain masses of fat, cartilage, bone, and skin elements. They vary in size, and may attain great dimensions; their

[1] Mr. Bland Sutton divided these tumours into four classes: (1) Sacral spina bifida; (2) Tumours originating in the post-anal gut; (3) Cystic tumours originating in the neurenteric canal; (4) Parasitic fœtuses.—Erasmus Wilson's Lectures, *Brit. Med. Jour.* February 12, 1887.

rate of growth usually corresponds with that of the child; they may become ulcerated from irritation. Such tumours give rise to trouble by their weight and bulk, and their interference with movement.[1]

CASE.—*Congenital Sacral Tumour.*—Elizth. Ann T., age 4 years; admitted February 2, 1885. Always a delicate child; more so since an attack of scarlet fever at 2 years. The tumour has gradually increased to twice the size it was at birth. She has had no fits; vomits frequently after meals; cannot retain her urine, but has no incontinence of fæces; sleeps badly and complains of abdominal pain. On admission, a delicate child. Over the lower lumbar and upper sacral vertebræ is a soft, pulpy tumour, about the size of a small orange; the skin is natural over it; there is no tenderness on pressure, and the swelling is not fluctuating. There is loss of power in both legs; the child can draw them up in bed, but cannot support herself upon them. February 13, the tumour was explored with a needle, but no fluid was found; a straight incision was then made over the swelling and the skin reflected, exposing a mass of fat. On dissecting this carefully away a small tumour the size of a filbert was exposed; this evidently contained fluid and could be seen to pulsate; it clearly was connected with the theca; this was left uninjured, and the fatty mass dissected away from it. The wound was drained and sutured; operation antiseptic. On making a section of the growth a small nodule of cartilage was found in its centre. February 14, dressed; about half an ounce of blood-stained serum escaped; child vomited once, otherwise well; no convulsions or pain; tube removed. 15th, was sick twice yesterday, and awoke several times in the night, screaming. 16th, sick again yesterday; no more screaming; lies very quiet. 18th, dressed; a quantity of serum collected beneath the skin, so tube was put in again; has been very irritable for last two days; sick once in the night; slept well; ice to head and spine; no squint or convulsions; temperature normal. 19th, is a little better. She became steadily worse, and died on the 21st with evidence of meningitis. The highest temperature was 99·2°.

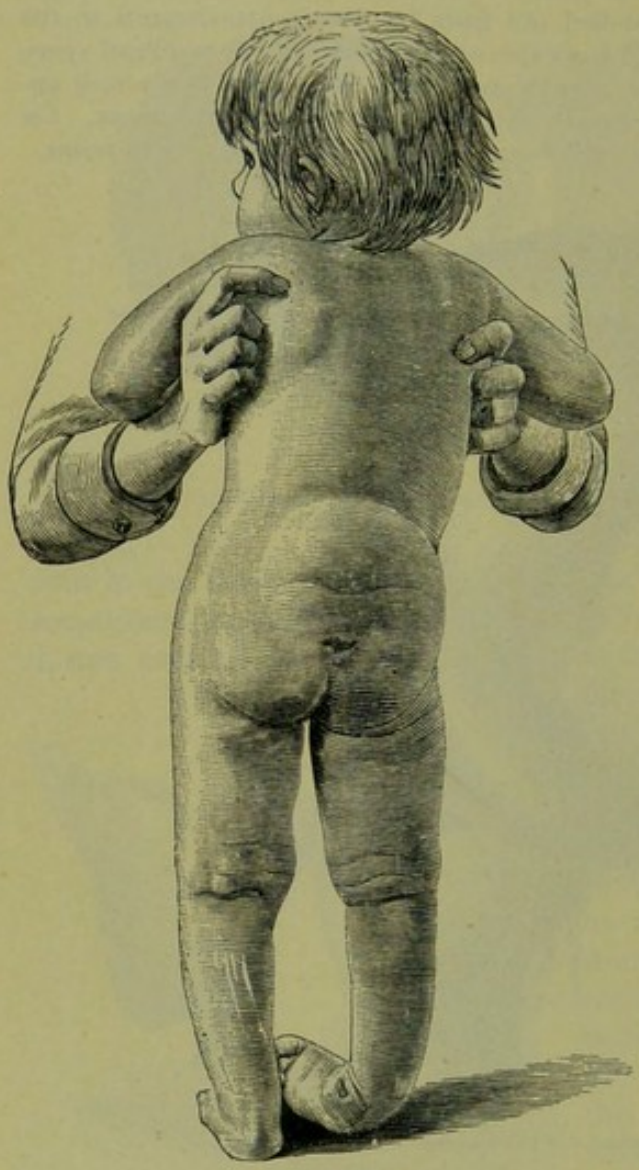

Fig. 221.—Congenital Sacral Tumour with Talipes.

Post-mortem.—On removing the brain an excess of fluid escaped; the surface of the brain was congested, but otherwise natural; there was some matting together along the Sylvian fissure, but no other abnormal appearance. *Spinal cord*, excess of fluid and much congestion at the seat of the tumour and for four inches above it. The cord ended in a

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[1] Vide *Clin. Lect.* by James Hardie, F.R.C.S., *Lancet*, May 2, 1885. Into the subject of teratology it is impossible to enter here, but the reader may refer, among other works, to Förster's *Missbildungen des Menschen* and Ballantyne's *Antenatal Pathology*.

fibrous expansion which spread out over the tumour. Small portions of the tumour extended downwards into the sacrum. The laminæ were imperfect at the seat of the tumour; the central canal of the cord was dilated below the mid-dorsal region, and the left cornu of grey matter had disappeared, leaving a hollow space. This was evidently a combination of spina bifida, syringo-myelia, and a congenital tumour of cartilage and fat. The operation was undertaken with the view of possibly relieving the cord of pressure and so removing the paraplegia, but there is much risk of meningitis in these cases.

As these growths are usually median in position, or nearly so, they simulate spina bifida: hence they have been called 'false spina bifida' (*vide* p. 602); they may have attachments within the spinal canal or pelvis.

Any congenital tumour of the vault of the skull or over the spine should be looked upon with suspicion, as likely to have intimate relations with the cranial or spinal cavities. The appearance of the skin, the mobility of the tumour, its reducibility, and the effects of pressure, &c., are the points to be looked to (*vide* Chap. XXVI.). It is sometimes impossible to diagnose nævus from other soft growths; the presence of cutaneous stains or of nævi elsewhere, the effects of straining or crying, the possibility of partly emptying the tumour, and its peculiar spongy feel, must be taken into account (*vide* Chap. XIX.). We had in 1899 under our care a child of a few months old with a large cystic abdominal tumour. On opening the abdomen the tumour turned out to be a 'parasitic fœtus' in the lesser cavity of the peritoneum. The tumour was firmly attached to various viscera and the posterior abdominal wall, but was removed. The child died of shock. The mass contained skin, bone, coils of intestine, and other imperfectly developed viscera. This case, with a report by Dr. Ballantyne, who was kind enough to examine it, and drawings by Dr. Fothergill, will be found recorded in the 'Brit. Med. Jour.,' November 17, 1900.

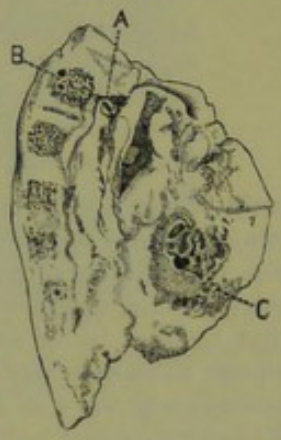

Fig. 222.—Section of Congenital Sacral Tumour. A points to the spinal canal; B to the body of a vertebra; C to a mass of ossifying cartilage in the tumour.

Treatment.—Congenital lipomata, if large, rapidly growing, painful, or inconvenient, should be excised. The congenital sacral tumours, unless for some very good reason, should be left alone—there is much risk of injury to the spinal contents, as seen in the case just related.

Cystic growths may be treated by tapping, injection, setons, incision, or excision; none of these modes are free from danger, and the last is sometimes impossible from the extent and connections of the mass. In large unilocular deep-seated cysts, such as 'hydrocele of the neck,' tapping, followed by injection with Morton's solution if the cyst refills, is the best plan; if suppuration occurs, free incision and drainage must be employed. The multilocular cysts are often best treated by setons, small threads being inserted and the process repeated if necessary. In the cavernous lymphatic nævi, much lymph may drain away if the growth is cut into, just as bleeding occurs from a blood nævus, and there is much risk of septic infection or exhaustion: hence these growths should be removed entire, if at all. Incision and packing with gauze will procure obliteration sometimes, but we have seen further growth take place after the wound has healed in multilocular hygromata (cavernous nævi), just as in blood nævi.

In the case of giant foot the fatty variety has a tendency to grow steadily, and though pressure may slightly retard it, we have not found it succeed as a means of treatment. Ligature of the anterior and posterior tibial arteries in the following case gave a good result for a time, but after a year or two the growth continued. In such cases the choice is between leaving the case alone and amputation ; the latter should only be done when the crippling from the presence of the growth is greater than would result from the mutilation.

CASE.—*Pes Gigas. Lipomatous Variety.*—Emily C., age 9 months ; admitted June 23 1884. Family history unimportant. At birth it was noticed that the left foot was distinctly larger than the right ; since that time it has steadily grown ; there has been no pain, and the child's health has been unaffected. [Thanks to the courtesy of Dr. Withers, of Sale, we were able to watch this case almost from the first.] On admission, a fat, healthy child ; the left foot much enlarged, chiefly the dorsum and inner side ; toes not affected ; skin natural, dimples on raising it ; at the outer side a few hard nodules can be felt. Measurements :

At root of toes	6½ in. . .	Right foot 4½ in.	circumference.
At middle of foot	7½ in. . .	,, 4¾	,,
Across heel and foot	8 in. . .	,, 5½	,,
Around ankle	7 in. . .	,, 5¼	,,
Middle of calf	7½ in. . .	,, 7½	,,

Elastic pressure was fairly tried for a long time prior to admission without apparently diminishing the rate of overgrowth. The temperature of the two limbs did not apparently differ, and the child could kick the foot about, though it did so clumsily. On July 2 the posterior tibial artery was ligatured in the middle of the leg by the usual method, a catgut ligature being employed ; the vessel was very small, and its pulsations feeble ; a drainage tube was used ; operation antiseptic ; all went on well. On the 11th the measurements were as before, except the one at the root of the toes, which was ½ in. less ; wound almost healed. July 12, the anterior tibial artery was ligatured doubly, and divided between the ligatures ; the veins were included in the ligatures. 21st, first dressing, wound all healed ; no drainage was used ; measurements as on 11th, except middle of foot ¼ in. less. 28th, Martin's bandage applied ; the warmth of the foot seems in no way interfered with. August 4, measurements : Root of toes, 6¼ in. ; middle of foot, 7½ in. ; across heel and foot, 8 in. ; around ankle, 7¼ in. ; middle of calf, 7¼ in. February 1885, the foot is getting smaller in all dimensions. Subsequently the growth remained stationary for a while and then increased.

Lymphoma (Lymphadenoma, Lymphosarcoma) is sometimes met with in the shape of large masses of glands in the neck (fig. 223) or elsewhere,[1] which slowly grow and give trouble from their size, unsightliness, and pressure effects (*vide* Hodgkin's Disease), as well as ultimately cause death.

Removal of such masses of glands is usually of only temporary value ; it is seldom that all can be got away, and recurrence often takes place in a short time. Section of such a tumour shows a pinkish-grey lymphoid tissue with no caseous foci.

The following was a characteristic case :

CASE.—*Lymphoma of Neck.*—John T., age 12 years 4 months ; admitted November 10, 1882. Family history good, except that the mother had abscesses beneath the jaw whilst pregnant with this child ; boy himself never very hearty, but had fair health ; four years

[1] Cystic lymphomata are sometimes met with, and these growths have been found in the rectum, among other places.

ago a swelling appeared beneath the lower jaw on the left side; this grew slowly till the last three months—since then it has increased rapidly; for three weeks has had pain. On admission, in the left posterior triangle is a large globular tumour consisting of lobulated lymphomatous masses; the swelling extends from 1 inch below the jaw to ½ inch below the clavicle, which it overhangs; it is 5¾ inches in transverse diameter; some of it projects beneath the trapezius, and outlying masses reach nearly to the middle line of the neck; the skin is movable over it, and it is not fixed to the vertebræ; no marked glandular enlargement elsewhere, though a few slightly enlarged glands can be felt in the left groin; some dulness over apex of left lung; left pupil slightly smaller and less sensitive than right. On November 16 the gland masses were removed, weighing 8 oz.; most of the glands shelled out easily, some were adherent; the external jugular vein was tied and divided; at times when traction was made upon the carotid sheath during the operation the pulse was much accelerated; the carotid sheath and cervical transverse processes were exposed. He bore the operation well and lost little blood. Operation antiseptic, with sponge pressure; recovery uninterrupted; antiseptics were left off on December 6, and he was discharged with a small superficial wound. February 1883, the boy has been better since the operation, but new masses of glands are already beginning to enlarge, though at and after the operation none could be felt.

Fig. 223.—Lymphoma of the Neck.

Another case is shown in fig. 223. It is not at all uncommon to find cases in which certain of the glands have broken down and discharged, while in other respects the conditions resemble lymphoma rather than tuberculosis. We have accounted for these cases by supposing that tuberculosis and Hodgkin's disease have co-existed. We have seen lymphoma also appear in a child the subject of hip disease. Variation in the size of the swellings, associated with fever, but subsiding without suppuration, is also often seen.

Multilocular Cystic Growths of the Jaws arise from epithelial ingrowths from the surface of the gum, which afterwards become shut off and develop cysts; they may be congenital or occur in infancy. Besides these, two other forms of cyst are found associated with the teeth (dentary cysts): (1) Cysts originating in connection with the tooth follicles—follicular, or, if they contain teeth, dentigerous cysts; (2) Periosteal cysts, originating beneath the periosteum of the jaw.

Dentigerous cysts arise from mal-placed or mal-developed teeth, and may occur at any part of the jaws; they contain clear, serous or glairy, white or coloured fluid, rarely pus. Most often they are associated with the permanent, sometimes with the milk teeth. Eggshell crackling, the presence of fluid, and suppression of a tooth are the common indications of the nature of these swellings.

For further details on the question of tumours we must refer to the general text-books.

CHAPTER XXXVIII

DISEASES OF THE THYROID AND THYMUS

Acute Enlargement of the Thyroid.—A slight enlargement with tenderness of the thyroid gland is not uncommon, but any acute enlargement, the result of inflammation, is very rare. A typical case of this kind is recorded by Sir T. Barlow,[1] in a boy of 3 years. The symptoms at first consisted in pain in the neck on movement, feverishness and slight enlargement of the thyroid gland. Later the swelling considerably increased ; the temperature varied from 100° to 103° F. ; there was some difficulty in swallowing, but no marked dyspnœa. In four or five days the swelling began to subside ; he finally made a good recovery.

Chronic Enlargement. Goître.—Simple or cystic enlargement of the thyroid is sometimes met with in children, most commonly in the inhabitants of certain hilly districts such as Derbyshire ; it is, however, met with in some cases among town-bred children, both with and without a family history of goître.

In the case here figured half the gland was removed ; it consisted of a mass about the size of a small orange ; in it were many cysts, the larger of which contained reddish-yellow fluid. The child did perfectly well, but died some months later of scarlet fever ; the other half of the gland had not appreciably altered after the operation.

We have been three times called upon to perform tracheotomy in young people for urgent dyspnœa, the result of pressure of an enlarged thyroid gland ; in two cases the patients were young adults, the third was an ill-developed, idiotic child, in whom there was enlargement of the tonsils, with post-nasal vegetations ; these had been dealt with once with marked improvement, but on the second occasion sudden dyspnœa, evidently due to pressure of the enlarged thyroid, was brought on by an attempt at examination, and on administering chloroform the breathing stopped ; tracheotomy was performed, and the child did fairly well for a day or two, but died of bronchitis on the third or fourth day. The operation under such circumstances may be of extreme difficulty alike from the presence of the large mass of gland, from the engorgement of the vessels, and from the altered shape of the trachea, which is compressed laterally. A specially long tube is required to reach down below the constricted part of the windpipe. There is no

[1] 'On a Case of Acute Enlargement of the Thyroid Gland in a Child,' by Dr. T. Barlow, *Clin. Soc. Trans.* vol. xxi.

doubt that in any case where attacks of dyspnœa, 'thyroid asthma,' have recurred, either removal of part of the gland or division of the isthmus should be performed in an interval between the attacks.[1] In simple cases of goître the treatment is the same as for adults.

We have divided the thyroid isthmus in a young gentleman of 16, in whom acute attacks of almost fatal dyspnœa had more than once occurred. The trachea was much flattened laterally ('scabbard trachea'). Three weeks after operation the gland had resumed nearly its normal size. In another case the operation was done during an attack, and the patient died a few hours later from rapid œdema of the lungs. In another, part of the gland was removed and tracheotomy performed; the patient recovered, though in cases where tracheotomy is necessary the danger to life is much increased.

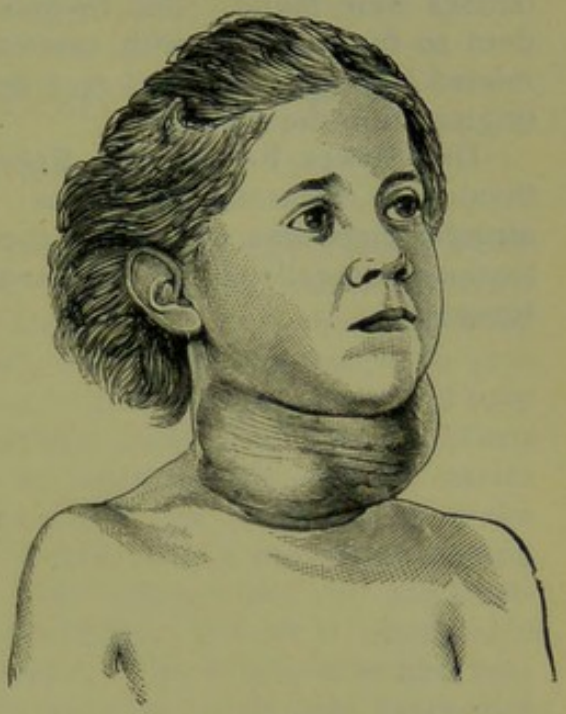

Fig. 224.—Cystic Bronchocele in a Child.

It is not very uncommon to see children in whom the thyroid is slightly enlarged and sometimes painful and tender, but in whom there is no very great deformity and no cystic development. These cases of 'simple bronchocele' may be met with at any age, but are perhaps most common about puberty. Under treatment with iodine or arsenic internally, and weak red iodide of mercury ointment, cautiously used, externally, the gland generally returns to its natural size. Iron is required if there is anæmia.

The thyroid gland is usually absent in cases of myxœdema or 'sporadic cretinism'; in any case of wasting or disease of the thyroid the possibility of myxœdema must be borne in mind. (See p. 591.)

Thymus Gland.—The thymus body or gland reaches its greatest size at two years of age, after which it dwindles, and by puberty is in most cases reduced to a mere vestige. At birth it measures some 2 in. in length and perhaps 1½ in. in breadth, and weighs about ½ oz. At 2 years of age it weighs from 1½ to 2 oz. It is situated behind the upper piece of the sternum, reaching as low down as the fourth costal space; it lies partly on the pericardium, the aortic arch, and large vessels.

But little can be said concerning the diseases of the thymus. Some authors have attributed laryngismus and spasm of the glottis to enlargement of the thymus and a consequent pressure on the nerves or trachea itself. It is very doubtful if laryngismus is due in any way to hypertrophy of the thymus, but cases in which there was evident pressure on the trachea by an enlarged thymus have been recorded by Goodhart, Jacobi, and Baginsky. Sudden death from spasm of the glottis is not uncommon during the first two or three years of life, and this has in some cases been attributed to the

[1] Vide *Med. Chron.* vol. xi. 1890.

presence of an enlarged thymus (Pott). We are by no means convinced of this. It is common to find small cysts at first sight looking like abscesses scattered through the substance of the thymus ; these have been attributed to syphilis. Jacobi has noted an excessive quantity of connective tissue in the thymus of syphilitic children. He has also observed tuberculosis of the thymus in cases of general tuberculosis. Demme has recorded a case in which caseous masses were found. The thymus when it becomes tuberculous probably does so from contact with caseous mediastinal lymph glands, as in case related at p. 351. In some recorded instances it appears that sarcoma has originated in the thymus.

Drs. Stokes, Ruhräh, and Rohrer have investigated the relation of the thymus to marasmus in infants. They found that in all cases of infantile atrophy there was atrophy of the thymus gland. The administration of thymus internally in infantile atrophy has not apparently met with any success.

CHAPTER XXXIX

DISEASES OF THE SKIN

DURING intra-uterine life the fœtus is surrounded by the liquor amnii, which softens and soddens the cutaneous surface. After birth the skin is subjected to the drying action of the air and the epidermis quickly assumes its normal condition ; it is, however, exceedingly easily fretted and excoriated by prolonged contact with the urine and fæces, and also by the hot water and soap of the bath. It is hardly surprising to find that under these new conditions the skin is often injured, especially when we remember the delicate nature of the horny layer of the epidermis in the infant. In consequence of the rapid growth which is taking place, there is necessarily a continual building up of the tissues of the skin to keep pace with body-growth, and any interference with the infant's digestion or assimilation of food is exceedingly likely to interfere with the nutrition of the skin. This is seen in various conditions of wasting during infancy ; the skin becomes rough and harsh, and the slightest irritation from the urine or fæces, or friction at the flexures of the joints, gives rise to an erythema, eczema, or to excoriations.

Another point to be remembered is that infants, especially those suffering from early rickets, sweat very freely, and in consequence their skins become sodden with moisture, and miliaria break out. Probably the sweat may contain toxins absorbed from the alimentary canal, which have an irritating effect on the skin and help to create a favourable cultivation ground for cocci of various kinds. Then, also, scratching plays a very important *rôle* in eczema, impetigo, &c.

Reflex inflammations are more common during infancy than in later life, a transference of inflammation readily taking place from one part to another, or an irritation present in one place may give rise to an inflammatory lesion at a distance. In this way we find blotches or scaly spots around the mouth and on the face of children who are suffering from dyspepsia or gastric catarrh, or herpetic patches in those suffering from pneumonia or bronchial catarrh. Urticaria or erythematous blotches may be the result of indigestible food in the stomach, or the pressure of a tooth upon the gum, or the presence of acari burrowing beneath the skin.

Eczema

Eczema during infancy, while proving amenable to treatment, is exceedingly apt to relapse, and in aggravated cases it forms one of the most troublesome complaints with which the practitioner has to deal. Probably

most physicians can call to mind cases of eczema in infants a few months old which have improved for a while, then relapsed again and again, and for which numerous ointments, lotions, powders, and medicines had been tried in vain. While the majority of these cases get well as the end of the first year is approached, or only relapse occasionally, in many cases the eczema continues to give trouble for years, or even for life.

The causes of eczema in infants are various, though, indeed, but little is known for certain about many of them. In some cases, especially in the local eczemas, there are irritants at work, such as scabies, pediculi, and the fretting produced by napkins constantly wet with urine or fæces. There cannot be a doubt that there is a close relation between the condition of the skin and the alimentary canal. It is interesting to note that if a healthy infant gets an attack of dyspepsia or diarrhœa, its muscles become flabby, there is some wasting, and the nutrition of the skin is lowered ; and now the contact of urine or soiled napkins sets up an irritative erythema or eczema, the irritation of the soiled napkins being powerless to excite an excoriation until the nutrition of the skin is interfered with by faulty assimilation. One of the commoner internal causes of eczema in infants and young children is an abnormal condition of the alimentary canal ; probably, in some instances, the eczema is due to a large extent to toxins in the blood, absorbed from the alimentary canal and excreted in the sweat. Eczemas are usually worse during the cold east winds of spring.

In what class of children is eczema the most common? The answer must be that eczema may be found in children of every type and of every social grade. In the first place, it must be said that eczema is by no means uncommon in infants and children who are apparently in perfect health ; and breast-fed infants suffer as well as artificially-fed infants. We have frequently noted in hospital that children admitted for some other disease, and who are quite free from any skin trouble, develop eczema as they become fat and well. In these cases there is a strong presumption that over-feeding may have something to do with the eczema ; it is certainly true that very fat children are often eczematous, and it is very possible that strong, healthy children with large appetites may habitually be overfed, and the system seek relief, as it were, in an acute or chronic discharge from the skin. Perhaps in some of these cases there is a history of eczema in the parents. Children suffering from early rickets and sweating freely seem peculiarly subject to eczema.

On the other hand, as already remarked, dyspeptic children, and those who are badly or poorly fed, are subject to eczema.

The so-called strumous children are exceedingly likely to suffer from eczema, especially of the impetiginous type. The scalp, face, and backs of the ears are most often affected : there is much oozing of a semipurulent fluid, which dries and forms yellow crusts. The lymphatic glands associated with the seat of the eruption are apt to become enlarged, and subcutaneous abscesses to form.

It is a popular notion that many of the eczemas of infancy are due to teething, and that a chronic eczema is always worse when a tooth is being cut. Mothers often look forward to the last teeth being cut, as they believe that then the child will be free from eczema. In all this we think there is a

great deal of exaggeration, but it is easy to understand that a swollen and tender gum may give rise to a good deal of crying, and some feverishness, and so any eczema, especially affecting the face, may be aggravated. We cannot emphasise too forcibly the important part which scratching plays in producing eczemas in infants and in preventing healing.

Vaccination is frequently blamed by the parents of eczematous children : it is certain that a local eczema may arise at the seat of the vesicles, and an impetigo be started elsewhere in consequence of scratching and inoculation of infective pus into healthy skin ; but we do not think that vaccination gives rise to a general eczema.

What part do micro-organisms play in producing eczema ? It is quite certain that many cocci may be found in every eczema, but it hardly can be said that they are the cause of eczema in the same sense that the tubercle bacilli are the cause of lupus or phthisis. Given a papular itching eczema, then scratching removes the cuticle and inoculates the broken skin with cocci, which find a congenial soil in which to flourish. Much of the chronic inflammation which follows is doubtless the result of the growth of the cocci thus inoculated. Eczema may be self-inoculated, like true impetigo, by scratching.

Symptoms and Course.—The commonest places for eczema in infants and young children (local irritants excluded) are the forehead, cheeks, scalp, and backs of the ears. The limbs, especially the flexures of the joints and backs of the hands, are often attacked. The usual form is eczema vesiculosum ; in weakly and scrofulous children the pustular variety, E. pustulosum or impetiginodes, is the most common. The former mostly begins with patches of redness, the inflamed patch quickly becoming the seat of numerous papules ; in less severe cases the papules may make their appearance in crops on apparently normal skin. In the worst cases the itching is intense, and the skin of the forehead or cheeks is hot, red, and œdematous. The papules quickly become vesicular and burst, or perhaps more often the inflamed skin begins to ooze without distinct vesicles being formed. A free discharge from the skin usually gives relief. The skin continues to weep, perhaps for some days, and probably also the eczematous patch is extending, covering the whole forehead and affecting the cheeks, so that at this period all stages of the affection may be seen. In one place there may be redness only, in other places excoriated and weeping skin ; at another place the discharge has dried, forming crusts with raw, tender skin beneath ; where the eczema is nearly well the skin is thickened and the cutis desquamating. The skin of the thighs, flexures of the groin and knees, the arms and back, are very likely to become affected, and as the eczema heals in one place it is very likely to break out in another. Sooner or later the eczema passes into the subacute or chronic stage ; the skin is more or less red and indurated, there is less oozing from the surface, while there is a tendency to form crusts and for free desquamation to take place from the skin. This desquamation or scurfiness is particularly noticed on the scalp.

In some cases the eczema is more of the erythematous type. The child goes to bed at night, and when warm in bed the face and forehead flush up, the skin becoming red, shiny, and hot ; the itching and tingling are intense, so that the child scratches and almost tears itself in its restlessness and

discomfort, while sleep is out of the question. In the course of an hour or two the congested vessels are relieved by a serous discharge through the perhaps already damaged skin, and the inflammatory stage is succeeded by the oozing and crusting stage. The raw and tender skin left after the discharge more or less recovers and dries up, and then there is another inflammatory attack and the process is repeated.

In weakly and scrofulous children the eczema is of a less acute type; there is less redness, burning, and itching, and a greater tendency to pus formation than when eczema occurs in strong and healthy children. The scalp and face are mostly affected: in these places much crusting takes place, the crusts being formed of dried pus, and on raising these more or less puriform fluid escapes. In the early stages pustules are usually present. In the worst cases the whole scalp is a mass of thick crusts, abscesses form in the scalp, glandular abscesses are present in the cervical glands, and perhaps 'cold abscesses' in various places throughout the body. In dispensary practice an eczema pustulosum of the back part of the scalp is almost certainly the result of pediculi.

All forms of eczema in infants and young children are apt to relapse, fresh attacks coming on before the skin has entirely recovered from the effects of the last attack, and the old place is soon as bad as ever. The tendency is for the attacks to involve the same places time after time where the skin has been injured or has 'contracted a bad habit.' Often, however, while healing in one place it breaks out in another. The younger the infant, the more troublesome is the eczema; the older it grows, the less likely is the disease to relapse.

The eczemas, or perhaps more properly erythemas, caused by the contact of foul napkins, or by two surfaces of skin coming in contact (intertrigo), are exceedingly common in dispensary practice; with ordinary care they never occur in healthy children, but in infants suffering from intestinal catarrh or diarrhœa, where the napkins are constantly soaked with the excretions, a certain amount of soreness may be difficult to avoid. The skin is usually at first red, the erythematous eruptions spreading from the anus and genitals; then the horny layers of the skin become detached, leaving superficial excoriations, from which serum and perhaps blood may ooze.

Eczema in older children does not differ from eczema in adults. Any part of the body may be affected—the face, trunk, or limbs, and especially the flexures of the joints. A subacute or chronic conjunctivitis is commonly associated with eczema of the face. The skin readily becomes red and infiltrated, with a dry, rough surface, which readily cracks, making painful sores. The itching is usually severe, and the affected part is constantly fretted and irritated by the scratching which goes on.

Children with eczema are usually constipated.

Complications.—Children who suffer from eczema may also be the subjects of bronchial asthma. In some cases the two diseases are co-existent, in other cases they alternate; there is no constant rule as far as we have been able to determine. Eczematous children frequently also suffer from gastro-intestinal catarrh. This is only another way of saying that there are children who are specially prone to catarrh of the bronchial tubes, catarrh of the stomach and bowels, and also to a catarrhal inflammation of the

external surface of the body. We have already remarked that eczema and impetigo may co-exist in the same subject, and so also may seborrhœa.

It is well known that at times infants who are suffering from eczema, especially when extensive, suddenly develop a high temperature, convulsions, and coma, and die in a few hours. We have seen this occur both in infants in hospital and in private practice, and do not doubt that there has been some connection between the eczema and the convulsion-fever. These cases are well known to the old practitioner, who regarded the fever, &c., as the result of curing the eczema. This view is certainly open to doubt, and need not deter us from using our best endeavours to cure the disease. It is well, however, to bear in mind that a sudden and fatal illness may occur at any stage of the disease.

Treatment.—The most scrupulous care must be taken to keep the healthy infant's skin clean, especially those parts which come in contact with the soiled napkins. A daily bath should be given from the first week, but a prolonged immersion must be avoided as likely to macerate and soften the cuticle too much. A good curd soap free from excess of alkali should be used,[1] and soft water in preference to hard. Some starch powder, such as finely ground rice or maize powder, with 20 per cent. of boric acid, should be applied after careful drying.

If the parts about the genitals become red or excoriated, attention must at once be directed to the state of the infant's digestive organs to see if gastric and intestinal digestion is in a normal state, or if there is diarrhœa ; and it will probably be found that something is wrong here. The affected parts must be kept clean, as little friction as possible being used, and thin gruel, or rice boiled in milk, being used instead of soap ; or the parts may be cleansed with a piece of absorbent cotton-wool dipped in carron oil (lime water and linseed or olive oil in equal parts). After careful drying, boric acid powder, or oxide of zinc and starch (1–5), kaolin, or finely prepared fuller's earth, may be used to dust on. Where there is constant diarrhœa the ordinary napkin may be dispensed with, and pads made of absorbent cotton or wood-wool used instead, as they more readily absorb the fæces and urine. Unna's 'powder-bags' are sometimes useful ; these are bags made of soft fine muslin, and filled with some dusting powder, as zinc and starch, or Taylor's cimolite, and quilted, to prevent the powder from gravitating to one end. These bags may be made ready and used as required ; their value consists in keeping the parts dusted by the powder, which escapes through the pores of the linen or muslin.

The dietetic treatment of general eczema is often difficult, as it may be by no means clear that anything is wrong with the digestive organs. If the infant is being nursed at the breast, great care should be exercised by the mother as regards her diet : beer, tea, coffee, salt meats or greasy dishes are best avoided, or taken only in moderate quantities, while milk, fish, fresh meat, and vegetables may be taken freely. The infant, if vigorous and full-blooded, is perhaps taking too much breast-milk, and the amount should be lessened. Possibly the breast-milk may be poor in quality—containing an excess of sugar, while deficient in proteids and fat—and the infant is flabby,

[1] Unna's 'over-fatty' soap or 'Vinolia' soap is good for infants.

poorly nourished, and suffers in consequence from impetigo or intertrigo ; in which case some form of artificial food must be given in addition to the breast-milk. In artificially reared children the question of diet is of great importance : eczematous infants being brought up on cow's milk are frequently constipated and pass large quantities of undigested curd in their stools. In such cases some form of modified milk or whey should be given. In older children, especially if there is an excess of fat, starchy and saccharine foods should be avoided, and the diet confined as much as possible to milk, cream, eggs, broth, underdone minced meat, and green vegetables.

The medicinal treatment must be directed to overcoming the constipation so often present, and getting rid of bye-products in the alimentary canal ; small doses of mercury, euonymin, or rhubarb and soda may be prescribed. (F. 95 or 96.) Small doses of Rubinat or Hunyadi water are often successful.

Of other internal remedies in the acute stages, alkalis, such as the citrate or bicarbonate of potass, with nux vomica, are frequently useful. Effervescing citrate of potass and lithia are useful, acting both on the bowels and kidneys. Carlsbad salts, taken in warm water before breakfast several times a week, may be prescribed in older children. Arsenic is rarely, if ever, of use in the early stages of infantile eczema ; indeed, we have seen cases which were made distinctly worse by it. In many cases in infants a dose of two or three grains of chloral hydrate (infant 6 months) will secure a good night and prevent scratching. In older children in the chronic stages, where there is a disposition to excessive desquamation, arsenic is usually beneficial. In the chronic impetiginous eczemas of scrofulous children cod-liver oil and the iodides may be prescribed with great advantage. Cod-liver oil and arsenic may be given, or arsenic can be added to some ready-made cod-liver oil emulsion. (F. 97.)

In the management of local remedies much depends upon how the application is used, and much time and trouble may be well bestowed in showing the friends of patients how to apply the dressings, and, what is by no means easy, to keep them in position. Merely smearing on an ointment or dabbing on a lotion may be an entirely valueless proceeding ; moreover, the newly formed cutis is very easily injured. The ointment or lotion requires to be kept in constant contact with the part if it is to be of any use. In infants and young children some method will have to be adopted to prevent scratching ; mittens must be placed on the hands, and in some cases it may be necessary to secure the arms by means of bandages.

For application locally the range of remedies is very wide, and various combinations have been called into requisition in the way of lotions, liniments, and ointments. As a rule, in all acute eczemas, where there is much excoriation of the skin, or thin newly formed skin is present, much washing or any rough handling should be avoided. On the other hand, in chronic cases, where the skin is thick, scaly, or infiltrated, baths are of great service in removing the scales and softening the skin. In all eczemas, however, a certain amount of cleansing is necessary to remove the remains of the old ointments and crusts : this can usually be done by gently applying some almond oil—or carron oil answers very well—ordinary soap being best avoided in acute cases.

In all acute or subacute eczemas soothing remedies are required, and must be persevered in as long as there is an irritable condition of the skin and free discharge. The most troublesome eczemas in infancy are those of the face. In these, when the skin flushes up and is hot and angry during the evening exacerbation, and the infant sleepless and restless from the burning and itching of the skin, hot poppy-head or boric fomentations often give relief. Perhaps more often cooling applications are the most grateful, and for this purpose carron oil, with or without ichthyol, may be applied on lint and kept in place with a bandage. (F. 98, 99, 100.)

When the eczema has passed into the scaly stage, and there is no large amount of discharge from the skin, more stimulating ointments may be used and the face kept continuously bound up to exclude the air. There should be a daily cleansing with carron oil to remove the excess of ointment and the accumulated scabs, and now Lassar's or Ihle's pastes are useful to form a protective covering to the newly formed skin, but they are difficult to remove if allowed to cake on to any extent. (F. 103, 104.)

In acute general eczema, where large surfaces of the body are affected, liniments applied on rag or lint should be used, and the parts firmly bandaged with gauze bandages so that the application may be kept in constant contact with the skin. When there is much discharge and the skin inflamed and tender, it is sometimes best simply to powder on some finely ground boric acid and surround the limb with absorbent wool, firmly bandaged on ; or strips of lint may be saturated with carron oil or calamine liniment. (F. 98, 99.) In a later stage, when the skin is thickened and scaly, with but little or no discharge, more stimulating applications containing sulphur, ichthyol, zinc, or lead are usually prescribed. (F. 102, 108.) The ointment should be of tolerably firm consistence, so as not to melt too readily and run into the lint. Ung. paraffini B.P. is one of the best. Mercurial ointments should not be applied to an extensive surface of skin or too continuously for fear of mercurial poisoning.

In impetigo, where the discharge is more or less purulent and much scabbing takes place, the scabs should be removed by poultices or carbolic oil, and some diluted mercurial ointment (F. 106, 109)—or an ointment consisting of five or ten grains of iodoform to the ounce—may be applied.

Eczema affecting the scalp must be treated in a similar manner to that of the face, except that, as a rule, more stimulating applications may be used. In the weeping and irritable stage carron oil or the calamine liniment or zinc and cold cream may be applied on lint or rags, and a nightcap worn by the child to protect the parts and prevent him from scratching. The hair must be kept short and the scalp cleansed every morning with some mild soap and warm water ; or thin gruel may be used. In the more chronic stages, especially in neglected cases, the crusts must be removed by oiling and poulticing, and some diluted white precipitate ointment or other mild mercurial ointment applied. Lassar's or Ihle's paste (F. 103, 104) may be used, being put on thickly, and the head covered with a cap made of old linen, or what is known as 'butter-cloth' ; the crusts and excess of ointment must be removed daily or every few days. Eczema of the scalp, the result of pediculi, should be treated by poulticing, cutting the hair, and the continuous application of white precipitate ointment.

In the chronic general eczemas of older children, especially where the skin is rough and coarse, and there is much infiltration, and the flexures of the joints are affected, baths and stimulating liniments, followed by some soothing protective ointment, usually answer best. Soft soap, the pure green variety, may be rubbed over the parts on a wetted flannel for a minute or two so as to soften the skin ; it is then washed off in a warm bath, the child dried, and some strips of lint coated with zinc and lead ointment applied. This plan answers well in hospital, but the application of the soft soap causes smarting, and in private practice the child's friends are apt to think it makes the eczema worse and fail to persevere. Instead of the soft soap, the old ointment having been cleaned off, the parts may be sponged with lead and carbolic lotion (F. 107) every evening for a few minutes, and this treatment should be followed by simple zinc or lead ointment.

In local eczemas, especially those about the nose, back of the ears, and flexures of the joints, Unna's salve plaisters or salve muslins are very convenient and efficacious. Pieces of these can be cut with the scissors to any shape, and when placed over the patch of eczema can be readily held in position by a light bandage. The zinc and red oxide of mercury salve muslin, and tar and lead are the most useful.

Impetigo Contagiosa, Staphylococcia.—This eruption is characterised by the formation of crops of vesicles of various sizes, which become converted into pustules. The pustules dry up or become ruptured, leaving a greenish-yellow thick scab. The eruption is most common about the face, especially round the mouth ; it may also occur about the neck, hands, and feet. In some cases there is marked febrile disturbance before the vesicles appear. When the patient is seen for the first time, after having been affected for several days or a week, but few vesicles may be present, and only scabs and crusts visible on the face and back of the neck. Deep ulcers may form at the seat of the pustules. The disease, as its name implies, is contagious, being transferred by means of the nails from one part of the body to another, and from one child to another in a similar way. The attacks may be acute in character, and the constitutional disturbance severe. It occurs in cachectic children, and is rarely seen except in hospital practice. It may follow midge bites. There is a close resemblance between impetigo contagiosa and some forms of eczema. Indeed, we should say clinically there is no sharp line of demarcation between them. The treatment consists in removing the scabs by oiling or poulticing, and applying dilute white precipitate or sulphur ointment on lint. Cod-liver oil should be given internally.

Seborrhœa.—Seborrhœa is a 'functional disorder of the sebaceous glands, producing increase of the secretion, which forms an oily, waxy, or scaly accumulation on the surface.' (Crocker.)

The most familiar example of this disorder is seen in dispensary practice in infants who are badly looked after and rarely washed ; in such there is often an accumulation of a dirty yellow material over the anterior fontanelle, which can be scraped off with a blunt instrument. A certain amount of eczema may be present. What has been termed 'dry seborrhœa' is not uncommon in the scalp of older children ; it may occur on the face as well as on the trunk and limbs ; the scalp is dry and covered with small scales or scurf,

which fly out when the head is combed or brushed. Care must be taken not to mistake diffused ringworm of the scalp for simple seborrhœa.

Treatment.—The excessive sebaceous secretion on the scalp of infants can usually be removed by gentle friction with a piece of flannel dipped in warm olive or almond oil, following this up with washing with soap and water; this process may want repeating once or twice, and care must be taken to keep the child's head well washed. If there is a tendency to excessive secretion, a little ung. hydrarg. ox. flav. (5 per cent. in vaseline) or ung. boracis (℥ss ad ℥j benzoated lard) should be applied. For dry scaly patches on the face an ointment consisting of precipitated sulphur in cold cream (℥ss ad ℥j) may be used.

Erythematous Eruptions.—The term 'erythema' is applied to those eruptions which consist in a redness or congestion of a more or less extended portion of skin, as well as to other eruptions, where there is not only a congestion, but an actual exudation from the cutaneous vessels, as in erythema nodosum.

A simple erythema or congested portion of skin occurs under various conditions; it may be the result of some external irritation, such as the contact of foul napkins; the application of various irritants, such as mustard, chrysarobin, arsenic; or the bites of insects. An erythema sometimes precedes the eruptions of the specific fevers: this occurs at times in small-pox, chicken-pox, vaccinia; and it accompanies other febrile disorders, which are not usually accompanied by a rash, as diphtheria, cholera, and septicæmia. An erythematous redness is often present when there is a high temperature, as in pneumonia and other febrile disorders. An **idiopathic erythema** or **roseola** is not uncommon in infants and young children, mostly as the result of some intestinal irritation, possibly also due to the irritation of the gum caused by dentition. It is more or less patchy in its distribution, occurring on the forehead, face, trunk, or limbs; there may be no marked constitutional disturbance, and the patches of redness may be the first symptom. In other cases there may be several degrees of fever, restlessness, and perhaps vomiting. The eruption is mostly fugitive, disappearing in a few hours to twenty-four hours. Other patches may appear as the first ones fade.

Erythema Scarlatiniforme.—Is a typical 'scarlet fever rash' ever present in any non-scarlatinal case? It is difficult to answer this question dogmatically, but it may certainly be said that in any case when there is a diffuse, well-marked, punctiform rash, remaining visible for at least twenty-four hours, the disease is almost certainly scarlet fever or rubella. It is certain, however, that some erythematous or roseolous rashes do closely resemble scarlet fever, and, as they are attended not infrequently with some constitutional disturbance and fever, the difficulty in diagnosis may be very great.

Some children are especially liable to roseolous rashes resembling scarlet fever, as the result of indigestion or some other source of irritation; a roseolous rash is also apt to occur in septic conditions, such as in an empyema, or wherever pus is shut up in a cavity.

The constitutional disturbance in these cases is generally slight; the temperature may reach 101° or 102° F., the tongue may be slightly coated,

but the child usually feels quite well and his appetite is normal. The rash may very closely resemble mild scarlet fever; it is, however, as far as our experience goes, never so intense as it is in a typical or well-marked case of scarlet fever; moreover, in some part of the body it is almost sure to be patchy and unlike scarlet fever. The distinction between a roseolous and a scarlet-fever rash may be difficult or impossible if one part of the body only happens to be seen, but the difficulty usually disappears if a careful examination of the whole body be made, as in some places, especially the face and trunk, the roseola is patchy, the patches having a sharp outline. Crocker speaks of a roseolous rash lasting two to six days, and followed by a more or less copious desquamation. We have never seen this, and should be extremely suspicious of scarlet fever in such cases. In our experience an erythematous or roseolous rash, while it may closely resemble a scarlet-fever eruption, is more fugitive, and rarely lasts more than twenty-four to forty-eight hours, and is not followed by desquamation. In the majority of cases the presence or absence of a tonsillitis will decide the diagnosis.

A roseolous rash may follow the taking of certain drugs, more especially belladonna, copaiba, and salicylic acid.

Erythema Pernio, Chilblains.—Children with slow circulations, especially the so-called strumous, are very apt to suffer from chilblains. The favourite spots are the toes, heels, and fingers; they begin with redness and intense itching, or aching, coming on towards evening, or when the patient is warm. The skin is smooth, livid, and shiny, and ulceration may take place if it is subjected to much friction. Children subject to chilblains should wear warm woollen stockings and well-fitting boots with broad toes and thick soles, and should take much exercise. In the early stages the affected areas may be painted with equal parts of tr. iodi and lin. aconiti, or lin. saponis co. with an equal quantity of lin. belladonnæ. A mild capsicum ointment also answers well (capsici ʒss, almond oil ʒij, lanoline ʒvj), rubbed in with a piece of flannel. Zinc ointment with ung. hydrarg. ox. rubri, or ung. picis liq., in varying proportion according to the stimulating effect desired, may be applied.

Erythema Multiforme is mostly seen during early life in association with rheumatism, or in rheumatic subjects; whatever importance it possesses is derived from this association. The outbreak of this form of erythema is always suggestive of the rheumatic state, and an examination of the heart for endocarditis should always be made. The most common form consists in red papules surrounded by more or less congested skin. In association with the papules there may be flat raised patches surrounded by a zone of redness (erythema marginatum). Sometimes the eruption becomes purpuric, and bullæ or vesicles may form.

Erythema Nodosum has apparently a relationship to the erythema just described, though the constitutional disturbance is often much greater. Prior to the appearance of the nodes there may be rheumatic pains and fever, the temperature perhaps reaching 103° or 104°, and the child is apparently quite ill (see fig. 56). The eruption appears most copiously over the shins, but the arms, especially on the extensor surfaces, or any part of the body, may be attacked; it appears as node-like, tender, red swellings of various sizes, accompanied by a burning or itching sensation. The patches come out two

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or three at a time in various parts of the body. At first rose-red in colour, they then assume a darker-red colour, and as they disappear become of a yellow colour like a fading bruise. Epidemics of erythema nodosum have been described, and this fact suggests that perhaps this disease really belongs to the infectious fevers.

Not much treatment is required for erythema multiforme or nodosum. A light milk diet, a mild aperient with some saline, or with salicylate of soda if rheumatism is suspected. Locally, lead lotion with some tr. opii or liq. carbonis detergens may be used.

Urticaria is characterised by the sudden appearance of elevated blotches or wheals, at first red in colour, afterwards becoming white and surrounded by a zone of redness. They are attended by much burning and itching. The blotches usually disappear in the course of a few hours, but most frequently there are successive crops. In some cases a certain amount of œdema is produced by urticaria; we have seen children with œdema of the eyes and backs of the hands following nettle-rash. There is usually some gastro-intestinal disturbance. Urticaria is sometimes, especially in infants, a distressing and troublesome complaint, the intense itching making the child restless, and entirely preventing sleep. Urticaria is the result, in the large majority of instances, of some irritation in the alimentary canal, less often of teething; sometimes it is due to the bites of insects or scabies. Worms are not an uncommon cause in young children; fruits of various kinds, especially strawberries, fish, sausages, stale meat, sour milk, or any kind of fruit which disagrees, may act as a cause.

The most troublesome form of urticaria is that variety known as **urticaria papulosa** or **lichen urticatus.** This is a very intractable affection and may last for many months or even years. When seen in dispensary practice it is very apt to be mistaken for scabies, as the rash consists of numerous papules; many are often scabbed over as the result of scratchings about the body, limbs, hands, and feet. In the worst cases the whole body is covered with itching papules, which in some places perhaps become pustular, making the resemblance to scabies a very close one, but no 'burrows' can be discovered. The eruption begins as small wheals, which become papules, fresh ones coming out every night in crops when the child goes to bed. Rest is broken, and health may be seriously interfered with. It is most common during the period of the first dentition, and the tendency to it mostly disappears at 3 or 4 years of age. In the milder cases there is a succession of papules, some of which are surmounted by a small vesicle, which is quickly broken by scratching. After two or three days the rash ceases to make its appearance, to return perhaps in a few weeks. Generally speaking, urticaria is more common in summer than in winter.

In some children fleas and other insects will produce vesicles as well as papules, and give rise to more or less constitutional disturbance.

Treatment.—An aperient should be given, calomel or rhubarb and soda being the best. Santonin and calomel may be given if worms are suspected. A saline such as citrate of potash or bromide of potassium may be ordered. Locally, sponging the wheals with lead and tar lotion (such as F. 107) is perhaps the best application, or each wheal may be rubbed with menthol or

painted with collodion. Sulphur baths (sulphuret of potassium, ʒij to a bath) are useful in the chronic varieties.

Lichen Scrofulosus 'is characterised by very small inflammatory papules of a red colour, fading to that of the normal skin, disposed in groups or circles, and occurring mainly in scrofulous subjects' (Crocker).

This form of lichen is not common in our experience, but it is easily overlooked, inasmuch as it is unattended with any great inconvenience to the patients: they may make no complaint, and it is only discovered accidentally. The important points in the diagnosis consist in the absence of irritation and the presence of caseous lymph glands or other well-marked evidence of scrofula. The papules are small, and of a bright red colour at first, gradually changing to dull red, then desquamating, and finally leaving a brown stain. They must be present on the trunk or limbs. Their course is very chronic, fresh papules appearing as the old ones fade, so that the patient may not be entirely free for months or years.

Psoriasis.—This affection is common in children over 3 years of age, but is seldom so severe or so intractable as it often is in adults. It is perhaps even more liable to recur in children than in adults. The symptoms are so similar during childhood to those seen in after life that no detailed description is necessary. The treatment we usually adopt is to give arsenic, beginning with two-minim doses and gradually increasing it; warm baths, with the moderate use of green soft soap to remove the scales, and the application of some tarry or mercurial ointment. In hospital patients we have used Auspitz's solution of chrysarobin with great success. The solution is applied to the spots twice a week, a patient wearing old linen to avoid damage. (F. 109, 110.)

Pityriasis Rubra.—We have occasionally seen this disease in children, but it is comparatively rare. The best marked case was in a girl of 8 years who was in hospital twice with a precisely similar attack. The rash appeared to commence on the chest, and spread over the arms, trunk, and extremities. It consisted of a red rash covered with fine thin scales. Both attacks proved very chronic. A lotion of bichloride of mercury (1–5000) was used, but had to be stopped on account of salivation.

Miliaria. Sudamina.—In various fevers, such as scarlet fever, enterica, and in other febrile disorders, as rheumatism, a number of minute vesicles with clear contents make their appearance on the skin. The clear fluid is sweat, which has been unable to escape from the orifice of the sweat gland; the contents of the vesicles are absorbed or dried up in a day or two, leaving a tiny desquamating spot. Sudamina are often seen in the sweating of rickets. In other cases a slight inflammation occurs at the blocked sweat gland, and a minute papule appears instead of the vesicle, though vesicles may also be present; this condition has been called **Miliaria rubra.** The so-called **Lichen strophulus** or **'red gum'** is, according to Crocker, a sweat rash; it consists of minute crops of red papules which make their appearance in infants; they are attended often with much itching and consequent restlessness of the infant. A somewhat similar rash has been attributed to dentition as well as to gastric irritation. The papules should be dabbed with the lotion F. 99 or F. 100, and powdered with boric acid or some drying dusting powder.

Pemphigus is rare in infants apart from syphilis, but attacks of the acuter form of the disease (*Pemphigus neonatorum*), occurring in epidemics in lying-in hospitals or in the practice of a midwife, have been recorded by continental writers. In these cases the disease appears to have been distinctly contagious: not only has it apparently passed from infant to infant, but also from infant to nurse. In a few cases the eruption is preceded by fever, restlessness, or convulsions; the rash usually appears at the end of the first week. The bullæ vary in size; their contents are clear or slightly cloudy, rarely pustular; they gradually dry up, forming superficial ulcers or crusts. All parts of the body may be attacked, and, unlike syphilitic pemphigus, there is no preference for the palms of the hands or soles of the feet.

Chronic pemphigus is seen occasionally in older children; in some of these cases the children appear to be in good health and complain of nothing except the eruption, for which no cause can be assigned. In most cases there is marked anæmia, and more or less fever and constitutional disturbance; the latter may be severe. The number of bullæ varies from two or three to perhaps twenty; they appear as vesicles on the face, trunk, and limbs, gradually enlarging, and finally drying up in the course of a few days. The treatment consists in giving arsenic in full doses, and cod-liver oil. Locally, boric acid or zinc ointment may be applied. In the severer cases continuous baths are useful.

Dermatitis Gangrænosa Infantum.—In speaking of varicella we have referred to a peculiar form of multiple gangrene of the skin, which is apt to follow varicella in anæmic or emaciated children (p. 330). There is reason to believe that this condition is not necessarily preceded by varicella, but may follow other pustular eruptions (Crocker); it has been known also to follow vaccination. It almost always occurs in infants or young children under 3 years of age, and in many of the fatal cases tuberculosis has been found. In these cases the varicella vesicle or pustule is succeeded by an ulcer, which rapidly extends in size and depth, several frequently joining together, so as to form large sinuous ulcers; the floor becomes black from the formation of sloughs. In the worst cases the scalp, face, body, and limbs are covered with sloughy-looking ulcers, either separate or confluent. There may be marked constitutional symptoms. In one of our cases there was recovery, the ulcers gradually healing up; in the majority of cases a fatal result ensues. The treatment consists in giving the child a generous diet, including beef tea and wine, and dressing the ulcers with iodoform or other antiseptic ointment.

Dermatitis Exfoliata Infantum.—It is not uncommon to find infants a few weeks old with a diffused red rash which desquamates freely, the skin coming off in scales or flakes. The skin is thickened, red and shiny, cracks or fissures appear round the lips, and in places large ulcers may form, especially over the sacrum. The disease usually begins during the first week or two of life, the infant suffers from marasmus, with perhaps vomiting or diarrhœa. It is generally fatal. This disease is often mistaken for syphilis, especially as there may be some coryza and the eruption first makes its appearance about the buttocks or 'napkin area.' It has, however, nothing to do with syphilis, but is probably a form of septicæmia. It apparently

occurs most frequently in Foundling Asylums. In all the cases we have seen the infant has been artificially fed. (See Ritter's Disease, p. 34.)

Drug Eruptions.—The most important rash belonging to this class is the **Bromide eruption.** In some children a few grains of a bromide salt are sufficient to cause a rash, while in other cases the salt may be taken for weeks or months together without giving rise to any eruption. Infants perhaps are more liable than older children. The eruption consists in most cases of a red papular rash, the papules being discrete and occurring chiefly

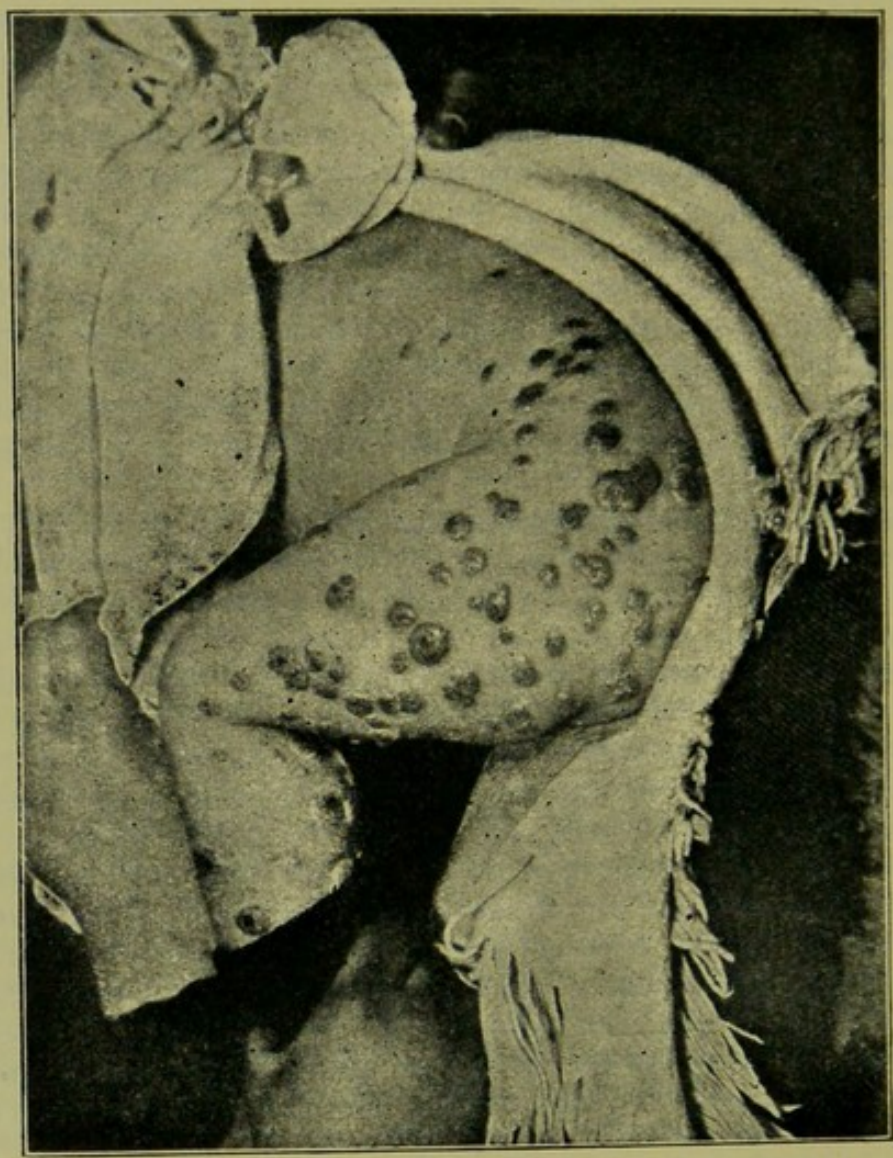


Fig. 225.—A se vere Bromide Eruption. (From a photograph by Dr. G. H. Lancashire.)

on the face, scalp, trunk, and limbs. On the summit of the red papules are one or more yellowish points, or small pustules. The rash looks more like acne than any other rash. It is sometimes confluent. Scabbing and ulceration may take place. We have seen the scabs and ulcers an inch in diameter on the limbs.

A somewhat similar rash also occurs after taking **Iodides,** but it is less common. **Antipyrin** and **Phenacetin** in some recorded cases have given rise to a 'measly' eruption or an urticaria. We have several times noted a

papular rash after giving antipyrin. The long administration of **Arsenic** is sometimes followed by a darkening of the skin, especially marked on the abdomen and trunk. The pigmentation mostly disappears after the drug is left off. **Salicylic acid** or the soda salt sometimes gives rise to a 'measly' or urticarial rash. **Belladonna** may produce a roseolous rash (see Roseola).

Tinea Tonsurans.—Ringworm of the scalp is one of the most troublesome local diseases with which the practitioner has to deal, and one which is apt to bring unmerited discredit on account of the many months or even years that the disease sometimes lasts. In some children there seems to be an especial disposition of the disease to spread, and to relapse when to all appearance it has been cured, or, in spite of the local treatment vigorously carried out for months, no marked improvement ensues and every one concerned becomes tired of the case.

Ringworm is exceedingly contagious, one child taking it from another in consequence of the spores of the tricophyton being transferred from one to another by direct contact, or by means of hair-brushes, combs, caps, or bed-linen being used both by the affected and the healthy. It rarely affects infants, or children after puberty, its subjects, especially in the chronic form, being the weakly rather than the strong, though exceptions may be met with.

The disease when recent may be recognised at a glance : the patches are circular, the central skin in the smaller ones being red in colour, while at the circumference desquamation is freely going on, the branny scurf giving the patch at this part a greyish or yellowish appearance ; the hairs from the central part may have come away, or they have broken off, leaving stumps. In the larger patches all traces of redness have disappeared, and they are simply bald or scurfy patches of varying size. Chronic diffuse ringworm of the scalp, especially if it has undergone a certain amount of irritation as the result of treatment, is more difficult to diagnose ; there may be much scurfiness, perhaps scabbing and pustulation. In the condition known as kerion the hair follicles suppurate, the hairs becoming loosened at their roots, and there is redness and puffiness of the patch. The diagnosis of ringworm is made from the stumps of hair left after the hair has broken off. These are best seen by means of a lens of two or three inches focal length : the stumps will then be readily seen often more or less twisted or bent, and having lost the gloss ordinarily seen on the hair. They are readily extracted with forceps, as they are mostly loose in their follicles ; they can then be placed upon a glass slide with a drop of liq. potassæ and examined after soaking for half an hour. The broken hair will be found to be frayed out at the end, and moreover infiltrated with conidia or spores ; the latter are readily seen with a power of 300 diameters if a sufficient time has been allowed for the caustic alkali to dissolve the fatty matters and render the hair transparent. The mycelium is less readily seen than the spores. It is needless to say it is mostly useless to examine the unbroken hairs, and in old cases which have been treated no spores may be present in the scurf. The greatest caution must be exercised before pronouncing that a case is well, or certifying that it is no longer infectious, as relapses occur again and again, and may be the means of communicating the disease to others. Before any patient can be said to be cured, repeated examinations must be made with the aid of a

lens for diseased hairs, any suspicious-looking stump being extracted and examined microscopically ; it is well to remember also that scurfy patches, even when the hair is growing freely over them, are extremely suspicious. In every case some mild parasiticide should be continued to be applied for some time after the disease appears to have been eradicated. In seborrhœa or non-parasitic scurfiness the whole scalp is affected, and, though the hair may come out, there are no broken stumps and no sharply defined patches of scurfiness as in ringworm.

The course of ringworm is apt to be exceedingly chronic, and when undertaking the treatment of a case it is well not to be too ready to name a definite time when it will be well.

Tinea Circinata.—Ringworm of the body is frequently associated with ringworm of the scalp. It is first seen as a raised red spot, which becomes scaly at the periphery as it enlarges, while the centre may present more or less healthy skin ; as the ring enlarges it becomes more or less broken and fainter. It may be present on all parts of the body ; it is perhaps commonest on the face and neck. The diagnosis is generally easy, for though sometimes the patches of scurfiness on children's faces may be mistaken for ringworm, they do not assume the formation of a ring with a normal skin in the centre ; if any difficulty occurs, an examination of the scales scraped off the patch for spores would decide.

Treatment.—The treatment of tinea circinata is a comparatively simple affair, and is readily effected by the continuous application of some mercurial ointment or solution for a few days or a week. It is well to commence treatment by removing the scales as far as possible with soap and water, and then some dilute white precipitate ointment may be gently rubbed into the patch morning and evening. An ointment containing sulphur, ʒss, and ung. picis liq., ʒj, to the ounce of benzoated lard also answers well. Carbolic oil or carbolic acid in glycerine (1–8) may be used.

In the treatment of ringworm of the scalp the first step to be taken is to cut the whole hair off with a pair of scissors to at least half an inch, leaving a fringe if thought desirable ; the scalp can then be carefully examined, and it will be usually found that there is more extensive disease than was at first thought. Wherever there are any patches of ringworm the hair must be cut close to the scalp both over and *around* the patch. The scalp should be thoroughly washed with soft soap or carbolic soap, removing all or as many of the scales as possible. The ointment or application selected should then be rubbed in by means of a mop of rag for a few minutes, at least twice a day. Very many parasiticides have been recommended ; the one we have mostly used, and which is certainly as successful as any, is the oleate of mercury, and we fully endorse Dr. Alder Smith's praises of it. An ointment containing 5 per cent. is used for children under 8 years of age, and 10 per cent. for older children ; a small piece of the ointment is rubbed vigorously into the affected patch every morning and evening ; if there is much tenderness it must be omitted for a day or two. Once a week at least the ointment should be washed off with soft soap, and the effects of treatment carefully noted. Oleate of mercury is especially suited for the diffuse form of ringworm ; it apparently penetrates better than iodine or carbolic acid, which tend to harden the epithelial tissues ; this power of penetration is

obviously of great advantage when the fungus extensively affects the hair-roots.

In the early stages, when there is a single circumscribed patch of ringworm or only a few patches, some more powerful remedy than the 5 per cent. oleate of mercury may be used with advantage. The 10 per cent. ointment may be applied, or carbolic acid and glycerine (1–6 by measure) may be rubbed into the patches night and morning. Coster's paint (iodine ʒij, oil of cade ʒvj) is also useful in recent cases painted on the patch, removing the crust every few days and re-applying. Glacial acetic acid and hydrarg. perchlorid. (gr. iv ad ʒj) as used by Alder Smith are good applications, as is also Auspitz's solution of chrysarobin in chloroform. (F. 110.) The last two must only be used to circumscribed small patches, and are not suitable for young children or those in whom inflammation is readily set up. It is well to keep the rest of the scalp well oiled with carbolic oil when strong applications are being applied to some local patch. A light skull-cap should be worn to prevent the ointment smearing the bed linen at night.

While in the chronic or diffuse forms we prefer mercurial preparations, yet some cases appear benefited by a change, or at any rate a change of ointment will sometimes work wonders in the eyes of the friends. An ointment containing equal quantities of carbolic acid (Calvert's No. 2), ung. hyd. nitr., and ung. sulphuris (Alder Smith), is a good and useful one ; or the formula (F. 111) recommended by Jamieson.

Whatever form of application is adopted, it is tolerably certain that much patience will have to be exercised before the disease can be pronounced cured. Weeks and even months may elapse, and while progress has been made perhaps scurfiness and diseased stumps can still be detected ; or, may be, while the disease appears eradicated in one place, it is spreading in another direction.

Epilation is useful in all stages, but timid and young children are too nervous to submit to much being done in this way. In cases which have proved intractable and resisted all treatment for months a local patch of inflammation may be set up by means of croton oil. The usual method is to paint some croton oil on over a patch of half an inch to an inch in diameter, to repeat it the next day, and to follow it up by a poultice ; the patch becomes red and puffy, suppuration takes place about the hair follicles, and the hairs readily come out. To this boggy condition the term *kerion* is applied. It is important to apply this treatment to only small patches at a time.

After the disease has been apparently cured it is well to continue for a time with some remedy containing a mild parasiticide. One of the formulæ 106, 108, or 112 usually answers for this purpose.

Alopecia Areata.—Alopecia consists of smooth, shining bald patches on the scalp. It occurs at all ages, both of childhood and adult life. Its cause is uncertain ; there is a difference of opinion as to the presence of a fungus. In some cases it follows severe headaches, in others there is no known cause, though it occurs mostly in those who are below par and out of health. It may occur first in patches, and perhaps after a while involve the whole scalp. It is extremely intractable, and little influenced by local or constitutional treatment. Cod-liver oil and tonics are usually given, and stimulating lotions, such as F. 114.

Favus.—Favus is not a common disease in this country, but is occasionally seen among out-patients at a children's hospital. It is known at once by the peculiar yellow cup-like depressions formed by the crusts, and by the peculiar 'mousy' smell. These crusts can be raised from the scalp by means of a blunt knife, carrying the hairs with them, leaving the pitted skin, which, however, crusts over again in ten or twelve days. The favus crusts may be present on the body as well as on the scalp. The subjects of this disease are generally cachectic and have been ill fed. The fungus—achorion Schonleinii—closely resembles the tricophyton of ringworm, but the mycelium is more jointed, and the gonidia are more numerous and larger, though they vary much in size.

The disease is very chronic, frequently lasting for years. The treatment consists in removing the crusts, applying parasiticides, and administering cod-liver oil and iron.

Scabies.—Scabies is very common in infants and children in dispensary practice, and by no means unknown among the well-to-do classes of society. Among the former there is rarely any difficulty in diagnosis, as they usually do not present themselves till the disease is well marked and pustules have formed, while in private practice the diagnosis may be difficult when the disease is local, as, for instance, on the hands. In infants and young children scabies gives rise to more irritation than in adults, and in infants at the breast urticaria and erythema of a more or less severe nature may be frequently seen. In infants the hands may be quite free, while the face and legs or genitals may be affected. In cachectic or weakly children there are usually much crusting and many pustules, pus being transferred from one part to another by means of the finger nails. The diagnosis is not as a rule difficult; urticaria, simple eczema, and lichenous rashes may be mistaken for it. The presence of burrows, the irregular distribution of the vesicles and papules, as well as the intense itching, are the characteristic points. We have, however, sometimes been in doubt regarding the nature of itching rashes present only on the backs of the hands. A cure is readily effected by a hot bath with the copious use of soft soap, followed by sulphur or storax ointment; the bath and ointment should be repeated for four or five nights in succession, and the clothes should be stoved. (F. 115, 116, 117.)

Pediculosis.—The pediculus capitis is exceedingly common among the children of the poorer classes, and is by no means unknown in other quarters. The insect's bite produces intense itching of the scalp, chiefly in the occipital region, and vigorous scratching takes place. As a result, more especially in the weakly and cachectic, scabs, crusts, and pustules form, and in many cases the occipital glands become enlarged and may suppurate. A diagnosis is readily made, by the presence of nits and also crusts and scabs in the occipital region. The hair should be cut short, the scalp thoroughly cleansed with hot water and carbolic soap, and white precipitate ointment applied. Liquid paraffin or spirits of wine are very efficacious, but the smell is disagreeable.

Flea-bites.—The common flea produces by its bite a small wheal surrounded by a red area, with a central red spot. The central spot, as also the distribution of the eruption, will generally distinguish it from urticaria or other rashes. The bite in debilitated subjects becomes petechial.

The itching and irritation produced by flea-bites cause great restlessness and fever at night. Some children are much more affected by flea-bites than others. Body-lice and bugs produce similar eruptions. Carbolic ointment (10 per cent.), lead and carbolic lotion, or diluted sp. ammon. aromat. are useful in allaying irritation.

Midge-bites.—Midges mostly attack the exposed parts, such as the face, arms, and legs. They will, however, crawl up arm sleeves, beneath the stockings and up the legs. In hot weather especially their bites give rise to large wheals, which may become vesicular or pustular. The irritation is worse at night, and much scratching takes place. If pustules follow the bites, an auto-infection perhaps takes place, and pustules make their appearance in various parts of the body. We have seen children on their return from their summer holidays with deep ulcers, pustules, and enlarged glands, the result of midge-bites.

Harvest bug.—Occasionally during holidays in the country children will suffer from the attacks of the 'harvest bug' (*Leptus autumnalis*). To the naked eye it is a small red point, which adheres to the skin and produces papules that itch greatly. It buries its head in the skin, and in this way produces great irritation. It may give rise to symptoms not unlike scabies, the feet and legs being first affected. Pustules, ulcers, and staphylococcia may result. A weak sulphur or mercurial ointment may be used.

Simple Onychia in children may be looked upon as a variety of the subcuticular form of whitlow, in which the nail matrix is involved instead of the skin of the finger. It is usually the result of some slight injury such as nail-biting, running a splinter beneath the nail, or too close cutting of the nails. Early letting out of the matter and removal of foreign material, with subsequent warm water or lead lotion dressing, is all that is required. Occasionally suppuration goes on intractably beneath the nail, or recurs again and again after drying up ; in such cases the nail should be cut away over the inflamed spot, and the surface scraped clean, and some solid nitrate of silver applied.

Onychia Maligna is a more formidable affection, nearly, if not quite, always due to injury of the finger-end. The whole nail matrix becomes inflamed, the end of the finger is swollen, congested, and bulbous, the nail becomes loosened, curled up, and blackened, and there is much burning pain ; a dirty, sero-sanguineous, often foul discharge comes away, and the mischief may go on for months if neglected, and even give rise to necrosis of the terminal phalanx and permanent distortion or destruction of the nail. The treatment we have hardly ever found to fail is dusting the raw surface over with powdered nitrate of lead night and morning for a few days ; the nail should be removed if the disease has involved anything more than the upper part of the matrix. We have often seen onychia of many months' standing get practically well in a week under this treatment. Occasionally it is necessary to scrape away the diseased tissue and remove a sequestrum, but this is quite exceptional.

Lupus.—Mention has already been made of superficial tuberculous ulceration of the skin (*vide* p. 258), but the special form known as lupus vulgaris needs a short notice here. The affection consists in the development of small circular deposits of inflammatory material in the thickness

of the true skin. These deposits, known as 'lupus tubercles, are found usually in patches which tend to spread by the formation of new tubercles at the margin of the patch. At first isolated, after a while the tubercles coalesce and break down, forming a larger or smaller superficially ulcerated patch, which is usually coated over with thick scabs or crusts. In earlier stages there is no obvious ulceration, and a thin pellicle covers over each 'tubercle.' If allowed to spread, extensive destruction of the skin may occur, and the deeper structures are in certain cases attacked. It is, however, very rare for lupus to penetrate through the deep fascia, and it probably never attacks bone. The most extensive destruction is usually of the nose, where the whole of the lateral and alar cartilages may be eaten away, leaving a short, pinched, and shrunken organ. Almost any part of the body may be attacked, but the face is the favourite seat, and especially the tip and sides of the nose. Less often the disease attacks the mucous membrane of the lips, cheeks, and septum nasi, and we have seen the tonsil and soft palate involved by extension from a patch of lupus at the angle of the mouth. We had one case under our care in which the skin of the shoulder, arm, and also the buttock and thighs, was extensively involved. The disease had lasted some years. Chronic in its course, and intractable to any but very thorough treatment, lupus is one of the most troublesome of the skin diseases met with in tuberculous subjects, especially as great deformity and disfigurement are often produced by its ravages. On scraping out a 'lupus tubercle' a hollow or pit is seen in the thickness of the dermis, while at the edge of the patch the superficial part of the skin is undermined.

Treatment.—The general treatment is that of tuberculosis, cod-liver oil and arsenic being of especial value. Locally nothing is so effectual as thorough removal of the disease mechanically. It is best to give an anæsthetic, and thoroughly scrape away and dig out all the soft tissue with a sharp spoon. All the material that can be scraped away should be removed; healthy skin will not break down under the use of a Volkmann's spoon. After the scraping the actual cautery or solid nitrate of silver, or, better still, powdered nitrate of lead, may be applied, but the mechanical removal is the most important part of the process. There is free bleeding at the time, but this speedily stops. The sore should be dressed with iodoform ointment, and a careful watch kept for the appearance of fresh tubercles, which should be at once attacked in the same way. The repeated application of powdered nitrate of lead has been very useful in our hands, both for lupus and other intractable tuberculous sores; it is somewhat painful, but very effective. Injections of tuberculin have been employed with some success. Certainly in many cases there is a temporary improvement, but relapses are very apt to occur.

The use of *X* rays and Finsen's light in the treatment of lupus in children is useful in cases where an anæsthetic is undesirable and time not an object, but in young children it is difficult to manage, and not practicable in all situations. For details of the use of these methods we must refer to the special works on the subject.

'Inveterate' lupus is occasionally met with, and resists all treatment. It continues for years and causes terrible disfigurement, but usually ultimately the active process dies out.

Papilloma.—Warts are very commonly met with on children's hands, and often appear in crops. They frequently disappear spontaneously, but if they are troublesome may be readily cured by some caustic application, or better by the steady use of salicylic collodion.

Hairy and Pigmented Moles occur congenitally, and sometimes cause great disfigurement, as in fig. 226. If small they may be treated by excision.

Fig. 226.—Hairy mole of the face and scalp. A large part of the patch was removed by the use of the actual cautery and nitric acid.

If extensive the growth may be removed in sections by the application of the actual cautery or strong nitric acid, but it must be remembered that any of these methods necessarily leave a scar. Mere overgrowth of hair may be removed by electrolysis and epilation.

CHAPTER XL

INJURIES, SHOCK, HÆMORRHAGE, ETC.

THE various injuries met with in children can only be very briefly described here, and only those more or less peculiar to childhood will be mentioned.

Injuries to the Head.—In young children it is not uncommon for one of the bones of the vault of the skull to be dinted or dinged in, and a well-marked but shallow saucer-like depression may be felt. Care must be taken to distinguish this lesion from cephalhæmatoma (*vide* p. 23). The symptoms of brain injury in such a case are usually those of concussion and often speedily pass off; recovery usually takes place without any bad symptoms, and the depression in most instances gradually becomes obliterated by pressure from within and modelling of the bone.

The treatment of such cases is simply rest and quiet; no operation is called for. Sometimes, however, where the depression is more abrupt and marked symptoms of compression exist, and always if the fracture is compound, the general lines of treatment for such cases in adults must be followed. In young children the rule, however, is not to operate unless the fracture is compound or symptoms arise.

Traumatic Cephalhydrocele is the name applied to a condition where there has been a simple fracture of the skull, with probably in all cases laceration of brain and laying open of one or other lateral ventricle. The fluid contained in the ventricle escapes beneath the scalp and forms a soft, fluctuating, usually pulsating swelling; this is distinguished from hæmatoma in some cases by its later onset and steady increase. The swelling, however, may appear immediately; sometimes it is not found for some months after the injury; in any doubtful case aspiration would settle the point.

Cephalhydrocele is most often met with in children under two years old, but may occur as late as the twelfth year; it is most common in the parietal region. We have seen several of these cases. There is often extensive absorption of bone after the injury, so that a considerable gap is left in the skull. Hydrocephalus not rarely ensues.

Treatment, &c.—Tapping appears to be of little use,[1] and pressure and quiet are the only treatment. A plastic operation has been proposed to close the aperture in the skull, and might possibly be advisable in any case that was clearly getting worse.

[1] Lucas, *Guy's Repts.* 1879 *et seq.*; T. Smith, *St. Barth.'s Repts.* 1884. Erichsen, Southam, Godlee, Howard, and Conner have recorded cases; also Golding Bird, *Guy's Repts.* 1889. *Year Book of Treatment*, 1895, p. 226.

The mortality is high : some 40 per cent. of the patients die ; in some instances temporary recovery takes place and meningitis develops later.

Occasionally after compound fracture of the vault a free escape of fluid occurs, as in one case of our own : there was a compound depressed fracture of the frontal bone, which required elevation ; an abundant flow of clear fluid took place from the wound before operation ; the boy recovered without any bad symptom.

Fracture of the Base of the Skull in children is a much less serious injury than in adults, and is often completely recovered from. Traumatic meningitis is rare in children, and they generally recover well from concussion and brain laceration.

Dr. Allen ('Lancet,' October 24, 1885) has described a fracture dislocation of the atlas occurring in infants ; the lesion is marked by hyper-extension of the head and a liability to 'epileptic fits' on attempts at extension or pressure downwards upon the head. The injury is probably inflicted during parturition. (*Vide* also Guérin, 'Gaz. Médic.' 1851.)

Injuries of the Chest.—The only fact about chest injuries that is peculiar to childhood is that, in consequence of the flexibility of the chest wall, visceral lesions without fracture of the ribs are not uncommon. When rupture of the lung occurs the laceration is usually in the neighbourhood of the root of the lung, and the usual complications—emphysema, hæmothorax, and hæmoptysis—are often present, though the last is less often seen, since young children rarely expectorate, and the blood is swallowed.

Injuries of the Abdomen have no peculiar features ; if the immediate shock is recovered from, subsequent complications are rarely fatal unless from some severe visceral laceration.

Fracture of the pelvis in childhood is less likely to be complicated by visceral injuries than in adults, since sub-periosteal fractures and separation of epiphyses take place in children. We have met with a case of fractured pelvis in which the urethra was separated from its normal position beneath the pubic arch and displaced backwards towards the anus, the injury occurring in a little girl.

Rupture of the membranous or spongy urethra is not uncommonly met with in boys as a result of falling astride some projecting edge, e.g. the top of palings or of a gate, or the bough of a tree. The symptoms are pain and swelling in the perinæum, escape of blood from the urethra, inability to pass urine, and distension of the bladder unless it has been recently emptied. A gentle attempt should at once be made to pass a catheter ; if this succeeds, the instrument should be tied in for two days, and then changed every other day ; after a week or ten days it is sufficient to pass a full-sized catheter daily. This is the common treatment, but a traumatic stricture usually results, requiring the passage of instruments frequently throughout life. Extravasation of urine often occurs either immediately or within a day or two of the accident, and necessitates free incisions into all the infiltrated parts. To avoid these misfortunes the best plan is, immediately after the accident, to cut down upon and suture together the ends of the torn urethra.

Injuries of the Limbs.—The peculiarities of injuries to the limb bones in children depend mainly upon two facts. 1. The bones of children are soft, contain relatively little earthy matter, and are therefore less brittle

than those of adults. 2. The epiphyses are yet ununited, and the periosteum is thicker, more easily detached, and more freely supplied with blood than in older people.

Greenstick and Sub-periosteal Fractures.—A greenstick fracture is one where more or less of the thickness of a bone has bent and yielded instead of snapping across; there is probably really always a fracture. Simple bending of bone without fracture is of doubtful occurrence, in health at least, though it may occur in rickets and osteomalacia. Many fractures in children are sub-periosteal, and to this fact and to the incompleteness of the fracture is due the absence of marked symptoms in many cases, so that fractures are not rarely overlooked; indeed, deformity, obvious mobility, and crepitus may all be absent, and it is common enough to see a fractured clavicle of a week's or a fortnight's standing, or even longer, in which the first sign that attracted the parent's attention was the 'lump in the neck,' consisting of callus round the fractured ends. Hence, after any severe injury, each part and limb should be systematically searched, especially in very young children, for all probable injuries. The treatment of greenstick fractures is the same as for ordinary fractures, any displacement being at once forcibly reduced.

Ununited Fractures.—Fractures in children usually unite well, and even in rickety patients non-union is rare. We have already mentioned cases of non-union in fracture after necrosis of the tibia and humerus. Occasionally one or more of the long bones is fractured at or shortly after birth, or even *in utero*, and in these cases non-union is not very rarely met with. It is a curious fact that such fractures have almost universally resisted all attempts to procure union when once the ends of the bones have become atrophied and a false joint has formed. Sir James Paget has pointed out this peculiarity.[1] In one of our patients we tried many methods before obtaining union, as will be seen below.

CASE.—John H., at 6 weeks old, was found to have a fracture of the leg, but it was not known how long it had existed. The mother had a fall two months before he was born. On admission there was an old ununited fracture of both bones of the right leg 1½ inch above the ankle; the limb was loose and almost flail-like. In May 1889 the ends of the bones were resected, and the tibia wired; no union followed. He was re-admitted in July and plaster of Paris re-applied. In October the ends, which were much atrophied, were again resected, and ten pieces of bone, taken from the femur of a freshly killed young rabbit, were grafted in. The wound healed by primary union, and the limb was put up in plaster. No union nor even any formation of callus followed. In January 1890 the operation was repeated; eight grafts being inserted, the wound was closed and the limb put up in plaster. Three pieces of the rabbit's bone were removed in April and May, and the wound healed. In June the wound was re-opened, and a long piece of rabbit's femur wedged in between the ends. The wound healed at once, and a good deal of thickening, but no real union, followed. In April 1891 the wound was re-opened and the large piece of rabbit's bone found bare and encysted in a cavity containing clear yellow fluid; smaller pieces were found embedded in fibrous tissue; there was no sign of any septic condition. The rabbit's bone was removed and the ends of the tibia freshened; an inch of the fibula of the same leg was then taken from just below its head and fitted in between the ends of the tibia. No union followed, and in September 1891 the ends were again resected, and stout steel pins driven crosswise through the fragments, which, by reason of the shortening

[1] *Studies from Old Case Books*, 1891.

of the fibula, could be brought well into apposition. Round the ends of the pins silver wire was wrapped as in a hare-lip suture; the wound was closed and the limb fixed in plaster. In December 1891 the plaster was removed, and the bones were found united; one of the pins was removed and the limb fixed in plaster of Paris. The union was firm when the leg was examined in August 1892, and the wound was quite sound, but the limb was still weak, and no restoration of the fibula had taken place. Ten years later he came to have the leg amputated, as it was still so weak and short as to be useless. D'Arcy Power has collected a series of 72 cases; in 45 of these, attempts to obtain union failed. ('Med. Chir. Trans.' vol. lxxv.)

Separation of Epiphyses.—For a full account of epiphyseal injuries we must refer the reader to Mr. Poland's standard work. A valuable account of fractures of the upper extremity by Mr. Platt has been published. Papers also by J. Hutchinson, jun., and his annotations in Helferich's work may be consulted. The discovery and development of radiography has of course enabled great additions to be made to our knowledge of these injuries. A pure epiphyseal separation is met with commonly in certain bones, as in the case of the lower end of the radius (Plates X. and XI.), the upper end of the humerus, and the lower end of the femur (J. Hutchinson, jun.). In many cases, however, and sometimes in those mentioned, the injury is a combination of fracture and diastasis (see Plates VI. and XII.); that is, the line of separation runs partly through cartilage and partly through bone. The periosteum in many of these cases remains untorn, and, as Mr. Hutchinson has shown, it is in many instances extensively stripped up from the diaphysis, and necrosis may follow. Hence the symptoms of epiphyseal separation or diastasis vary considerably; thus there may be little or no displacement, crepitus may be absent, or very indistinct; and undue mobility may only be recognisable on very careful manipulation. We have seen many cases in which there has been a history of previous injury, supposed to be a strain, in which the amount of thickening found at the time of examination makes it almost certain that a more or less complete separation of an epiphysis had occurred. This is especially common about the lower end of the humerus, and our experience fully bears out Mr. Hutchinson's statement that these accidents are exceedingly common, and in any doubtful case of injury about the elbow they should always be suspected. Curiously, Hamilton ('Fractures and Dislocations') says he has never met with a case. It is, however, possible that in some instances the violence may strip up muscles and the thick loose periosteum without any fracture or diastasis, and this injury of the periosteum may be the cause of the subsequent thickening.

In well-marked cases there are deformity, undue mobility, loss of power, and sometimes indistinct or so-called 'false' or 'dummy' crepitus; the outlines of the fragments are more rounded than in ordinary fracture, and the line of separation coincides with that of an epiphysis. It must be remembered that an epiphyseal junction is not a flat, plane surface, but there is in many of the bones a cup-shaped hollow in the epiphysis which receives the rounded convex end of the shaft. It is often difficult to reduce and keep in place the fragments, and a certain amount of deformity is often persistent, though this diminishes by a gradual process of modelling as time goes on. Arrest of growth occurs in some cases, not in others; probably this depends upon the

accuracy with which the lesion has followed the epiphysial line, and the amount of destruction of the growing bone or of premature synostosis that results. Occasionally acute necrosis of a separated epiphysis occurs, or at least acute suppuration around it, and this is said to be disproportionately frequent in cases of separation of the epiphysis of the great trochanter and the lower end of the femur. (J. Hutchinson, jun.) These injuries are most common about the two ends of the humerus, the lower end of the radius, and the lower end of the femur. It is sometimes said that separation of the lower end of the femur is the most frequent accident, but in our experience it is not nearly so common as the diastasis of the humerus. We have once met with diastasis of the upper femoral epiphysis (*vide* 'Hip Disease in Childhood,' by one of the present writers) and once with a case [1] which possibly (Plate XIV.) may have been an instance of diastasis and fracture combined. Poland has collected a number of instances. Robinson quotes Whitman's view that in children fracture of the neck of the femur is likely to occur, and in adolescents separation of the epiphysis. Robinson has operated and found it necessary to remove the epiphysis. The separation is apparently sometimes due to a slight injury in a previously weakened bone. Occasionally diastases are met with at the upper end of the tibia.[2] Tubby [3] has collected cases of separation of the clavicular epiphysis. The diagnosis depends upon the age of the patient, the fact that the projecting edge of the bone is sharp and unlike the natural inner end of the clavicle, as it would be in the case of a dislocation, and also that a lamella of bone can be felt between the

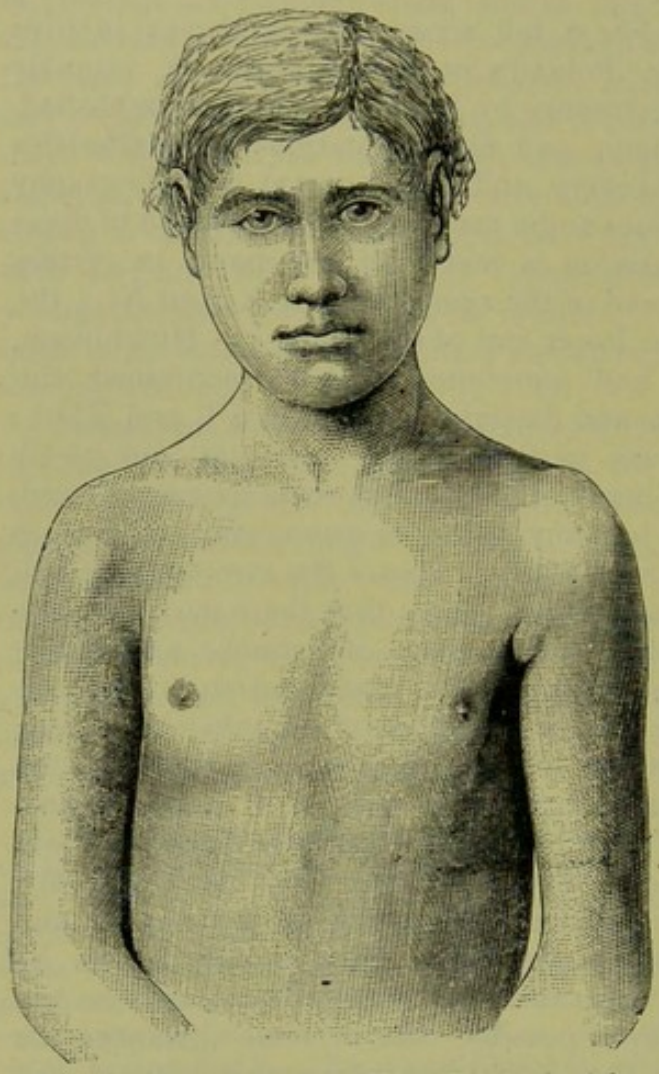


Fig. 227.—Separation of the Upper Epiphysis of the Right Humerus.

[1] See also Stimson on Fractures, and Hutchinson, *Arch. of Surgery*, April 1892, and Tubby, *Annals of Surgery*, 1894, vol. xix.; also R. Whitman, *Annals of Surgery*, Nov. 1902, and H. B. Robinson, *Brit. Med. Jour.* Oct. 10, 1903.

[2] Separation of the upper epiphysis of the tibia has been caused by the bad practice of applying extension for hip disease below the knee instead of above it.

[3] *Guy's Reports*, 1889.

Note.—For an account of separation of epiphyses due to congenital syphilis (syphilitic telostitis) *vide* chapters on CONGENITAL SYPHILIS and on BONE DISEASES. Similar multiple separations may be the result of so-called 'scurvy rickets.'

sternal notch and the end of the shaft. It must be remembered that the epiphysis is only an extremely thin plate. We have met with an instance of this injury.

According to Tubby, separation of the coracoid epiphysis is of extreme rarity, and no case of separation of the acromial epiphysis appears to be authentic.

Diastasis of the upper end of the humerus is not rarely met with. It results from injuries such as blows or falls upon the arm, which, in the adult, would probably cause either fracture of the shaft or dislocation of the shoulder. It appears to be not uncommonly the result of injury at birth. The appearance of the shoulder is characteristic, though much like that of fracture of the surgical neck of the bone. There is no depression below the acromion, but some flattening a little lower down, with a marked prominence on the anterior and inner aspect of the arm, a short distance below the coracoid process. This prominence is the upper end of the shaft of the humerus displaced forwards and inwards; the edges of the projecting bone are more rounded, and less sharp and irregular than in the case of fractured surgical neck, and on reduction, which is usually, though with difficulty, managed, 'dummy' crepitus instead of that of a true fracture is felt. It is difficult to keep the fragments in position, but, as the surfaces are broad, there is very rarely or never any actual overlapping. Since the upper epiphysis of the humerus includes the tuberosities, there is abundant blood supply to the upper fragment, and union usually takes place speedily. The treatment consists in applying a long inside angular splint, well padded at the top and fitting high up into the axilla. The fragments are brought into position, and a felt or gutta-percha shoulder-cap is then moulded on. Gentle active movement should be begun in ten days. The deformity is rarely entirely reduced, but good union and a useful though possibly somewhat shortened limb results. If the displacement is considerable and cannot be reduced, operation is justifiable to correct it. The injury may be

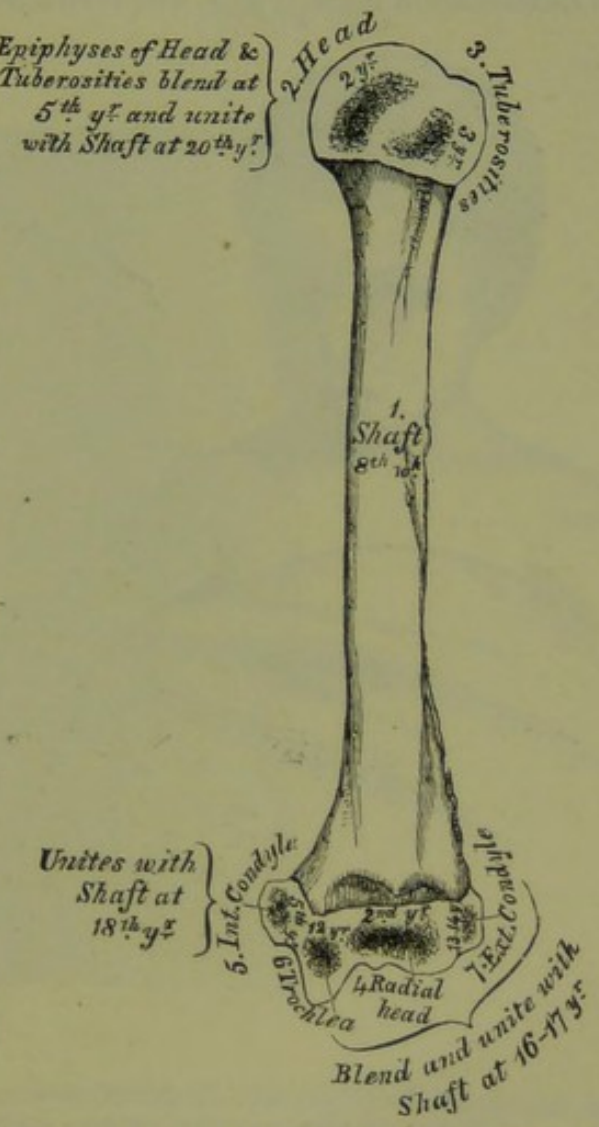


Fig. 228.—Plan of the Development of the Humerus. By Seven Centres. From Gray's 'Anatomy.'

compound or complicated with rupture of the axillary artery. We have wired one case of compound separation with a good result. Instances of non-union have been met with, and shortening to the extent of five inches ten years after the injury.

Partial separation of the lower epiphysis of the humerus, with or without an associated fracture, is probably the commonest lesion of the kind met with in children. It is common to have children brought with an injury of some days' duration, and a statement that the limb has been strained or the joint put out. On examination there is pain and restricted movement about the elbow joint,

Fig. 229.—Separation of Epiphysis of Humerus, showing adduction of the forearm with loss of the 'carrying angle.'

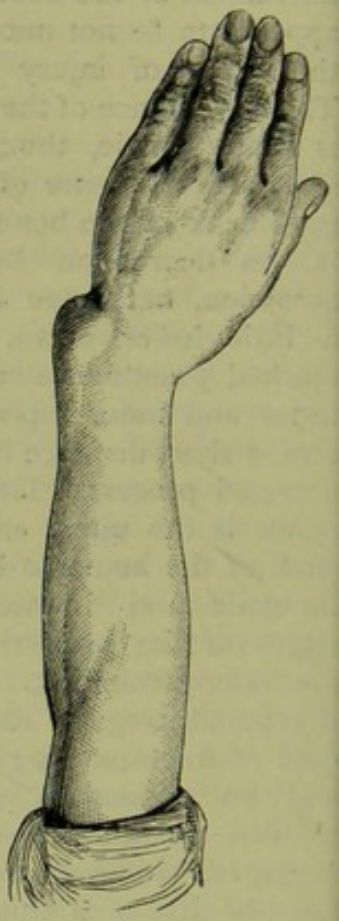
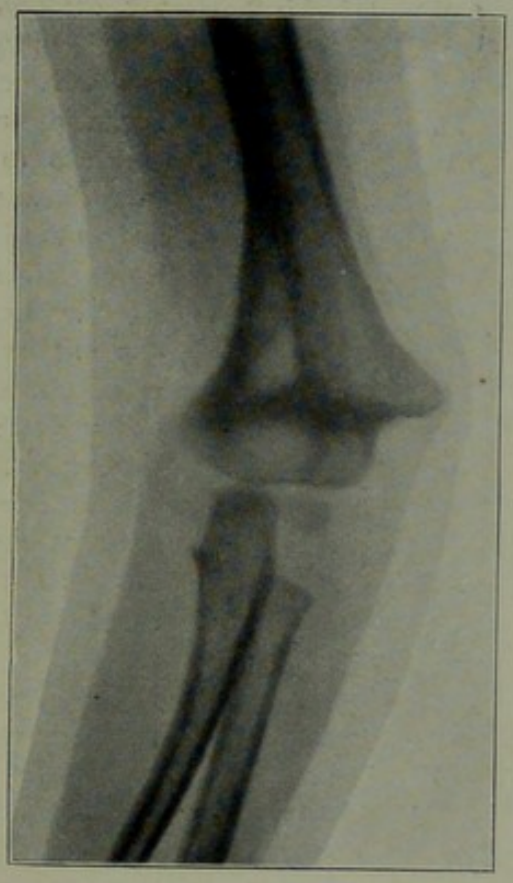


Fig. 230.—Arrest of Growth of the Radius from separation of the lower epiphysis many years before.

but the olecranon, the head of the radius, and the internal condyle occupy their normal relations to one another. On grasping the lower end of the humerus between the finger and thumb, marked thickening as compared with the other side is felt usually just about the internal condyle. In such cases, if occurring in children under the age of 6 or 7, a mere loosening without displacement of the whole lower epiphysis may have occurred, or more probably the injury shown in Plate VI. without the displacement, and this is very likely the most common accident, though we have as yet no sufficient proof that it is so. Sometimes the whole lower epiphysis is separated and displaced backwards (Plate VII.); more often the capitellum and outer condyle are detached

PLATE VI.



Beatrice D., æt. 2½ years. Separation of the whole lower epiphysis of the humerus, with inward displacement, and a vertical split in the shaft. The diaphysis projects outwards. Loss of 'carrying angle.'

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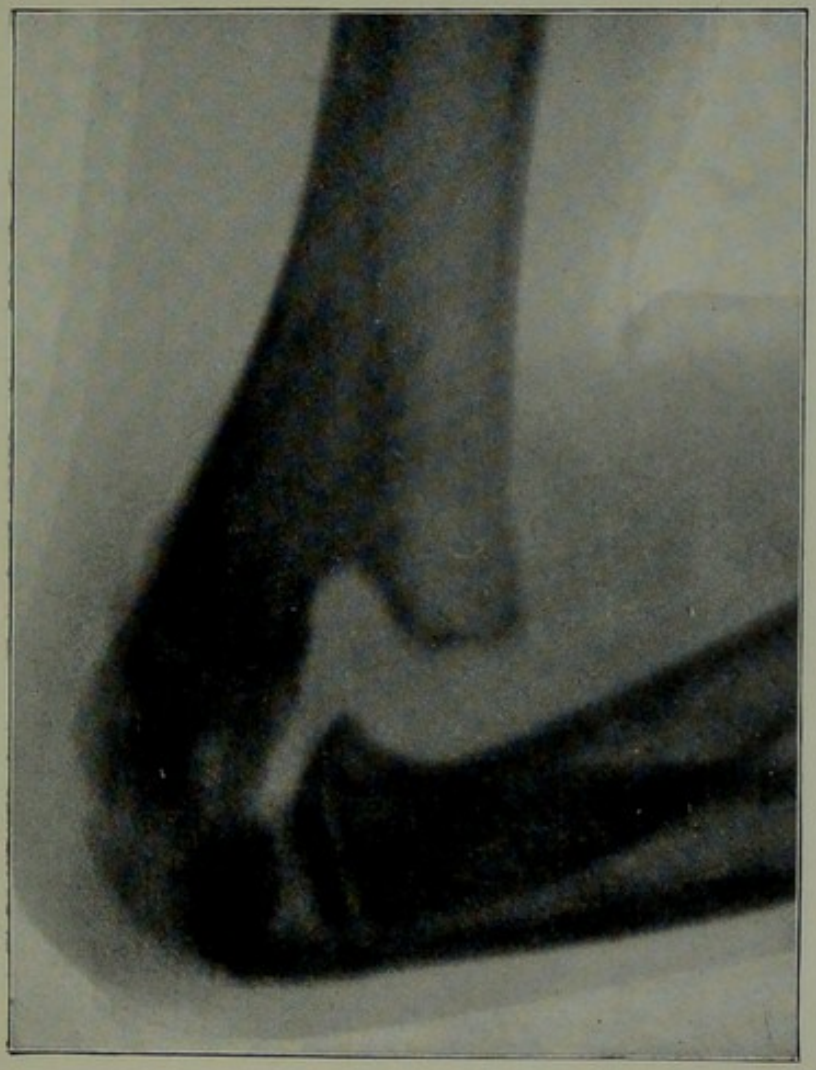
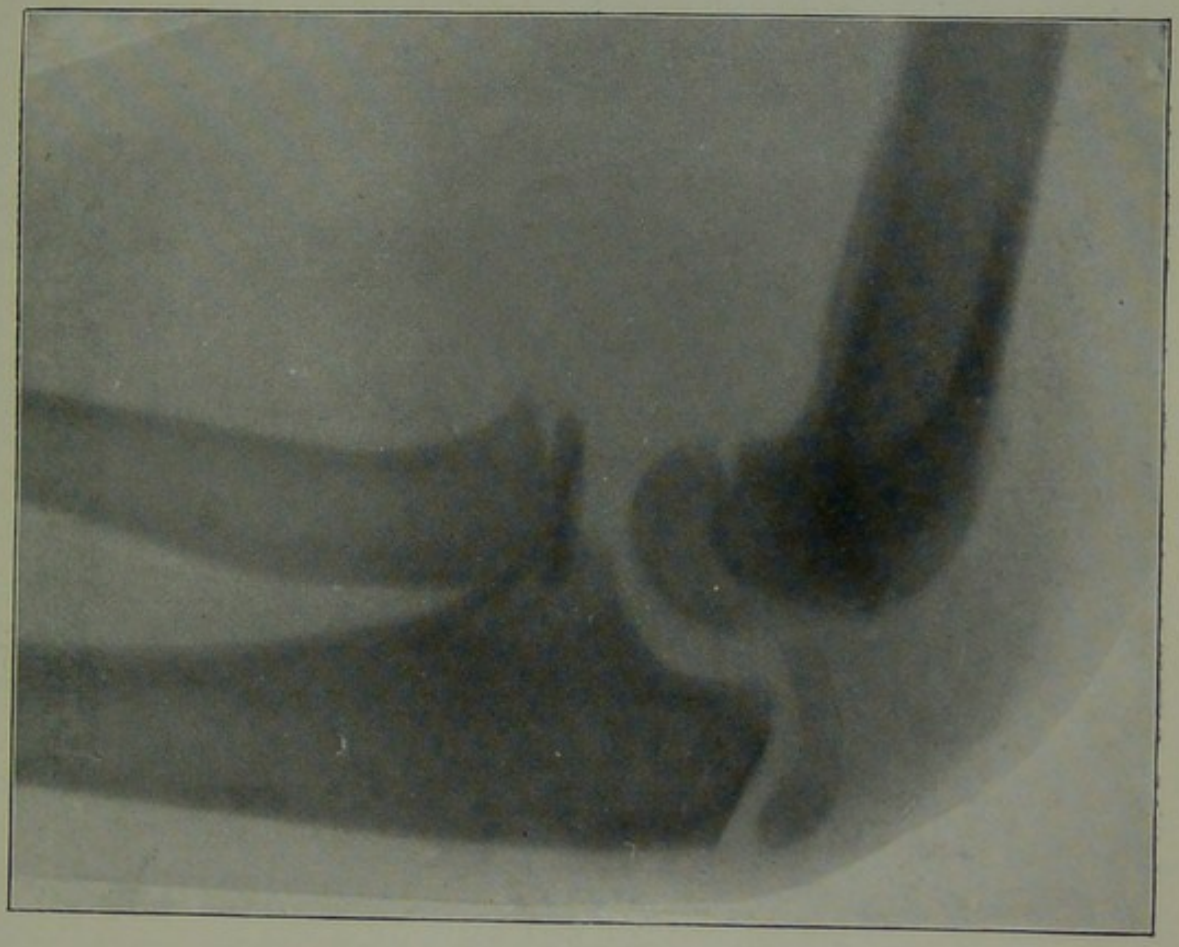
PLATE VII.

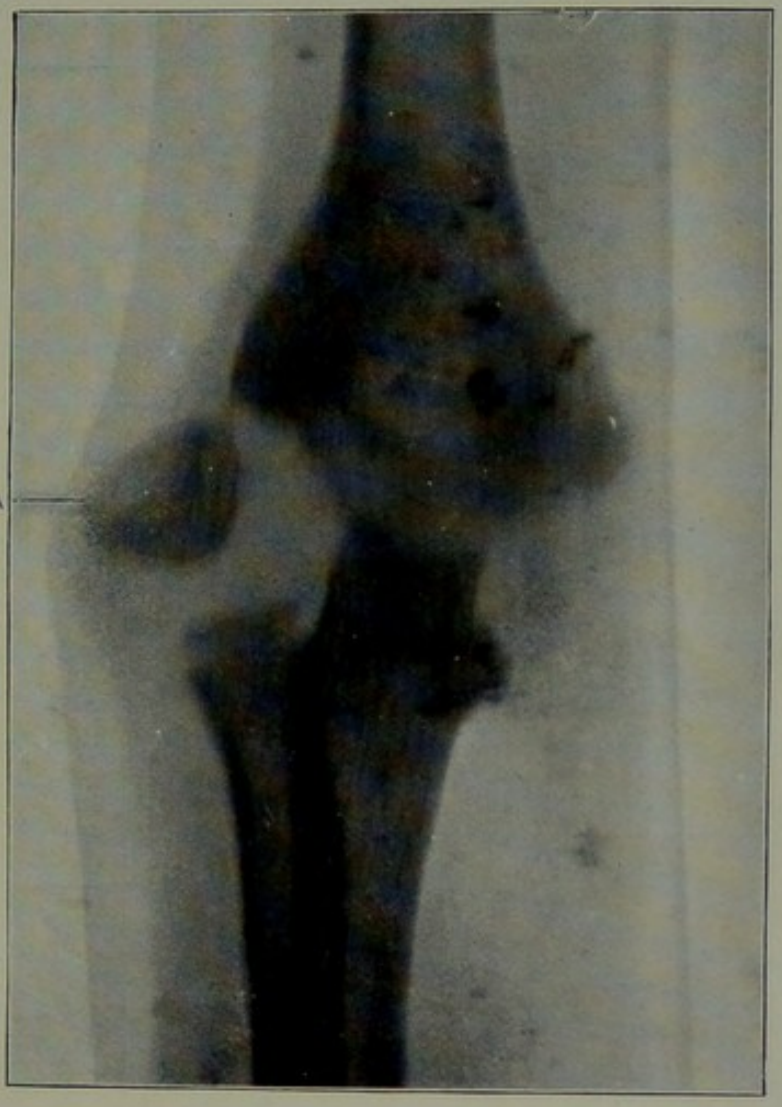


Separation of the lower epiphysis (? fracture) of the humerus, with backward displacement.



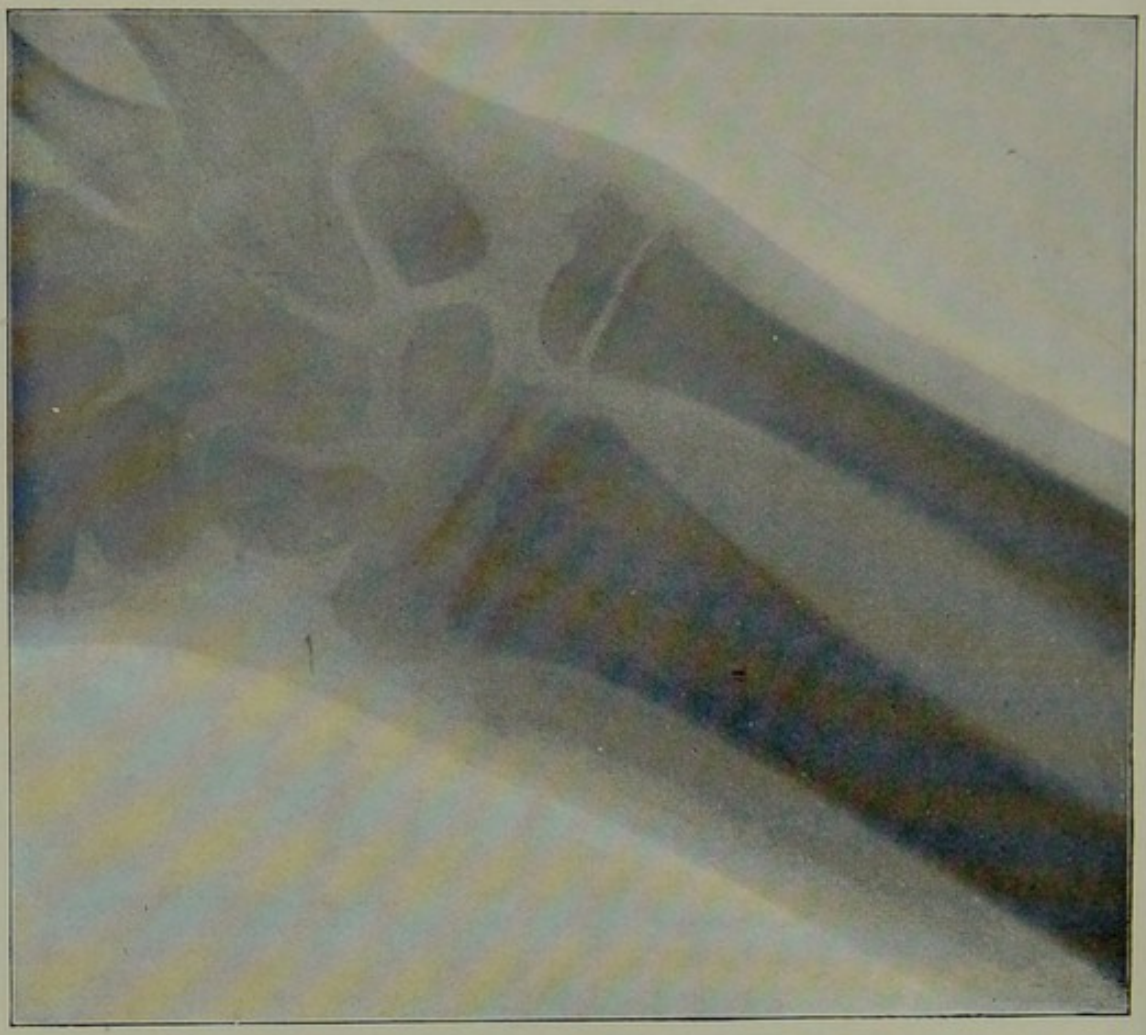
Separation of lower epiphysis of humerus, with T fracture. Subluxation of radius forwards. Injury four years ago. Good mobility. Boy æt. 11 years.

PLATE IX.



Separation of the capitellar epiphysis in a girl æt. 7 years. There was mobility through about 70°, and good power of pronation and supination. A points to loose fragment.

PLATE X.



Separation of the lower epiphysis of the radius in a boy æt. 10 years.

PLATE XI.

Separation of radial epiphysis, with arrest of growth two years later. Boy æt. 12 years. A centre of ossification for the styloid process of the ulna exists.

(Plate IX.) and the inner side of the bone fractured (Plate VI.). Such cases, if seen at once, should be treated, after reduction of any obvious deformity,

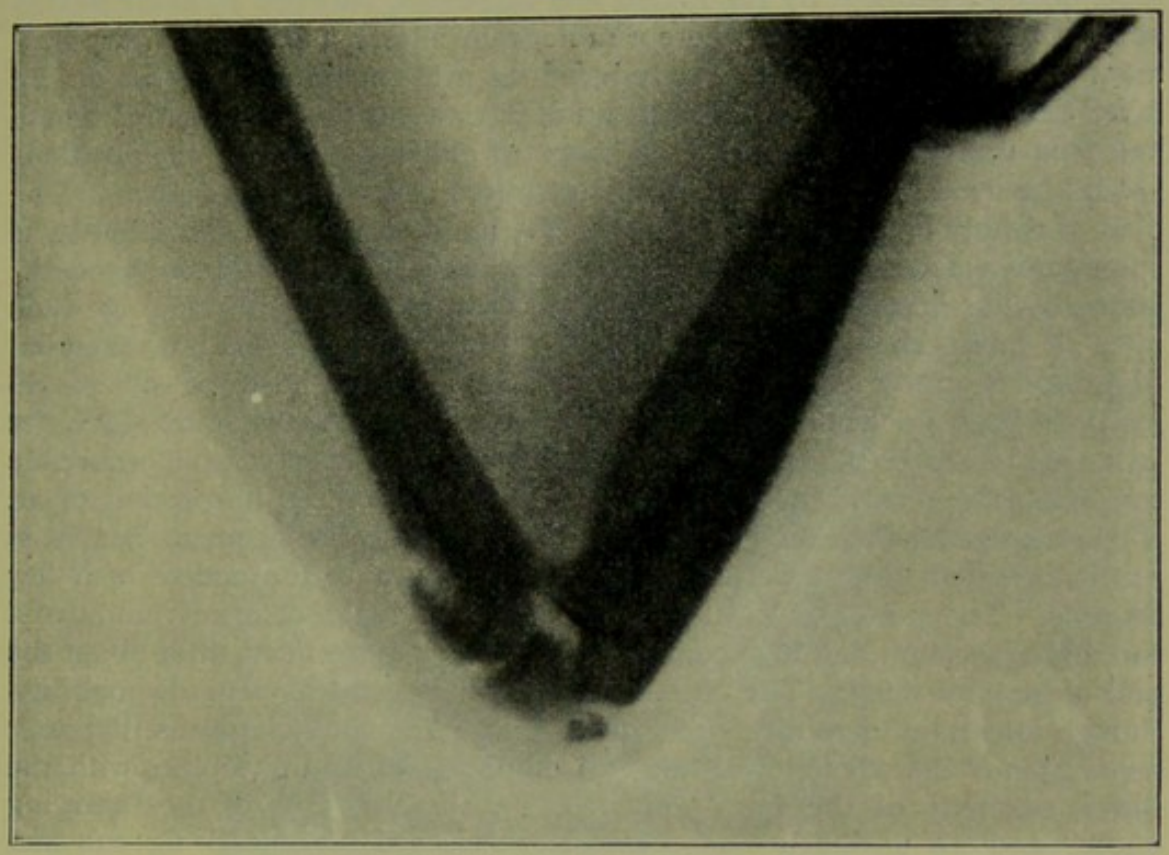


Fig. 231.—Comminuted T-fracture of Lower End of the Humerus. Replacement was possible in full flexion.

by gutta-percha or Gooch's splint, on one side, and on the other an angular splint, reaching from the shoulder to the end of the fingers, or a posterior angular splint may be used. Treatment of these injuries of the lower end

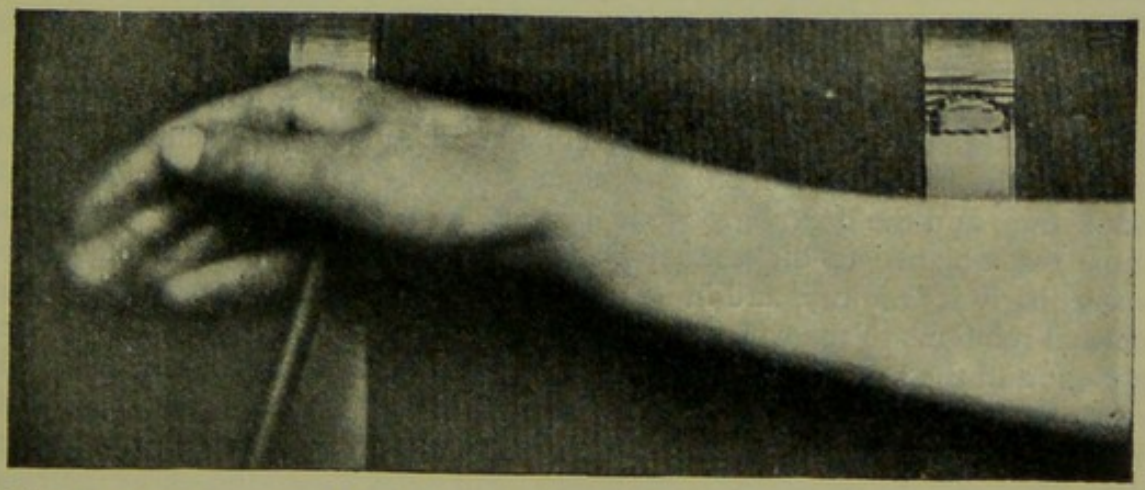


Fig. 232.—Separation of the Lower Epiphysis of the Radius. (Photograph by Frank Ashe, M.B.)

of the humerus by keeping the arm extended has been recommended as tending to diminish the displacement due to contraction of the triceps and

the tendency to tilting of the fragments, but this method of treatment has not become the accepted one. H. O. Thomas, R. Jones, and others recommend treatment by supination and extension, followed by acute flexion of the elbow,[1] and in cases where a radiogram shows a backward displacement which cannot be otherwise reduced the arm should certainly be put up in full flexion. (*Vide* fig. 231, in which full flexion was the only position which kept the fragments replaced.) In cases of difficulty the various positions should be tried till it is found which procures the best replacement. The plan of simply bandaging the arm with the hand on the opposite shoulder is sometimes efficient. At the end of a week the splints should be removed, gentle active movement encouraged, and the splints re-adjusted. A week later all splints should be left off and the arm worn in a sling, but taken out night and morning for gentle exercise and massage. Violent passive movement to keep up flexibility is mischievous and delays the cure, since the irritation increases the amount of callus thrown out. If no passive or forcible movement is allowed, but just gentle voluntary exercise, absorption of all thickening gradually takes place, and, provided the displacement has been fairly corrected, almost perfect mobility will return in the course of a few months. The great point in treatment is to reduce the deformity and avoid forcible movement, but to encourage *gentle active* movements after about the end of the first week. The ultimate prognosis is good as regards mobility, though uncertain as to arrest of growth. It occasionally happens that after separation of the whole lower humeral epiphysis union takes place with the lower segment of the limb adducted, i.e. there is loss of the 'carrying angle,' and an unsightly and somewhat awkward limb (*vide* fig. 229 and Plate VI.). Loss of the 'carrying angle' or cubitus varus may arise in injuries of the elbow from displacement of one or other side of the lower end of the humerus or from abnormal growth after injury. It is very unsightly, but does not very seriously interfere with the use of the arm in most cases. In one case we twice osteotomised the humerus to remedy the deformity, which, however, recurred. Even if the limb is in the natural position after the accident, it may become deformed in the course of subsequent growth (Platt). Separation of the epicondylar epiphysis is fairly common in patients from 10 to 16 years old, and the displacement is usually downwards.

Separation of the lower epiphysis of the radius with fracture of the ulna is said to differ from Colles's fracture in that the palmar projection is more obvious, the hand is not held so obliquely, i.e. there is not so much radial adduction, and the dorsal groove is horizontal instead of oblique. There is more resemblance to dislocation of the carpus backwards; but this is an exceedingly rare injury, and in it the styloid processes do not maintain their normal relations to the carpus as they do in fracture, while the age of the patient and the sensation of crepitus, together with the ease of reduction, but ready renewal of deformity, will point to diastasis[2] (figs. 230 and 234, and Plate X.). If the ulna is not fractured the resemblance to Colles's fracture is very close, and the treatment is the same. For cases illustrating these injuries in the upper extremities we must refer to Mr. Tubby's paper and Mr. Poland's

[1] *Brit. Med. Jour.* January 23, 1892, and November 3, 1894; also Helferich.

[2] *Vide* R. W. Smith on *Fractures and Dislocations.*

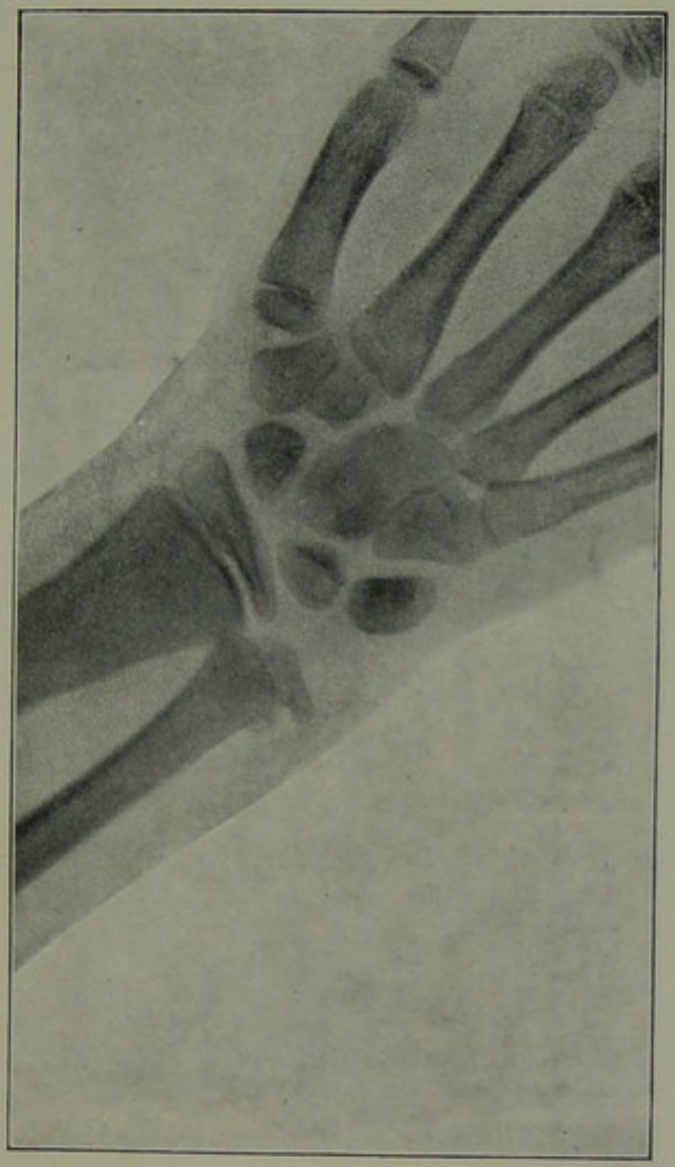


Fig. 233.—Separation of lower epiphysis of ulna.
Girl of about 11 years.

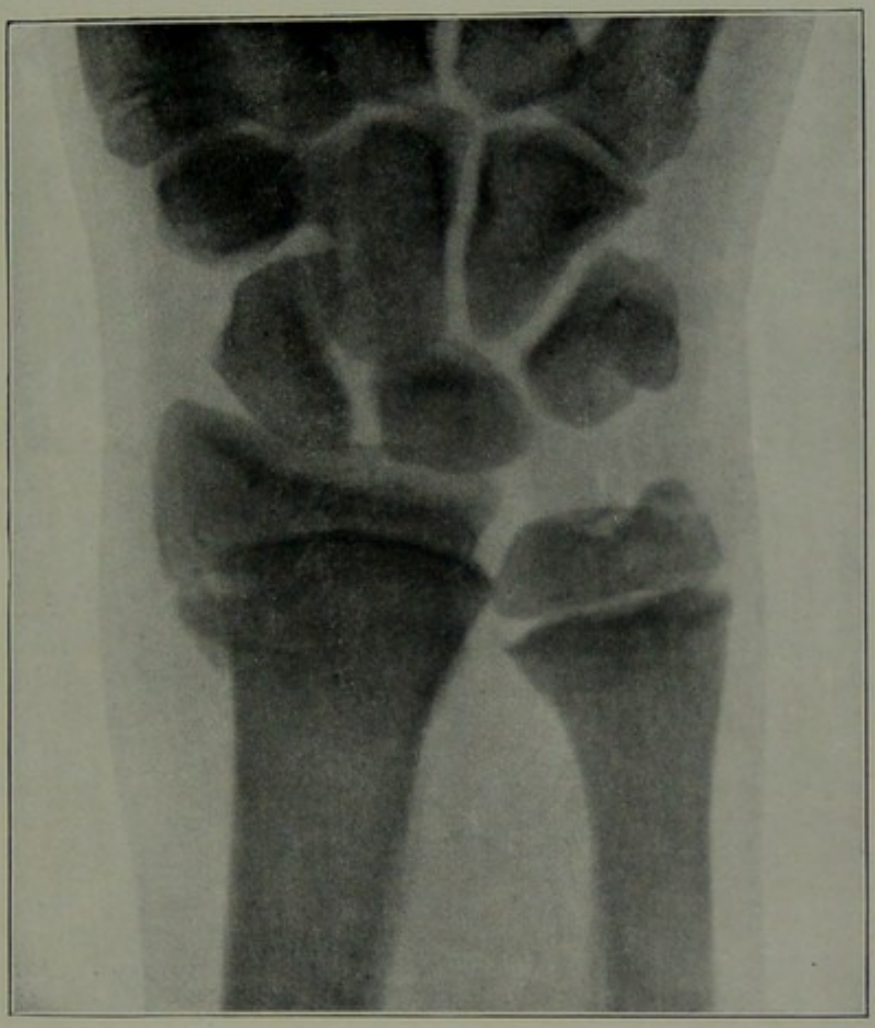
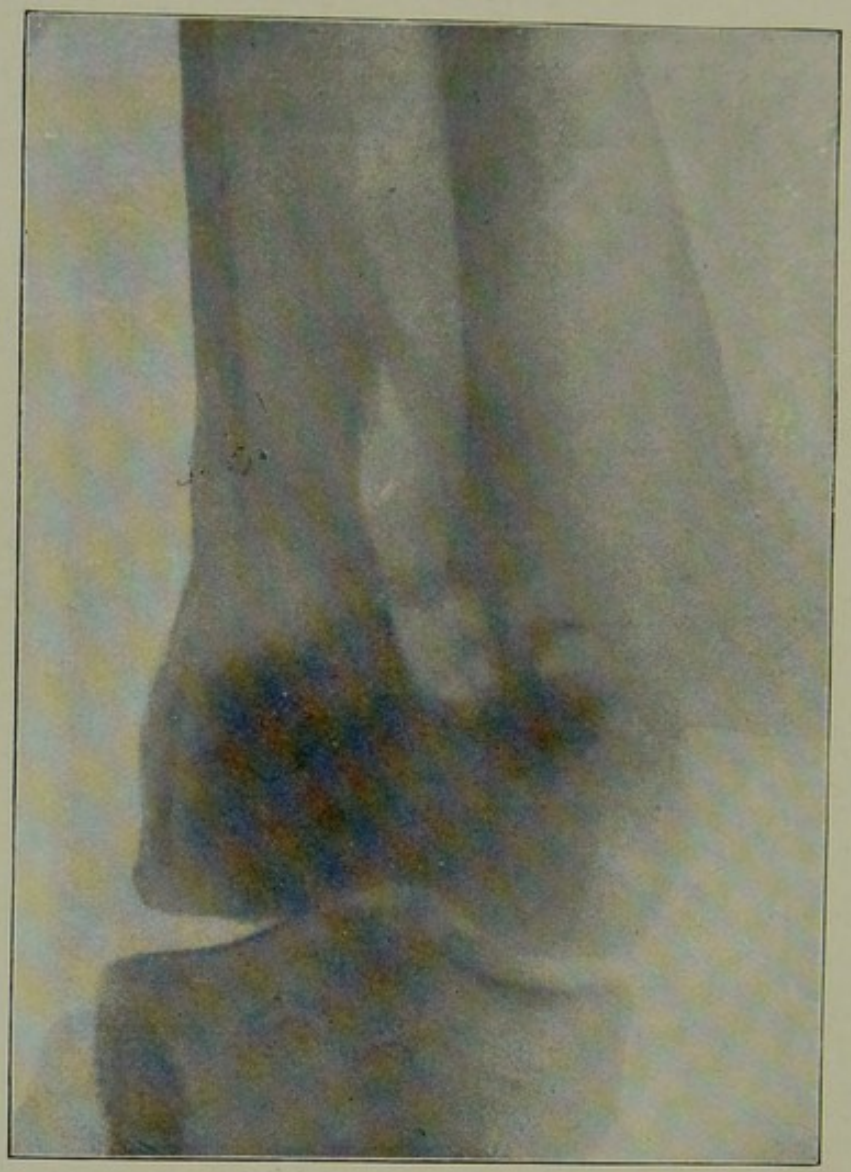


Fig. 234.—Separation of lower epiphysis of radius, with probably some loosening of ulnar epiphysis.

PLATE XII.



Separation of the lower epiphysis of the femur, with vertical fracture of the shaft. From a young man æt. 18 years.

work. Arrest of growth may follow (fig. 230, and Plate XI.). Very rarely the upper epiphysis of the radius is detached.

We have once met with epiphysial separation at the symphysis pubis associated with rupture of the urethra.

In separation of the lower epiphysis of the femur the lower fragment is usually displaced forwards, and the backward pressure of the diaphysis upon the vessels may cause gangrene, as in cases of Wheelhouse's and McGill's of Leeds.[1] We have seen cases of compound separation of the lower epiphysis with similar displacement. The displacement should be rectified under chloroform, and the limb put upon a Macintyre's splint or an inclined plane. Reduction is more easily effected by flexion of the limb at the knee and hip joints (Hutchinson). If necessary, the part should be exposed by operation and the deformity reduced. In many cases the onset of gangrene appears to have necessitated amputation.[2] The displacement is occasionally lateral, and may be backward.

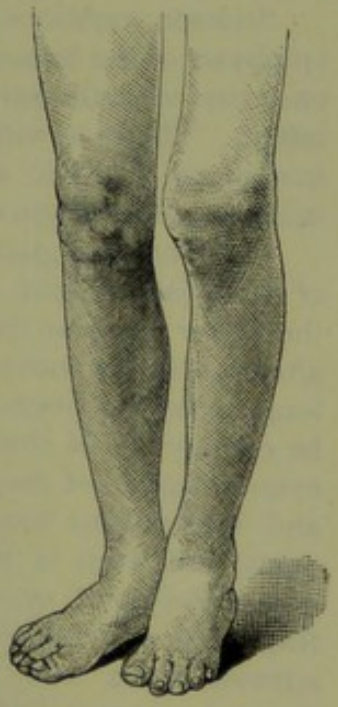


Fig. 235. — Separation of Lower Epiphysis of Left Femur. The epiphysis is displaced forwards, and the knee is flexed.

In separation of the upper epiphysis of the tibia, which is rare, the epiphysis is usually displaced forwards, though it may be laterally. We have seen a case of separation of the lower epiphysis of the tibia in a boy of about 10 years who was under the care of our colleague Mr. Hardie. The case was complicated by the presence of a vertical fracture running upwards from the epiphysial line. The foot and lower fragment were displaced outwards, and the deformity could not be reduced until some weeks after the accident, when the ends of the bone were exposed by operation and with some difficulty replaced. We have also met with an instance of compound separation of the lower epiphysis of the fibula. The lower fragment became necrosed and was removed. Loosening or separation of the anterior tubercle of the tibia, which is developed from the upper tibial epiphysis with or without a separate additional centre of ossification, is sometimes met with. It has been recently specially described by Mr. Makins. We think, however, that some of the cases in which this lesion is thought to have occurred are really rather inflammation as a result of strain. It is not rare.

The diagnosis of epiphysial separations need not be further described here: the locality, age of the patient, and the symptoms mentioned usually make the case clear, and any injury of doubtful character in the neighbourhood of a joint should be treated as if a diastasis had occurred. After a few days the subsidence of the general swelling and the presence or absence of callus will clear up the doubt, even if a careful examination under chloroform fails to reveal the exact nature of the injury.

[1] *Brit. Med. Jour.* May 24, 1884.

[2] Mayo Robson, *Annals of Surgery*, 1893, vol. xviii.; Tubby, *Annals of Surgery*, 1894, vol. xix.

For further details, with records of cases, we must refer to Mr. Tubby's interesting papers, to Mr. J. Hutchinson's, jun., Lectures, published in the 'British Medical Journal,' 1893-94, and above all to Mr. Poland's book, which gives a complete account of the whole subject.

The *treatment* of these cases is simply that of a fracture in the same position, though lighter appliances may of course be used in the case of children than of adults; thus poroplastic felt, Gooch's splint, Hide's felt, gutta-percha or light wooden splints may be employed. Most careful padding is necessary in all cases to protect the tender skin; absorbent wool will be found the best material for this purpose.

In separation of the lower epiphysis of the femur, as already stated, the limb should be put up in the flexed position, since the gastrocnemius, whether attached to the upper or lower fragment, tends to tilt the ends of the bone.

Stimson mentions that Volkmann has three times separated the lower epiphysis of the femur in manipulations required in cases of hip disease; we once met with the same mishap in a case of acute suppurative arthritis in an infant. The ease with which diastasis occurred was probably due to inflammatory or atrophic softening of the epiphysial line. The child recovered without arrest of growth.

In all cases a guarded opinion should be given as to the future mobility of the adjacent joint, and movement should be begun early—in the case of the elbow not later than the end of the first week, the splints being re-applied afterwards, and movement employed daily after the first fortnight; a week longer may be given for other joints. No forcible passive movement should be employed; if the fragments have been replaced it is unnecessary and even harmful; if they are still out of position, forcible movement is useless; and if, after time has been given for absorption and modelling down of the parts, the limb is still seriously crippled, it is probably better either to resect the joint or to cut down upon and chisel away any projecting fragments of bone. Hence, if it is found that the thickening does not subside it is well to cease movement and allow the parts to settle down, and mobility will probably return without any special effort. As we have already said in the chapter on DISEASES OF JOINTS, we are convinced that it is quite wrong to go on practising and recommending *passive* movement after fractures; the procedure is very painful, often, if continued for any considerable time, quite demoralises a child from fear and suffering, and is utterly unscientific in that it is, if any force is used, sure to tear young tissue of union in the soft parts, and so increase the amount of scar material and lead to denser adhesions. *Active* movement has none of these disadvantages. We are not, of course, alluding to a single operation for breaking down old adhesions under an anæsthetic, but to the daily *passive* movements and manipulations which are still written of. Separated epiphyses unite with great rapidity, much more so than fractures.

Occasionally, however, non-union is met with. We have had such a case in the capitellar epiphysis of the humerus. Even if there is considerable thickening and distortion for some weeks after the injury, and perhaps considerable loss of power and mobility, so much modelling of the parts takes place that ultimately the result is usually good.

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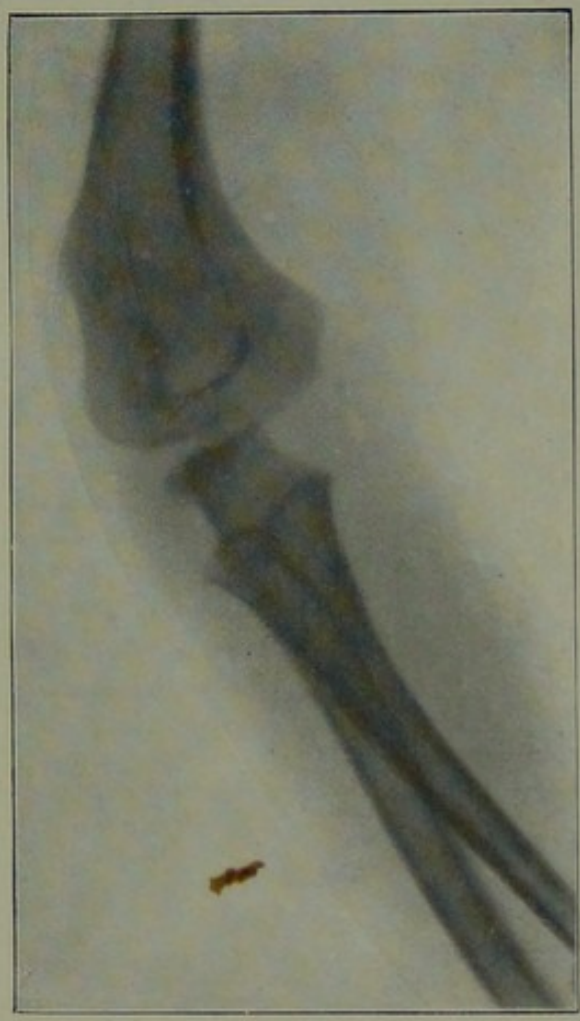
PLATE XIII.



Fracture above epiphysial line of lower end of humerus. Loss of 'carrying angle.' Boy æt. 6 years. Injury four months ago,

In cases of compound separation of an epiphysis it may be necessary to resect part of the shaft of the long bone in order to reduce the displacement. Even in such cases the amount of ultimate shortening may be very little, though it is quite uncertain how much it will be.

Implication of the musculo-spiral nerve in the callus of a separated lower epiphysis of the humerus is not uncommon, and there may be paralysis of the nerve for a time; usually, however, this disappears, and no hasty operation for the release of the nerve is called for.

The following table of the dates of ossification and union of the epiphyses of the principal long bones is inserted from Quain's 'Anatomy':

Humerus.

Nucleus of head appears in second year.
„ capitellum appears in third year.
„ internal condyle appears in fifth year.
„ trochlea appears in the eleventh to twelfth year.
„ external condyle appears in thirteenth to fourteenth year.
The lower epiphyses unite with shaft in sixteenth to eighteenth year.
The upper epiphysis unites with shaft in twentieth year.[1]

Radius.

Nucleus of lower extremity appears at end of second year.
„ head appears in fifth year.
Upper epiphysis and shaft join in seventeenth to eighteenth year.
Lower epiphysis and shaft join in twentieth year.

Femur.

Nucleus of lower end appears at ninth month.
„ head appears at end of first year.
Head joins shaft at eighteenth or nineteenth year.
Lower epiphysis joins shaft after twentieth year.

Tibia.

Upper epiphysis appears about time of birth.
Lower epiphysis appears in second year.
Lower epiphysis joins shaft in eighteenth to nineteenth year.
Upper epiphysis joins shaft in twenty-first or twenty-second year.

Fractures.—Simple complete fractures of the long bones may be met with at any age, and even occur sometimes *in utero*; indeed, compound fractures may occur before birth. Intra-uterine fractures may be the result of falls or of blows upon the mother's abdomen, or of muscular contraction. Almost any number of fractures may thus occur; 200 were found in one instance and 113 in another. Such fractures may be found united at birth; they are not very rarely produced during labour by instruments or traction upon a limb. For 'Fragilitas ossium' *vide* chapter on DISEASES OF BONE.

[1] Stimson says sometimes as late as the twenty-fifth year.

Fractures of the clavicle in quite young children are best treated by a flannel bandage to fix the arm to the side with the hand on the opposite shoulder, and a soft pad of absorbent wool in the axilla. The child's arm is, of course, kept inside its clothes, and not put through a sleeve; as Mr. Owen suggests, a jersey may be usefully worn over the bandage to keep the limb quiet. In this, as in all fractures, it is an excellent plan to keep the skin well powdered with boric acid or sanitary rose powder, so as to prevent irritation of the skin.

Fractures of the arm are treated in the ordinary way ; the splints should always be carried well up to the ends of the fingers to prevent disturbance of the fragments by the restless movements of children. We are well aware that this is not usually recommended, but we believe it to be the proper, as it certainly is the anatomically correct plan. Fractures of the pelvis are treated by bandaging the legs together firmly with a broad flannel bandage, which is carried upwards to above the crests of the ilia, the child being, of course, kept in bed.

In fractures of the femur in babies under a year old a piece of gutta-percha or Gooch's splint, lined with wool, should be applied to the thigh, and the legs bandaged together with a flannel bandage ; this is, we think, the simplest, cleanest, and, on the whole, most effectual plan, though a good result may be obtained by almost any method. In older children, up to the third or fourth year, we prefer the vertical suspension plan, as more cleanly and efficient, and less troublesome after it is once applied than other methods ; simple extension by a weight, with Gooch's splint, or an outside long splint, is, however, satisfactory, and a Croft's, a Bavarian, or a Thomas's hip splint may be applied at the end of a fortnight. Thomas's knee splint may also be used successfully in fractures of the lower half of the femur.

After fracture of the thigh in simple cases there should not be at most more than half an inch shortening in young children, and this will very likely disappear after a time.

Fracture of the neck of the femur occasionally occurs in children.

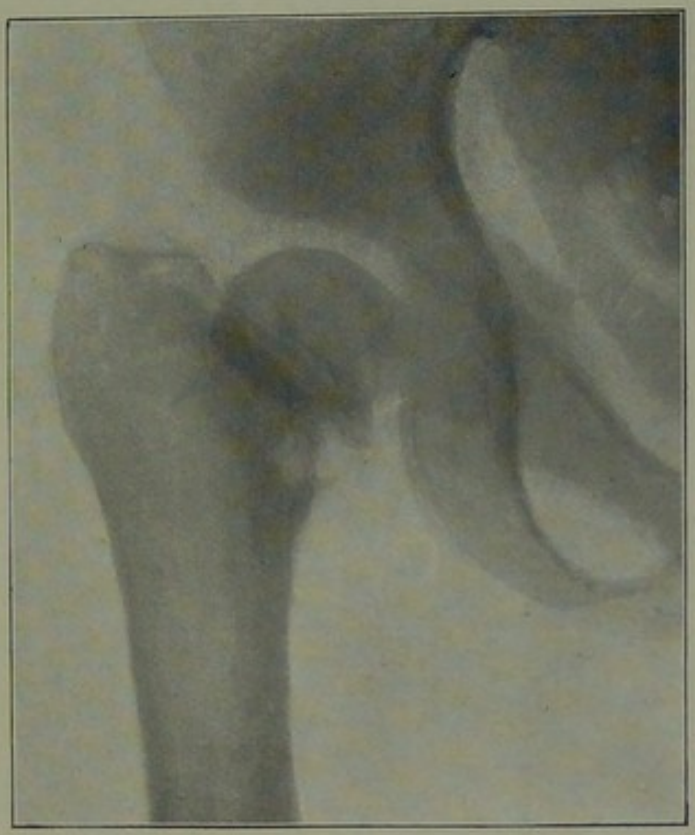
CASE.—W. L. S., æt. 14. Fell from a door in May 1896. He was laid up for a fortnight. When seen, six months later, there was one inch shortening of the right leg, no abduction or adduction. The trochanter was raised to the level of the anterior superior spine. There was some stiffness, but no pain. The radiogram Plate XIV. was taken six months after the accident, when he was an out-patient at the Children's Hospital.

We have only once (in 1905) seen fracture of the patella in a child. In this case a girl of 11 years, the subject of spina bifida occulta, fell off her bicycle and fractured the left patella. Probably the weakness of the limb, which existed as a result of the spinal defect, was a contributory cause. Dr. Crowe, of Didsbury, kindly brought us this case. A skiagram showed that only a small portion of the apex of the bone was detached. Abundant callus was formed, and the prospect of a useful leg is hopeful.

Fractures of the leg should be treated by a back splint with a foot-piece and two side splints for the first ten days or a fortnight, or more, according to age, and then one of the forms of stiff apparatus applied.

In all cases the most careful watch must be kept for tight bandages ; no bandage should ever be applied beneath a splint, nor should a limb be ever

PLATE XIV.



Fracture of neck of femur, possibly diastasis.
Boy æt. 11 years.

bandaged in extension and then put up in flexion. Pressure sores and gangrene are real dangers in children.

As is well known, any cause, such as hip disease, infantile paralysis, old ankylosis with atrophied bone, rickets, and so on, may produce weakening of the limb and may predispose to fractures from slight violence. When extensive necrosis has occurred, a slight injury may produce a fracture in childhood ; this usually unites well, but in some cases union is tedious, and in others does not occur : in such cases resection and wiring is a successful operation in our experience, but if the fracture remains long ununited the wasting of the fragments is apt to be extreme, and in one instance the upper

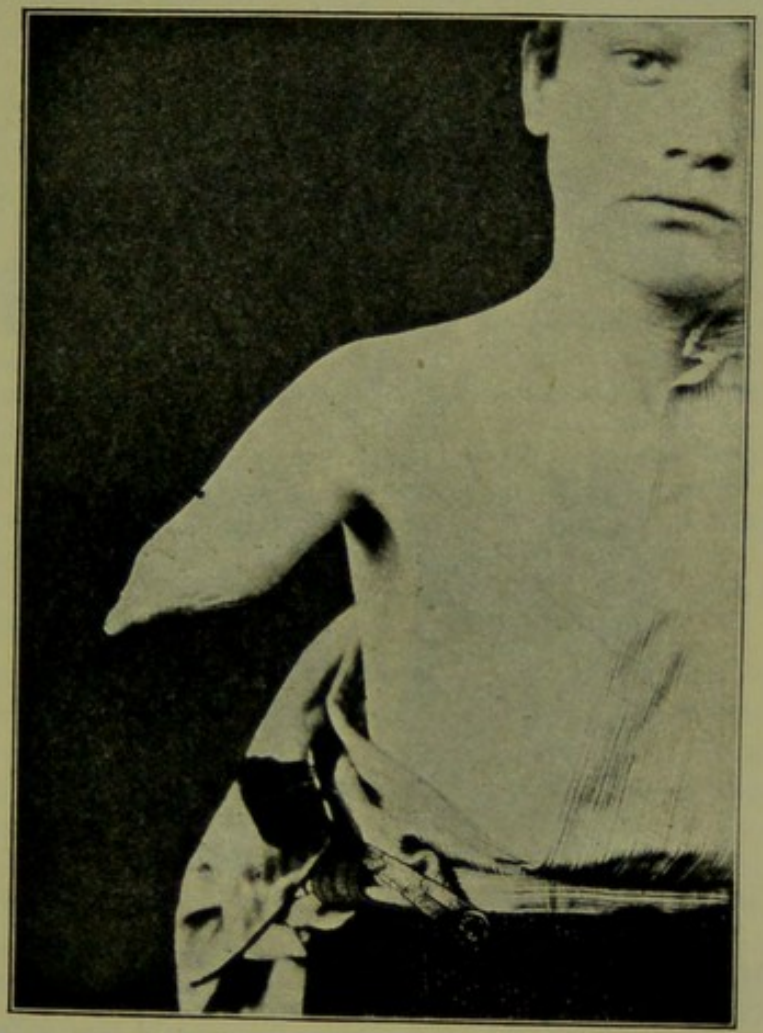


Fig. 236.—'Conical Stump' from growth at the upper epiphysial line ; an unavoidable result after amputation in such cases. The operation had been done some years before. (From photograph kindly lent by Mr. Collier.)

fragment of the humerus was so small that it was found impossible to steady it sufficiently to obtain union. Macewen has dealt with such a case most successfully by transplantation of bone (*vide* 'Ununited Fractures'). This bony atrophy should always be borne in mind when dealing with such limbs.

Mal-united fractures, if recent, and especially if greenstick, should be refractured at once ; if seen after three or four weeks, and when union has occurred, gradual reduction with splints often produces good results. Failing this, refracture or osteotomy may be called for.

It is worth remembering that in some positions amputation is practically sure to be followed ultimately by development of a 'conical stump,' simply by natural growth of bone (fig. 236).

Primary Amputations in children are very rarely required, and conservatism should be carried to extreme limits ; when amputation is necessary, if the immediate shock is got over, recovery is usually rapid. We have had once to perform a primary amputation at the hip in a child 5 years old for a tramcar injury, and, though there was much 'prostration with excitement' for the first two days, he ultimately did well.

Primary Resections of joints are occasionally required, and in cases of injury to the elbow are spoken very highly of by Mr. Holmes. The need for them is, however, now exceedingly rare.

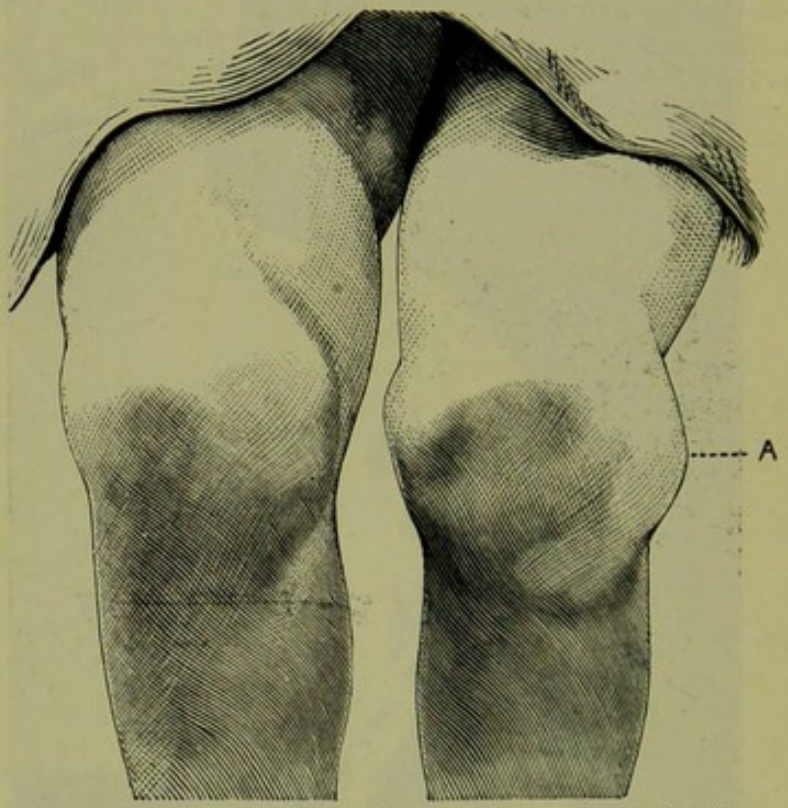


Fig. 237.—Dislocation of the Patella. A points to the displaced bone.

Dislocations.—Almost the only dislocation at all common in children is that of the elbow—both bones being displaced backwards. This is usually said, and we believe correctly, to be more frequently met with in childhood than in adult life. Dislocation of the elbow is, however, often complicated with separation of epiphyses or fractures, and the displacement is often not directly backwards, but backwards and laterally, either inwards or outwards. Active movement should be begun at the end of a week at latest.

Dr. W. T. Clegg, of Liverpool, has sent us a case of subspinous dislocation of the shoulder, probably caused at birth ; this is the only case we have seen.

Subluxation of the head of the radius is often met with in children as a result of lifting the child by one arm, swinging it round, or dragging it along. The head of the radius slips partially out of the orbicular ligament, and the arm is found to be fixed, powerless, somewhat flexed and pronated ; there is

usually pain both at the elbow and wrist, so that sometimes the injury has been thought to be situated at the wrist joint. Reduction is effected by steadying the upper arm, and, with the thumb over the head of the radius, supinating sharply, and then flexing the forearm upon the arm ; sometimes a distinct click is felt or heard, and the power of using the arm at once returns.[1]

We have only rarely met with a traumatic dislocation (dorsal) of the hip in children. Reduction is easy by manipulation. Dislocation of the patella is occasionally met with ; there appears to be usually some congenital weakness of the part as a predisposing cause, as in the case appended.

CASE.—*Dislocation of Patella.*—Mary Alice N., aged 7 years 6 months ; admitted February 7, 1883. History: Not strong, did not walk till 3 years old ; seven months ago fell while dancing and dislocated the left patella outwards ; since then has been constantly falling on account of the displacement recurring, especially if she runs ; the injury caused her no great trouble for a week, when the displacement was noticed ; was treated as an out-patient for some time, with pads and various appliances to keep the patella in place, but without success. On admission, the left patella during flexion lies quite on the outer side of the external condyle, coming back to its normal position on extension ; both femora have their external condyles very prominent ; no pain on manipulation or movement ; the patella was unnaturally small and could easily be moved about from side to side ; when walking it sometimes maintained its proper position, and then without warning would slip quite over the outer condyle and make the leg yield. February 17, a lateral incision was made over the inner side of the joint down to the capsule, the patella pushed strongly inwards, and two catgut sutures, passed through the inner edge of the patella, were tied firmly down to the tissues on the inner side of the joint; operation antiseptic ; back splint. 19th, has had a little pain ; did quite well ; antiseptics left off on March 3, and she was sent out in plaster-of-Paris splint on the 5th. Seen January 1884, the patella keeps its place and the knee does not trouble her. In this case the patella was apparently congenitally small and ill developed, and this probably accounts for the condition. (Fig. 237.)

Subluxation of the knee has been described by Mr. H. B. Robinson as occurring in children about 12 months old, and apparently the result of relaxed muscles and ligaments. The tibia becomes displaced outwards, and rotated out on attempts being made to walk. Attention to the general health and friction are the only modes of treatment required, and the tendency to displacement disappears as the child grows stronger.[2] A condition of hyper-extension, with tendency to backward displacement of the tibia, is also seen after infantile paralysis, and sometimes in rickets.

Congenital Dislocations are considered under the head of Malformations (p. 791).

Injuries of the Soft Parts in children require no special notice ; if the immediate shock is got over, such wounds usually heal with great rapidity, even if very severe, and nothing short of actual gangrene (Holmes) should be considered justification for amputation. Warmth, opium in small doses, and free stimulation are especially required for all severe injuries in children.

Burns and Scalds are exceedingly fatal, chiefly from shock, lung complications, and cerebral effusion. If the first few days can be tided over, recovery is usually satisfactory, and much more rapid than in adults. Careful

[1] This injury has been specially described by Mr. Jonathan Hutchinson, jun., and by Drs. McNab and Lindeman, *Brit. Med. Jour.* December 5, 1885.

[2] *Brit. Med. Jour.* July 27, 1895.

watch for cicatricial contraction must be kept up, and provision made against it by suitable extension apparatus and manipulation, as well as by grafting. Plastic operations may be required at a later date.

Shock.—The question of how children bear the shock of severe injuries or operations, and the effects of loss of blood and of pain, is one of much importance to the surgeon, and may be shortly considered here. First, then, as regard operations in infants and quite young children one great depressing element is removed. They do not anticipate and are not cast down by the thought of the effect upon their future usefulness of any mutilation. In somewhat older children anticipation of pain is of course keen, but it seldom depresses in the same way that it does in adults. Again, the temperament of children is usually mobile, and, even if mental depression occurs, it is not long lasting. So with shock from a severe injury or operation, the symptoms are often severe, even more so than in adults, for a short time ; but if by means of stimulants the first few hours can be got over, children very quickly rally. It is common to have a great amount of shock in a child after such an operation as an amputation or excision of one of the larger joints, and yet the next day the child is often as bright as if nothing had happened. On the other hand, occasionally we see 'prostration with excitement' in a severe form in children, and we have known a mental condition practically identical with acute mania, coming on after amputation at the shoulder joint, and lasting for some weeks, followed by complete recovery.

Loss of blood is always very ill borne by children, and the more so the younger the child. Still, recovery is rapid if the child survives. Even the small quantity lost in a hare-lip operation sometimes seriously endangers the life of an infant a few weeks old, and in all cases great care should be taken to avoid hæmorrhage as much as possible. The only instance of death from amputation at the hip joint that we have had in a child was in one where, from removal of a large part of the pelvis, free oozing took place.

Next to loss of blood we should put **cold** as having the most depressing effect upon children, and this should always be carefully guarded against by exposing as little as possible of the body beyond that part actually being operated upon.

Pain, if really severe, very seriously depresses a child, far more so than it does an adult, and many of the cases of severe burn die speedily from the combined effects of pain and fright. Hence, no child should be allowed to lie in pain after an operation, and opium should be given freely for a few hours till the first soreness has passed off, bearing in mind, of course, that opium has a disproportionately strong effect upon children, and that some children bear much smaller doses than others. The general rules, then, to be followed as to the management of surgical cases in childhood are: (1) Do not let a child know that he is going to be operated upon, until the time actually comes for the operation. (2) Avoid with the utmost care unnecessary loss of blood. (3) Keep the child warmly wrapped up. (4) Never let a child suffer pain if it can be avoided ; thus, an anæsthetic should be given for any painful dressing or manipulation, and opium as soon as recovery from the anæsthetic has taken place.

As Mr. Holmes has well pointed out, in children 'irritability is chiefly directed against sudden and acute pain ; but confinement to bed and

protracted disease, which wear out the patience and exhaust the hopes of older persons, soon become customary in childhood, and then produce little impression.' As Mr. Holmes shows, freedom from mental depression and healthy unimpaired excretory organs probably account for this difference.

Children are, of course, liable to the same **septic diseases** as adults, and pyæmia is, though happily rare in both, quite as common in childhood as in older patients. Diphtheria, and especially scarlet fever (*vide* Chap. XIV.), are very apt to attack surgical cases among children, i.e. those in whom there is a wound or a local inflammatory focus ; while erysipelas, though not very rare and occasionally fatal, is mostly of a mild type in children, and in our experience the so-called 'erysipelas vagans' is the variety most commonly met with. See, however, Vaccination Erysipelas, p. 332.

'Surgical scarlet fever,' so-called, is nothing more than ordinary scarlet fever. It is now well known that children who have open wounds, who have been recently operated upon, or who have local inflammatory foci, such as abscesses, are specially susceptible to scarlet fever. For further details and references we must refer to papers by Dr. Goodhart and Sir H. Howse and Mr. Paley, in the 'Guy's Hosp. Repts.' for 1879, and to an account of an outbreak in our own surgical ward, by R. W. Murray, in the 'Brit. Med. Jour.' June 18, 1887.

No special remarks are required upon the subject of dressing wounds in children ; the same rule should be followed as in adults. We use antiseptics—chiefly boric and mercurial lotions, and sublimate wood-wool wadding—and are fully satisfied of the value of these agents. Mercurial poisoning in children we have not certainly met with. We have twice had a fatal result follow within twenty-four hours of emptying and washing out a large abscess, but we have been unable to connect the death definitely with the use of any particular antiseptic agent, though we have suspected perchloride of mercury of being dangerous in such cases.

In certain cases—for instance, in circumcision—it is well to avoid the fright of a second manipulation by the use of catgut sutures in closing the wound, and it may be remarked that primary union of wounds in children is much more easily obtained than in adults, providing the child is healthy and not too young ; in the very young the tissues are too soft to bear any strain, and in childhood the very smallest disturbance of health is sometimes enough to prevent union of a wound ; hence all plastic operations should be performed only after careful inquiry into the child's general condition. The same slight causes will often produce a temperature chart that would be very alarming if it were not known how little is required to raise a child's temperature. As to the dieting of children after operations, it will be found that children can without harm much more speedily return to their ordinary diet than can adults, and it is common for a child to resume its usual food the day after an operation.

We have two or three times met with cases of persistent vomiting after operation resisting all treatment and even proving fatal by exhaustion. In one instance, after operation for cleft palate, the vomiting was followed by purpura, gangrene of the extremities, endocarditis, and death from acute septicæmia.

CHAPTER XLI

ANÆSTHETICS FOR CHILDREN

By Alexander Wilson, F.R.C.S.

In the production of anæsthesia in children, as compared with adults, there are two questions to be chiefly considered: the physical conformation of the children—that is, their capacity for the inhalation and absorption of the anæsthetic vapour—and the reaction of the anæsthetic vapour on their more unstable nervous and usually healthy vascular systems.

General anæsthesia takes place when the blood of the subject contains a certain definite quantity of the anæsthetic agent employed, which is introduced through the lungs, by the inhalation of air impregnated with the anæsthetic. It follows that the strength of the anæsthetic vapour being the same, the rapidity with which the blood absorbs and distributes the necessary amount of the drug will depend upon the depth and frequency of the respirations, i.e. upon the vital capacity, and also upon the vigour of the circulation in proportion to the size of the animal—small animals, which breathe deeply or quickly in proportion to their size, becoming affected sooner than larger animals, which breathe slowly.[1]

Compared with adults, children present well-marked differences. Their chests are usually well developed and highly expansile, and the lungs are more likely to be healthy and in better working order. They consequently have, in proportion to their size, a larger vital capacity than most adults, that is, a proportionately larger lung area for the inhalation and absorption of any anæsthetic vapour. Their healthy vascular system and active circulation enable the blood to quickly absorb and transfer the inhaled drug to the tissues, and their smaller size causes the system to become more quickly affected. In practice the influence of these factors is often increased by the way in which young subjects usually take anæsthetics, e.g. crying, and alternately holding the breath and taking deep inspirations. The foregoing considerations account for the rapidity with which children go 'under' with anæsthetics, and one has seen a crying struggling child reduced to an almost lifeless condition by one deep inspiration of a concentrated vapour of chloroform. Owing to this capacity for the inhalation and absorption of anæsthetics in proportion to their size, less anæsthetic is required; so in giving children anæsthetics caution is necessary, as an over-dose may easily be inhaled.

As regards the effect of the anæsthetic, children possess no special resisting power against the lethal action of either chloroform, ether, or any other anæsthetic. In proportion to the number of administrations, probably

[1] Snow, *On Anæsthetics*, p. 70.

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fully as many accidents have happened in the case of children as in adults. They are better subjects than adults merely in so far as they are more free from those degenerative changes which in older subjects complicate the administration. They also have an advantage in not being habituated to the excessive use of alcohol, &c. Further, as, from the elasticity of their chest wall and their smaller size, treatment in accidents can be better and more successfully applied, there are in consequence fewer fatal cases.

Apart from the rapidity with which the anæsthetic can take effect, such differences in its action as exist are to be traced largely to the activity of the reflexes and the lack of inhibition over certain functions which obtain in young subjects. Thus the occurrence of defæcation and micturition is more common in children, probably because these acts are with them normally under less control. The crying reflex is abnormally active in early life, and so during an operation a child will often cry out at a stage of the narcosis where an adult would either exhibit no sign of feeling or merely move slightly. Sensation of pain does not necessarily accompany the crying. It is a common occurrence for a child to emerge shrieking from nitrous oxide anæsthesia, and yet for it to have no painful impression nor any idea why it is crying. This readiness with which children cry out is partly responsible for the belief that they 'come out' of chloroform anæsthesia more quickly than adults.

In adults we see spasm of the glottis producing loud crowing inspiration as a reflex from forcible dilatation of the sphincter ani. In children this is more readily originated, even when the patient is apparently well 'under,' and accompanies any painful operative procedure. It is especially well marked on division of the prepuce or in operations involving the anus during moderately deep narcosis. It represents an abortive expulsive effort, and denotes an imperfect degree of anæsthesia, and is relieved but not removed by extending the head and pushing forward the jaw, and giving more of the anæsthetic. If the painful part of the operation is of momentary duration, it is not necessary or advisable to push the anæsthetic to the extent of abolishing this reflex.

Other points of difference between children and adults dependent upon the nervous system are the various reflexes by which the degree of narcosis is estimated. The corneal or lid reflex, uncertain as it is in adults as a guide to the condition of anæsthesia, is still more unreliable in young subjects. In applying this test do not hold up the lid in such a way as to prevent it closing, and always test both eyes. The reflex may be present throughout an operation though no other signs of sensation are exhibited, it may be present in one eye and absent in the other, and it may be absent in both eyes and yet the patient exhibit signs of sensibility. In the latter condition the pupils are contracted and the eyes have a fixed look, and there are generally other indications of decrease in the anæsthesia. This abolition of the lid reflex is probably due to the reflex being inhibited either by the irritation from the seat of operation, or occasionally from the onset of vomiting. It has been suggested that this absence of corneal reflex may be due to the local anæsthetic effect of the chloroform vapour. The inferences deduced from the lid reflex must be checked by observation of other

conditions, such as the quantity of anæsthetic the patient has taken, the respirations, facial expression, the swallowing reflex, movements of the fingers, and nature of the operation.

Emergence from the narcosis is indicated by alteration in rhythm of the respirations, slight holding of the breath with tendency to spasm of the glottis, or acceleration of the respirations.

Alteration in the facial expression, pursing of the lips, or wrinkling of the forehead, and movements of the fingers are signs of recovery. Swallowing is a late reflex to disappear and an early one to re-appear, and is a valuable index to the stage of anæsthesia.

Symptoms of vomiting also denote a return to consciousness. An intelligent observation of all these points will usually enable the administrator to avoid making mistakes.

The state of the pupils alone is not much guide to the degree of narcosis. They are dilated at an early stage, generally moderately contracted later, dilate on the onset of nausea and vomiting, and dilate widely in collapse. The significance of these signs, like others, must be interpreted in conjunction with other symptoms.

Children are very susceptible to shock, and no suddenly painful procedure (e.g. wrenching a joint) should be undertaken when they are in a semi-anæsthetised state. Though the occurrence of reflex paralysis of the heart has been denied by certain recent observers (Hyderabad Chloroform Commission), we have seen one case (a young girl) in which death was clearly due to shock produced by flexing a limb when the patient was not completely under the influence of the anæsthetic.

The Choice of an Anæsthetic.—In this connection it is not necessary to consider any anæsthetic agents other than ether, chloroform, nitrous oxide, and ethyl chloride, or their various combinations. As regards relative safety, children are in the same position towards these drugs as are adults. In lethal power chloroform comes first, ethyl chloride is probably equal to chloroform in lethal capacity, ether comes next, and nitrous oxide last; the latter, it must be remembered, has not been used to any extent for the production of prolonged anæsthesia. The attempts at present being made to employ it for long operations may possibly prove that there is a limit to its safe use. In selecting an anæsthetic for a young subject, too much stress must not be laid upon the mere question of age; extreme youth does not necessarily contra-indicate the exhibition of ether, nor make imperative the use of chloroform; if necessary, ether can as readily be given to an infant as to an adult.

Nitrous Oxide is well borne by children; they pass rapidly under its influence, but the period of anæsthesia is short, and muscular movements, spasm, and opisthotonos are usually much greater than in adults. It may always be used in dental and short surgical operations. The period of anæsthesia can be prolonged and the muscular disturbance diminished by combining it with oxygen or a little ether. This latter is, however, liable to cause sickness, which may also occur after prolonged anæsthesia from the gas alone.

Ethyl Chloride (C_2H_5Cl) within the last few years has come into very general use as an anæsthetic for short operations, and is to a considerable

extent displacing nitrous oxide in these cases. It has the advantages of being more portable, of requiring less apparatus for its administration, and of giving a longer period of anæsthesia, while in the case of children there is less muscular disturbance. It is, however, probably not so safe as nitrous oxide, and after-effects such as headache and nausea are more common.

It may be employed as an introduction to chloroform or ether narcosis to induce rapid unconsciousness.

The dose for a child is 3 c.c., the average time for the induction of anæsthesia is about 30 seconds, and the duration about 70 seconds. It may be given sprayed on to a handkerchief or lint, but is best administered from an Ormsby's or other special inhaler.

Somnoform, a mechanical mixture of ethyl chloride, methyl chloride, and ethyl bromide, appears to possess no advantages over pure ethyl chloride and is less pleasant to inhale.

Chloroform in the case of children possesses many advantages, but it is not altogether the safe and desirable anæsthetic it is often represented to be. Children, as already stated, possess no special powers of resistance against the lethal action of chloroform, and a fair number of deaths, and many more alarming but non-fatal accidents, have occurred from its use in young subjects.

The youth of the patient is a source of safety only because it implies a freedom from degenerative changes in the nervous, respiratory, and vascular systems.

The advantages of chloroform consist in the simplicity of the apparatus required, the small quantity needed, its sweet pleasant flavour, and the fact that it produces no bronchial irritation. As disadvantages may be mentioned the facility with which an overdose may be inhaled ; the depression it produces, indicated by pallor, feeble pulse, dilated pupils. The nausea and faintness after the administration are often considerable, and have led some surgeons to prefer ether as the routine anæsthetic for children. With chloroform there is often difficulty in producing narcosis, and in estimating and graduating the degree of anæsthesia. If during the operation there is a return of sensation, it is not so easy to re-induce anæsthesia with speed and safety. This arises from the circumstance that when once a certain degree of unconsciousness is produced the breathing becomes so shallow that barely enough chloroform is inhaled to advance the narcosis, or if the patient is 'under' to keep it up.

Ether, compared with chloroform, is less depressing ; the pulse continues strong throughout, the respirations active ; the face keeps a good colour ; the tendency to syncope is diminished, and the after-sickness is of shorter duration, often ceasing when once the stomach is emptied of mucus. It is quicker in its action consistent with safety, so that the distressing struggles of a child can be speedily ended without danger in a way that could not be done with chloroform. It is much easier to calculate and maintain a definite degree of narcosis, and if signs of returning sensation or of vomiting appear a deeper anæsthesia can be speedily and safely re-induced, probably because the drug causes active respirations and is therefore more freely inhaled. The risk of suddenly giving an overdose is almost nil. Ether, however, has disadvantages ; it requires some apparatus for its proper administration, it

occasionally causes a considerable secretion of mucus, and when given alone it is unpleasant. The last of these objections can be overcome by giving it in combination with nitrous oxide, or by first giving a little chloroform. The secretion of mucus in children is no greater than it is in adults, and when the inhalation is properly managed only in the minority of cases is it enough to give any trouble. When excessive it may readily block up the small trachea and bronchial tubes, and give rise to inconvenience, especially if the patient is kept deeply narcotised. In these cases changing the anæsthetic to chloroform does not immediately improve matters, as the change does not remove the mucus; it is better to allow the patient to recover consciousness enough to clear the lungs by coughing. Ether is contra-indicated in lung disease, and is supposed to be dangerous in kidney diseases.

The A.C.E. Mixture and Ether-chloroform Mixtures possess the advantages of being more stimulating than pure chloroform, and with them there is less risk of an overdose being inhaled.

These anæsthetics are also used in combination, the object being to blunt the sensibility to the pungency of ether vapour. The principle of all these combinations is first to give the more agreeable anæsthetic until sensation is dulled and then replace it with pure ether before the stage of excitement. The most useful is nitrous oxide and ether; but as it entails the employment of apparatus, its use is confined to older children. The initial exhibition of chloroform or A.C.E. followed by ether is very valuable. Certain anæsthetists have reduced the arrangement to a definite system. As an example of these methods, Mr. Rowell recommends that A.C.E. should be first given in drop doses on a piece of lint or Skinner's inhaler, to be followed by a stronger vapour of A.C.E. from a Rendel's mask, to which when unconsciousness supervenes should be added a drachm of ether, to be followed when narcosis is further advanced by the exhibition of pure ether from a Rendel's mask, with which the anæsthesia is afterwards kept up throughout the operation.

Local Anæsthesia.—Of late years considerable progress has been made in this department, and extensive operations can be performed under local anæsthesia. It is sufficient to mention the intra-spinal injection of cocaine and stovaine, and the various infiltration methods, of which that advocated by Mr. Arthur Barker is an example. For dental extractions there are available a number of proprietary preparations which give excellent results. The basis of all these is cocaine, or beta cocaine, mixed with anodyne antiseptics, such as thyme, eucalyptus, menthol, &c. However, in young subjects the mental factor has to be taken into account; and as all these local anæsthetic agents labour under the disadvantage that their application is painful, their scope is very limited. For exploratory punctures local anæsthesia may be produced by holding a piece of ice dipped in salt against the surface until it is frozen, or a like result can be produced by ethyl chloride or ether spray.

Preparation of Patient.—As anæsthetics are best taken when the stomach is empty, their administration should not be undertaken within three or four hours of a meal. When possible, it is best to arrange for operation at the time when a meal is due—e.g. about the hours nine, one,

four or six. As children bear badly the deprivation of food, any longer interval, besides being unnecessary, is injurious, making the patient feel faint. A feeble child, or one kept long without food, should be given some liquid nourishment some little time before operation, by the mouth or as a nutrient enema.

Administration.—It is well to have always at hand chloroform, ether, and A.C.E. mixture ; the administrator should also have a plentiful supply of lint, tongue forceps, a hypodermic syringe, nitrite of amyl capsules, sponges, an electric battery, and a mouth-gag with a sponge-holder. These latter are occasionally required in cases of vomiting.

Before beginning the administration, examine the mouth for any loose temporary teeth which might become detached, especially if a gag is to be used, and also in better-class children for any dental regulating plates ; avoid, if possible, alarming the patient, for with a struggling, crying child the danger of giving an overdose is increased. By a little tact most children can be anæsthetised without any crying, even when inhalers are used. If the child is nervous, let it sit on its mother's or nurse's knee. If the little patient is not undressed, do not have the clothes removed until it is anæsthetised ; the undressing can then be managed without alarming it. Let the child see the inhaler or lint and smell it before any anæsthetic is put on, and begin with a very weak vapour. During the administration, when the smell is objected to, incite the patient to 'blow it away.' It is not absolutely necessary that the child should be lying down in the early stages ; if quiet can be gained by letting it sit up, permit this. These small details are of importance, as there is no doubt that to a highly sensitive child the struggling and shock of being 'choked off' by an anæsthetic may have injurious after-effects. Should the child cry, go on steadily with the administration, but do not give an *extra* quantity or 'push' the anæsthetic to get it 'under' the quicker. As it is breathing more deeply than normal, rather exhibit less of the anæsthetic, and so avoid all chance of the sudden inhalation of an excessive dose.

Ether when given alone is best administered by a Clover's inhaler. It should be given slowly, with a free admixture of air. In nervous subjects the face piece may be applied first, and when the patient is accustomed to it, the ether box and bag may be added and free respiration into the bag established before ether is admitted. Should the patient become highly excited and rough, it is allowable to turn on a stronger vapour and hasten the anæsthesia.

When possible it is always desirable and more humane to begin the anæsthesia with some less pungent anæsthetic. Of these nitrous oxide is the best, and the most convenient apparatus is Hewitt's modification of Clover's inhaler ; but ethyl chloride may also be used. Very little gas is required, and the ether should be turned on before the nitrous oxide has produced any muscular disturbance. The strength of the ether vapour can be estimated by its effect on the pharynx ; if it produces swallowing, or catching respiration, it is too strong, and a weaker vapour should be presented to the patient, as it is important not to irritate the pharynx and lungs. It is better that the patient should breathe freely a weak vapour of ether than have a strong irritating vapour forced on him. The onset of anæsthesia is

indicated by the signs already mentioned ; of these an important one is the absence of swallowing or irritation when the index of the inhaler is turned to 'three' or 'full.' When once 'under' a very little ether is needed to maintain narcosis. Should there be indications of excessive secretion of mucus, chloroform or A.C.E. may be cautiously substituted for the ether ; care must, however, be taken that in the deeper respirations and quicker pulse induced by the ether an overdose is not inhaled. Failing nitrous oxide, a little chloroform or A.C.E. may be first given.

Chloroform is most conveniently given on lint. First put a little vaseline on the face to prevent blistering ; place the fold of lint over the nose and mouth, and then gradually drop the chloroform on it. When the patient objects, coax him to 'blow it away.'

It is a good plan, standing on the patient's right, to hold the lint on the nose with the left thumb and forefinger, pressing on the nasal bones, while the third and fourth fingers spread over the forehead, feel the pulse of the anterior temporal artery, and steady the head ; the right hand is then free to drop on the chloroform and control any movements. In dropping the chloroform hold the bottle near the lint ; if it is dropped from a height, it is extremely easy for some to get into the eye.

Hold the child as little as possible. If it seizes the lint, quickly replace it with a fresh piece rather than waste time struggling for the first ; never try with chloroform to 'send it over quickly.' Each inspiration means one dose of the drug, which takes effect some seconds after its inhalation ; therefore remove the lint at the first sign of anæsthesia, or the patient will inhale several unnecessary doses. The quickness with which children become unconscious has been referred to. It occasionally happens, especially when there is some obstruction to respiration, that after a certain degree of unconsciousness is reached the patient breathes so quietly that it is difficult to induce complete narcosis, and nausea with feeble circulation is produced. This may be overcome by stimulating the respirations by rubbing the chest, pinching the jaw, or, better still, by giving a little ether.

As the pain during an operation varies with the tissues cut, it is not necessary to keep the patient deeply narcotised throughout the operation, and though the patient may wince with the skin incision, the remaining steps of the operation may cause no signs of sensation.

Should there be coughing, in the deep inspiration following the cough do not let the patient inhale too much chloroform vapour, and be careful not to mistake the general jerking of the limbs caused by the coughing for voluntary movements requiring more chloroform. It is occasionally difficult to abolish reflex movements entirely during an operation on the skin, and the anæsthetist must therefore not respond too readily to the 'More chloroform, please,' of the operator.

Spasm of the glottis with crowing inspiration is very common, especially if the patient is not quite 'under' or is beginning to have nausea ; it is generally a sign of imperfect anæsthesia, and when accompanied by such signs as rigidity of the jaw muscles, contracted or slightly dilated pupils, and a good pulse, is an indication for more of the anæsthetic ; the spasm is partly relieved by pushing forwards the jaw with the neck hyper-extended. As previously remarked, pulling out the tongue with forceps does not remove

the spasm. Such treatment is rarely required, and should be avoided as much as possible, as being liable to cause unnecessary after-pain in the shape of a sore tongue. If it is considered advisable to keep the tongue drawn out, it should be gently held out with a pair of tongue forceps, or, better still, by the fingers and a piece of lint. The lower jaw can be conveniently held forwards by using the closed forceps as a lever, the upper teeth acting as the fulcrum, care being taken not to loosen them.

During the administration the same rules should be observed with children as with adults.

When once the child is 'under' it is very important to avoid moving it suddenly or roughly; such treatment tends to cause syncope. This caution is especially necessary if there has been any loss of blood or if there is faintness. Under these circumstances never allow a patient to be raised up into a sitting or semi-sitting position for the application of dressings. This can easily be avoided by drawing the patient to the end of the table and supporting the body so that the head and shoulders project beyond the table; full access can thus be gained to any part without in the least raising the trunk. We have seen a serious attack of faintness brought on by the sudden raising of the head and shoulders of a child at the end of an operation in which a considerable amount of blood had been lost.

In connection with this it is important to remember that feeble respirations are not always associated with shock. One of the most serious symptoms of cardiac and general failure is deep gasping respiration accompanied with a quick running pulse. If, in a patient undergoing a severe operation, ordinary quiet respiration suddenly gives place to deep inspirations, especially if they are of a gasping character, associated with a quick pulse and dilated pupil, it is a sign of the onset of serious if not fatal syncope. This is not as common in children as in adults, but it occurs in them under similar conditions. It is due to sudden anæmia of the respiratory centre, whether caused by actual loss of blood or cardiac failure.

Vomiting, if the stomach is empty, can be overcome by giving more chloroform; otherwise it is better to suspend the administration until the stomach has been emptied, and then to resume it; turn the patient well on one side during vomiting, and keep the mouth and pharynx clear. A patient with a loaded stomach will breathe badly, have stertor, and present a more or less cyanotic appearance. Frequently the vomiting will be preceded for some time by a condition in which the patient presents a feeble pulse, irregular, stertorous, or spasmodic respirations, and more or less cyanosis, which is improved when once actual vomiting begins.

Anæsthetics in Special Operations. — There are practically no conditions under which an anæsthetic is contra-indicated; if an operation can be performed, an anæsthetic can be given. A few operations, however, require special notice.

In *Tracheotomy* an anæsthetic, though not absolutely necessary, is a distinct advantage, especially where it is desired to clear membrane from the trachea. The danger that it might set up a fatal spasm can be avoided by giving it gradually in a diluted state and by delaying the administration until the operator is quite ready. If there is much difficulty in breathing, great relief is given by the exhibition of oxygen. For this a special apparatus,

though an advantage, is not a necessity, as a current of the gas can be arranged to play under the chloroform lint. As preparation for any emergency, it is well to arrange the patient on a definite plan—e.g. on the back, with the shoulders and back of the neck supported by one firm pillow and a second smaller one under the occiput. In the event of a sudden spasm and cessation of respiration demanding immediate operation, by pulling away the second pillow the head at once drops backward, making prominent the trachea without any lifting of the patient. This plan, though most useful in dealing with heavy adults, is equally valuable in children.

Operations on the Mouth.—In all operations on the mouth or pharynx it adds materially to the patient's safety, and to the chloroformist's comfort, to have the patient's head hanging downwards; either hanging over the end of the table, or with the neck so extended over pillows that the vertex of the head rests on the table. The head must lie supported, or the weight of it hanging on the thorax tends to fix the chest. This position keeps the larynx quite free from blood, which, while it is fluid, will escape through the nostrils or mouth, or collect in the palate. A damp towel or bathing cap should be fixed around the head to keep the hair from being soiled. If the patient be properly arranged in this position, the risk of blood entering the larynx, even when the hæmorrhage is excessive, is very slight, providing the patient is well 'under.' In all cases of bleeding from the mouth it is, we are convinced, safer to have the patient quite insensible and to keep the blood from the larynx by arranging the patient in a proper position, and by the use of sponges, than to trust to a semi-conscious patient coughing up the blood. In the latter case there is an equal risk that the blood may be sucked into the larynx, and with a struggling partially insensible patient it is more difficult to control any bleeding.

As regards the selection of the anæsthetic, the fact that the operation is one involving the mouth or throat does not in itself confine the anæsthetic to chloroform. Mr. Warrington Haward has shown that ether may be used in the operation for cleft palate, and ether is constantly given in operations for post-nasal adenoid growths.

In cleft palate, chloroform is the most convenient anæsthetic; it should be given on lint until the patient is 'under,' and the administration continued by Junker's inhaler, by which means the operator can work continuously without being interrupted by the chloroformist. If respirations are feeble it is a good plan to apply the ether mask until moderately deep narcosis results, when it can be kept up with the Junker.

Post-nasal adenoids and enlarged tonsils, by interfering with the free entrance of air, and consequently of the anæsthetic, are apt to delay the induction of anæsthesia unless means are taken to keep open the mouth. The best position for these cases is the dorsal position, with the head hanging over the end of the table. The selection of the anæsthetic depends largely upon the length of anæsthesia required by the surgeon. Some operators, who prefer to work extremely quickly, are satisfied with the 40 seconds or so obtained by nitrous oxide and oxygen. A longer period of anæsthesia can be gained by ethyl chloride (some 60 to 90 seconds), which has come largely into use for these cases. It possesses the advantages of being very speedy in its action, and leaves few, if any, unpleasant after-effects, but to what

extent it is safer than chloroform is still uncertain. With ethyl chloride, and to a greater extent with nitrous oxide, the period of anæsthesia is so short that there is always a risk that the patient may begin to struggle or cry out before the operation is completed, and so spoil the 'finish' of the proceedings. Besides, so short an anæsthesia allows the surgeon no time in which to make a careful examination of the effect of his manipulations. Certainly from the anæsthetist's point of view, especially in nervous subjects, it is more satisfactory to induce an anæsthesia which can be kept up until the operation is deliberately completed.

For this purpose chloroform or A.C.E. may be used with or without a little ether as a respiratory stimulant, or nitrous oxide and ether for older children.

In *empyema* cases chloroform is best. Care must be taken not to produce coughing by giving it too strongly at first, and the child must not be turned to the sound side, but may be sat up or turned on the diseased side, as recommended by Mr. Godlee.

For the operation of *laminectomy*, chloroform should be given. The best plan, especially if there is paralysis of the intercostals, is to turn the patient right on to the face and support the body on pillows in the following way: the anterior iliac spines rest on a firm sand pillow, an ordinary thin pillow supports the chest, and the forehead rests on a second smaller firm sand pillow. By this means the operator gets free access to the spine, the abdomen is not pressed upon, the abdominal viscera fall forwards (i.e. downwards), and the diaphragm has full play, while the mouth and nose are supported some distance from the table, and the chloroform lint can be slipped under the nose as required; any secretion flows easily out of the mouth. If care be taken that the chest is not pressed upon, the patient will breathe quite comfortably in this position.

Operations on the Bladder.—In these cases it is important to have the patient 'under' before injecting the bladder. If this is neglected the manipulations will most likely set up spasm of the glottis and straining, which will impede the inhalation of the anæsthetic and delay the production of anæsthesia.

Delayed Chloroform Poisoning.—Since 1850 certain continental observers have held that the inhalation of chloroform produced fatty degenerative changes in the liver, kidneys, and heart. In consequence of the lesions thus produced, death might result even many days after the inhalation. Further, that many cases, especially in young children, of death after operations attributed to shock are really due to this delayed action of the chloroform. These views obtained little attention in this country until Dr. G. L. Guthrie[1] in 1894, and again in 1903, published a series of cases of this nature, and the question has recently been exhaustively treated by Messrs. Harold J. Stiles and Stuart McDonald.[2]

We are unable to recall clearly any case which would come under this category.[3]

[1] *Lancet*, 1894 and 1903.

[2] *Reports of Society for Study of Disease in Children*, 1904.

[3] A typical case of delayed chloroform poisoning has recently occurred at the Manchester Children's Hospital; the liver was infiltrated with fatty globules.

The symptoms described come on either immediately after the operation on the return of consciousness, or after an interval of some hours of apparent well-being, and appear to bear no relation to the length of anæsthesia, severity of the operation, or degree of immediate shock. The nervous system is chiefly affected ; the condition is stated to resemble acute delirious mania, there is always extreme restlessness and sleeplessness, sometimes screaming and delirium. Vomiting, of a copious and persistent type, is invariably present, and resembles the vomiting which accompanies cerebral disease. The temperature, usually subnormal immediately after the operation, rises above normal, reaching in some cases as high as 103° and 104°. Death results from gradual exhaustion, slight jaundice is sometimes present, and occasionally albuminuria. In all the cases there were found marked changes in the liver, which are described as 'intense fatty infiltration apparently unaccompanied by fatty degeneration.'

As similar symptoms and *post-mortem* changes may be produced by acute sepsis, it is difficult to estimate the part played by chloroform in the production of this condition. Dr. Guthrie, who most carefully excludes all other possible causes of death, comes to the conclusion that in such cases the deaths are due to an auto-intoxication, produced by the effect of the chloroform and shock of the operation on an existing fatty liver ; the result being that the functions of the liver are so far interfered with that the system becomes loaded with toxic alkaloids.

Accidents are of a similar nature to those which occur in adults, and should be treated on similar principles. As examples of the various kinds of accidents may be quoted cases in which an attempt is made to anæsthetise speedily a crying child, with the result that it is allowed to take several deep inspirations of a highly concentrated chloroform vapour, and so obtains a sudden overdose ; in other cases during deep anæsthesia the dangerous symptoms may be initiated by some sudden movement of the child. We have seen two cases of this class when the patient was deeply narcotised for the operation of cleft palate ; the sudden raising of the child produced symptoms of syncope. In unprepared patients the embarrassment of respiration caused by a loaded stomach and the onset of vomiting gives much trouble. The patient breathes with difficulty, has spasm of the glottis, becomes pale and slightly cyanosed, has a feeble pulse, &c. ; most of these symptoms are relieved by vomiting.

The serious accidents happen almost invariably under chloroform, and are due to a primary failure of the circulation. This may be due to a paralytic dilatation of the heart, or to vaso-motor paralysis. In young subjects the latter occurrence is probably the more common.

Judging from the reports of fatal cases, one point seems to be constantly overlooked. It is, that serious failure of the circulation under chloroform, as in other conditions, is indicated by increased respiratory movements. With these are associated other signs of failing circulation, pallor, imperceptible pulse, dilated pupils, and occasionally muscular twitchings, or even convulsions. The exaggerated respirations are produced by the anæmia of the respiratory centre, and, when present with other symptoms, indicate a grave state of the circulation and approaching dissolution.

This condition may set in at any stage of the anæsthesia, but it happens

most frequently very early in the administration. The generally accepted belief that only cessation or paralysis of the respiration is to be feared under chloroform, has led to the significance of these symptoms being overlooked, and to the loss of many cases.

Too often it is the sudden cessation of these free respirations which draws attention to the fact that something is wrong. It is then found that the patient is pale, with dilated pupils, and pulseless, at which late stage treatment is generally futile. During narcosis, as during consciousness, the respirations afford most valuable information as to the condition of the heart and circulation. During the administration of anæsthetics, especially chloroform, every alteration in the rhythm of the respirations, particularly in the direction of increased respiratory movements, should be checked by observation of the circulation.

Under an anæsthetic the respirations become accelerated from many causes, but there is no mistaking the free, somewhat gasping inspirations, accompanied with pallor and dilated pupils, due to failure of the circulation.

The treatment of this emergency must be immediate. The indications are to encourage the flow of blood to the head and to stimulate the heart and keep up the blood pressure. This is best achieved by lowering the patient's head and the vigorous performance of artificial respiration in such a fashion as to compress the heart. The object of artificial respiration being to stimulate the circulation and keep up the blood pressure, it should be employed at once, even if respiratory movements are still present. The head should not be held in the dependent position too long, but the patient should constantly be momentarily raised into the sitting position and lowered again. By this means the blood is kept from stagnating in the head, and a certain degree of artificial circulation may be maintained. If, from the congested cyanosed condition of the face and engorged condition of the veins of the neck, there is reason to suppose that the heart is in a state of paralytic dilatation, the patient should be early raised into a sitting posture (artificial respiration being continued), so as to relieve the heart of the pressure of the blood in the abdominal vessels and enable it to recover itself.

The success of the treatment in such chloroform accidents depends largely upon the promptness with which it is applied. Begun early during the stage of exaggerated respirations it will almost certainly be successful.

A number of drugs have been suggested as cardiac or circulatory stimulants under such circumstances—e.g. liq. ammon. fort. and acid. hydrocyan. by inhalation ; and ext. suprarenal capsules and nicotine by hypodermic injection. All these labour under the disadvantage that to be effectual a certain considerable degree of circulation must be present for their absorption and conveyance to the heart, &c., and this is as a rule absent. Of all, ammonia, from the method of applying it by inhalation and its powerful effect as a cardiac stimulant, would seem most likely to be useful. The injection of adrenalin has also proved useful.

The main reliance, however, must be placed upon efficient artificial respiration. The battery is useful only as a means of producing artificial respiration by stimulation of the phrenic nerves, and then it must be combined with compression of the chest.

APPENDIX

MODIFIED MILK; MILK LABORATORY

THE WALKER-GORDON LABORATORY,

79 DUKE STREET, GROSVENOR SQUARE, W.

Prescription Form

Per Cent.		REMARKS
Fat		Number of feedings .....
Milk-Sugar . . .		Amount at each feeding .....
Proteids . . .		Infant's age .....
Mineral Matter . .		Infant's weight .....
Total Solids . . .		Alkalinity ..... %
Water		Heat at ..... ° F.
	100 00	

Ordered for .....

.....

Date,	Signature,
..... 190	.....

If the physician does not care to mention the especial percentages, he can ask for percentages which will correspond to the analysis of human milk, and he can then vary any or all of these percentages later, according to the need of the especial infant prescribed for.

REFERENCE has been made (p. 50) to the milk laboratories established in Boston and other cities of the United States (also in London—the Walker-Gordon Laboratory, Duke Street, Grosvenor Square, W.) for preparing and modifying cow's milk in order to suit the varying needs of infants and children, both in health and disease. The physician writes a prescription stating the amount of fat, milk-sugar, caseinogen, whey-proteids required in the infant's food, and also the amount at each feeding; the prescription is dispensed at the laboratory, and delivered at the house daily according to the directions given. One of the most important points in connection with these establishments is that they have control of the milk from the first; they keep their own cows, not purchasing any milk. Their cows are selected, fed, and cared for solely with reference to the employment of their milk for infant feeding, and the health of the animal is most carefully looked after. The milk is cooled at once to 40° F., and kept at this temperature till used. The food is sent out in separate feeding bottles, ready sterilised or pasteurised, and all the nurse requires to do is to warm the food and fit the india-rubber teat to the bottle when the infant is to be fed.

A specimen of a prescription form is given on p. 875.

'FETTMILCH'

Gaertner has utilised the cream separator to obtain 'humanised' milk on a larger scale than is possible in the household. His method is the following: 50 litres of good cow's milk are mixed with 50 litres of water, warmed to a temperature of 90° or 100° F., and placed in the cistern of the apparatus. The separator is set to work and made to revolve at such a rate that the two outgoing streams are equal in amount—that is, 50 litres are delivered from the tube which is connected with the centre of the revolving funnel, and 50 litres are delivered by the tube connected with the eccentric part of the funnel. The former ('Fettmilch') contains nearly all the fat of the milk, half the proteids, sugar, and salts; the other, the 'separated' or 'Magermilch,' contains a trace of fat, and half the proteids, sugar, and salts, as well as any dirt or grit or other heavy particles present in the milk.

The composition of 'Fettmilch' compares thus:

—	Proteids	Fat	Lactose
Cow's milk, diluted with half water .	1·76	1·81	2·4
'Fettmilch'	1·76	3·00	2·4
Woman's milk	1·94	3·10	6·3

It will be seen from these analyses that it will only be necessary to add 4 per cent. of milk-sugar to the 'Fettmilch' in order to make it very closely correspond with the percentage composition of woman's milk. This will be equivalent in round numbers to adding 350 grains of milk-sugar to every pint of 'Fettmilch.'

The separator fulfils the useful office of removing the sand, grit, dried fæces, &c., present in the milk.

BACKHAUS'S MILK

The method of preparing 'humanised' milk as suggested by Professor Backhaus is carried out commercially by Herr Gottschalk at Frankfort-am-Main. Cow's milk is first passed through a centrifuge; the separated milk is heated to 40° C., and

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20 grammes of a powder consisting of pepsin and trypsin added to every 100 litres of separated milk. About 50 per cent. of the proteid is precipitated, and the remaining 50 per cent. is peptonised or pre-digested during the twenty or twenty-five minutes the process is carried on. The mixture is heated to 80° C. to destroy the ferments, and filtered; cream is then added to the filtrate in sufficient quantity to represent 3·5 per cent. of fat. Milk-sugar is also added to the milk food thus obtained; it is then bottled, and sterilised.

MILK STERILISERS. (See p. 53.)

Hawksley's milk steriliser (fig. 238) consists of a milk bottle which is placed in a strong tin containing water and provided with a lid and a thermometer. The

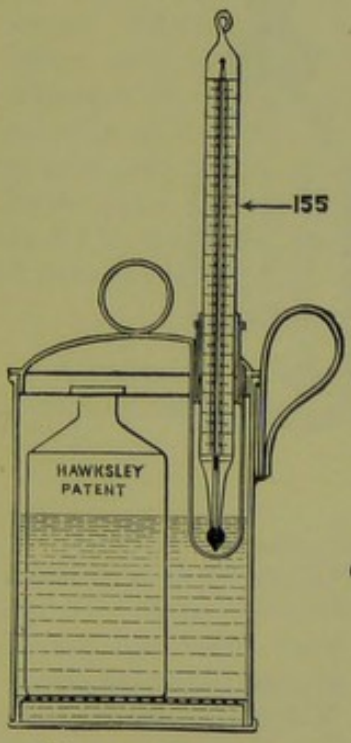

Fig. 238.—Hawksley's steriliser.

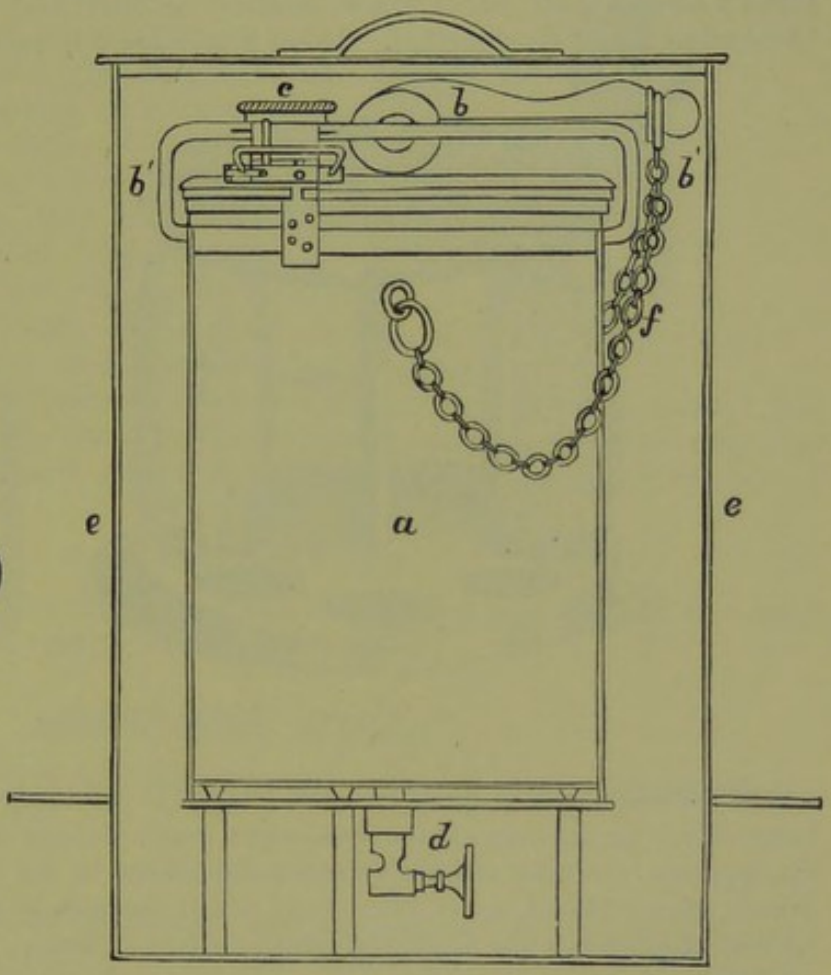

Fig. 239.—Escherich's steriliser.

apparatus is placed on a fire or stove, and the water in the tin maintained at a temperature of 155° or 160° F. for half an hour. The milk bottle, covered with a cap or plugged with sterilised cotton wool, is kept in ice or a cool place till required. (See fig. 11, p. 51.[1]) A siphon for drawing off the lower half of the milk after standing is supplied with the apparatus.

Soxhlet has devised an apparatus for household use by means of which 'sterilising' can be carried out efficiently; or, in other words, milk in bottles is exposed to a temperature of 212° F. for an hour or more. This process has the great advantage

[1] Can be obtained of Hawksley, 357 Oxford Street, London, W.

of effectually destroying all organic matters; and the continued heating of the casein appears to render it less readily precipitated. The 'steriliser' consists of a sheet-tin vessel resembling a potato-steamer, into which eight or ten bottles containing the infant's food, and provided with a stopper or flat india-rubber disc, are fitted; water is placed in the apparatus so as to surround the bottles, and the whole placed on a stove and kept boiling for three-quarters of an hour. At the end of this time it is allowed to cool, and the bottles are kept in a cool place till required for use. When the infant is to be fed, one of the bottles is taken, the stopper removed and replaced by a teat, and the infant fed from the bottle after warming. In this way all organic matter is destroyed, and at the same time the curd is less readily precipitated. The most recent form of the apparatus may be obtained of Maw, Son & Sons, Aldersgate Street, E.C.

Escherich's milk steriliser (fig. 239) consists of two tin cylindrical vessels: an outer one (*e*) which is placed on the fire and contains the water surrounding the inner vessel; and an inner tin (*a*) which contains the milk food in sufficient quantity for twenty-four hours' consumption. It has a movable lid, which is kept in position by

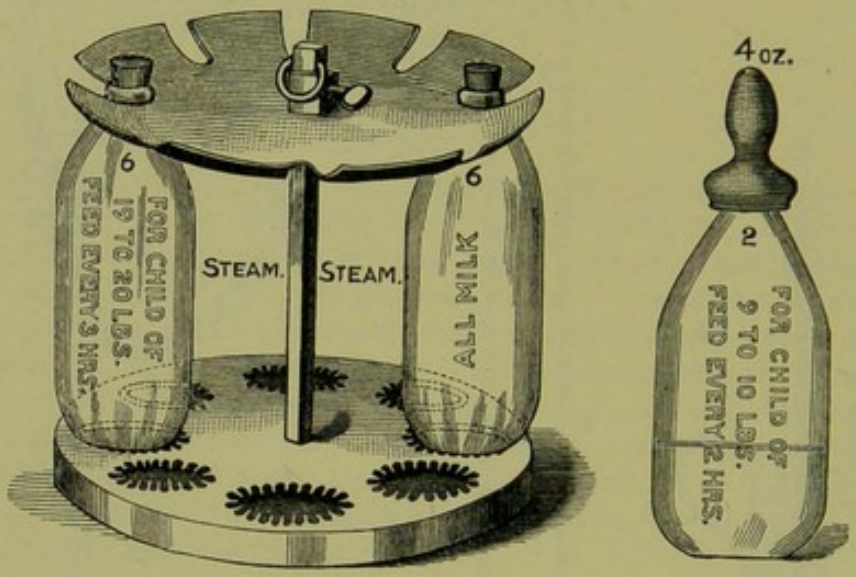

Fig. 240.—Siebert's steriliser.

a lever (*b*) and a curved piece of metal (*b'*); it is provided with an air filter (*c*) and a stopcock (*d*) for drawing off the milk when removed from the outer vessel. To use the apparatus the milk and barley water are placed in the inner vessel, and the lid closed; this is placed in the outer vessel which contains water, and the whole placed on the fire or over a gas flame and boiled for half an hour. The inner vessel is then removed and hung up in a cool place; the food is drawn off as required by means of the stopcock in the bottom of the apparatus, the stopcock in connection with the air filter being turned on at the same time. In connection with this apparatus Escherich uses feeding bottles on the outer surface of which are engraved the amounts of food required at the various ages, and the amount of water to be added to the milk.

Siebert, of New York, has devised a simple milk steriliser, with bottles of various sizes to suit the different ages of the infant. It consists (fig. 240) of a metal support for six or eight bottles, the whole being placed in a steamer from thirty to forty-five minutes.

Freeman, of New York, has devised an ingenious milk 'pasteuriser,' which is much used in the United States.

ESTIMATION OF FAT IN MILK

Dr. Gerber's acid butyrometer is a simple and convenient apparatus for estimating the amount of fat in milk or milk mixtures. The process consists in well mixing 10 c.c. of sulphuric acid, 1 c.c. of amyl alcohol, and 11 c.c. of milk in a special tube with a graduated neck and then 'centrifuging.' The fat which separates from the mixture is measured in the graduated neck. The centrifuge is set in motion by a piece of catgut, wound round the axle, and then quickly pulled off like spinning a top.[1]

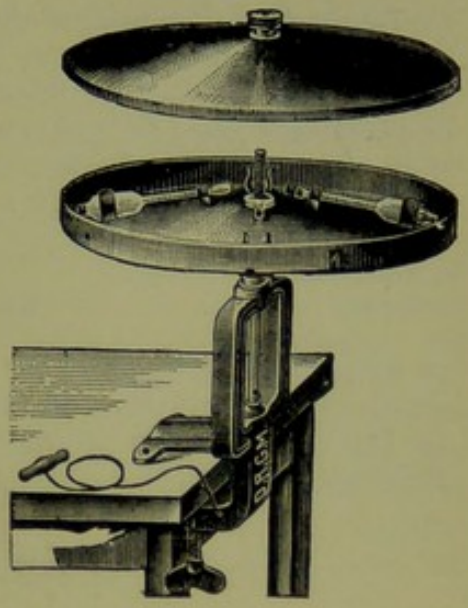

Fig. 241.—Gerber's acid butyrometer.

BARLEY WATER

Place a teaspoonful of best pearl barley in an enamelled saucepan, add a pint of water, and boil for a few minutes, stirring all the time so as thoroughly to cleanse the grain. Pour the water off the barley, replace by a pint and a half of clean water, and simmer *gently* for an hour, and strain. Another and better method is to use barley meal prepared from the whole grain, inasmuch as the greater part of the gluten is found in the cells lining the husk (Jacobi). The grain should be well washed and ground in a coffee-mill kept for the purpose. The barley water used during the early months of infancy should be a thin mucilaginous fluid; in the latter months it should be thicker, or barley jelly may be used to thicken the milk.

OATMEAL WATER

A tablespoonful of coarsely ground oatmeal should be placed in a pint of water; simmer gently for an hour, replace the water evaporated.

ARROWROOT WATER

Take two teaspoonfuls of best arrowroot and a pint of water; simmer for five minutes, stirring constantly.

WHEY

Warm a pint of milk to blood-heat; add a teaspoonful of 'artificial rennet' (Benger's is an active preparation); in a few minutes the curd will have separated from the whey; break up the curd with a fork and strain through a colander or fine linen cloth. Decant and boil the whey; a second straining is often necessary after boiling. Whey thus prepared may be given to a newly-born infant, cream or milk being added according to its powers of digestion. Whey with some added brandy is useful as a substitute for 'white wine whey,' and generally agrees better.

VEAL TEA

Take one pound of veal free from fat and bone, cut into small pieces the size of dice, place in a covered jar with a pint and a half of cold water or barley water; place

[1] Dairy Supply Company, London.

in an oven not too hot, and bake for three or four hours—or it may be left in the oven all night; strain and remove fat; replace the evaporated water.

SCRAPED MEAT

Take a thick rumpsteak of the best quality; scrape it with a knife until reduced to shreds. A sandwich can be made by placing a small portion between very thin slices of bread and butter. Some children will take the meat pulp out of a teaspoon or mixed with gravy or beef tea. Scraped meat can also be prepared from rumpsteak which has been frizzled for a few moments on a quick fire, the burnt outside being cut off before the meat is scraped.

RAW MEAT JUICE

Finely mince a pound of the best rumpsteak freed from fat. Place in an earthen vessel with sufficient cold water to well cover it, add some lump sugar, and let it stand for four hours. Strain through muslin. It can be given with brandy or port wine if thought desirable.

LINSEED MEAL POULTICES

Warm a basin, pour in *boiling* water; sprinkle in the meal, stirring vigorously, till it becomes of the consistency of thick porridge; spread on tow or old linen, turning in the edges all round; before applying put it against one's cheek to feel that it is not too hot. Retain in position with a broad flannel roller, secured with safety-pins. Renew every four hours or oftener. The poultice should not exceed half an inch in thickness. Caution is necessary in poulticing the chests of *infants*, in order not to overload the chest and tire out the respiratory muscles.

MUSTARD POULTICES

These may be made in a similar way to the above, the mustard being mixed with warm water, and stirred well into the linseed poultice. One part of mustard to three or four of linseed meal may be used for infants and young children, kept on for four hours, and repeated according to the amount of redness produced.

BRAN POULTICES

Bran poultices are preferable to linseed poultices when the weight of the latter is an objection, as in colic. A flannel bag is filled with bran; boiling water is then poured over it till it is thoroughly saturated; it is then wrung dry in a towel, placed against one's cheek to test the temperature, and applied.

HOT FOMENTATIONS

Flannel or spongio-piline may be used, being wrung out of boiling water in a towel, sprinkled with laudanum or turpentine according to the effect desired, and applied. The fomentations should be retained in position by means of a flannel bandage.

ANTIPYRETIC METHODS

Sponging.—The readiest means of reducing temperature when the fever is moderate in degree is by sponging. The child should be stripped and lie upon a blanket or sheet with a waterproof beneath ; a large sponge should be used, and the face, trunk, and extremities sponged for five or ten minutes. The water used should be cold, but with nervous patients it is well to *begin* with tepid water. If the child is feeble, it may have a hot bottle to its feet during the sponging. Cold sponging is a useful and safe means of reducing temperature in all febrile conditions, but its action is only temporary.

Packs.—The efficacy of a continuous pack in reducing temperature depends upon its action on the skin in producing sweating, the cooling effect of the application of the wetted sheet being temporary only, unless the pack be frequently reapplied. Packs are most useful in conjunction with certain drugs, as aconite and quinine. To give a cold pack, a sheet should be wrung out of cold water and applied to the patient from the neck to the feet ; a blanket is then wrapped round the sheet. It should be reapplied in a quarter of an hour if the temperature appears high, but frequently the patient goes to sleep in the pack, and it may be wise to leave him undisturbed, for an hour at least. Cold packs are often of great service in scarlet fever, measles, and other febrile conditions. In pneumonia packs are often useful, the wet sheet being applied only round the chest.

Baths.—The cold or graduated bath is the most rapid means of reducing a high temperature, and has the advantage of being readily applied. The child may be placed in a bath of 100° F. and the temperature of the bath reduced by the gradual addition of cold water. The cold water may be poured over the patient's head if the temperature is high. Cold baths may be used in enteric, pneumonia, measles, indeed in a high temperature from any cause excepting scarlet fever or diphtheria. In severe attacks of these diseases the cold bath is apt to depress too much, the patient becoming cold and collapsed.

Enema.—Enemata of cold water have been successfully used in reducing temperature, but can only be of limited application.

Icebags.—Ice applied to the head or chest in a rubber bag, or flannels wrung out of ice and water, form effectual means of reducing temperature.

Aconite, given in the form of tincture, is useful as an antipyretic in conjunction with packs. It is necessarily of limited application on account of the depression it produces if pushed. Half to two minims may be given every hour in pneumonia, the effect being carefully watched.

Quinine.—Quinine may be given to reduce temperature in doses of two to ten grains of the sulphate in syrup of orange-peel, milk, or cocoa ; it is useful for this purpose in conjunction with packs in malaria, scarlet fever, pneumonia, and measles. If given by the rectum, the neutral bisulphate should be used, or the sulphate should be dissolved with the least possible excess of acid. It is well to bear in mind that it is useless to expect absorption from a rectum loaded with fæces, and a drachm of glycerine must be administered in order to relieve the bowels before injecting the quinine. The quantity given by rectum must be double that given by mouth.

The subcutaneous injection of quinine is not often resorted to in infants, inasmuch as a neutral solution is not often at hand when wanted. In a high temperature due to malaria it would be of service.

Phenacetin.—This drug is much used for reducing fever at the present time. One grain may be given to an infant 6 months to 1 year old, two to five grains for children from 2 to 7 years, doses up to ten grains for older children. It may be

repeated every two or four hours. It is best given suspended with pulv. tragacanth. co., as it is very insoluble.

Phenazone (antipyrin) may be given in similar doses; as it is soluble in water, it may be prescribed in tabloids or powders.

HOT PACKS

Hot packing is most useful in nephritis, especially when the kidneys are choked. A blanket is wrung out of hot water as dry as possible and quickly applied, care being taken that it is not too hot; it may be renewed in half an hour.

HOT AIR OR VAPOUR BATHS

These are useful under similar circumstances to the hot pack; they are applied by means of a special apparatus, Allen's being the best. A hot vapour bath can be improvised for a child with a 'bronchitis kettle,' or even an ordinary kettle, and spirit or paraffin lamp, a chair being used as a 'cradle.' There is, however, some risk of accident.

MUSTARD BATH

An ounce of mustard to a gallon of water (100° F.) is the right proportion. The mustard should be made into a paste in a basin, and gradually stirred into the water of the bath. Useful in diarrhœa, pneumonia, or collapse from any cause; more especially in infants and young children.

NARCOTICS AND SEDATIVES

Opiates.—Infants are sensitive to the action of opium, and this drug requires to be administered with great caution and its effect carefully watched. At the same time there cannot be a doubt as to its value in many instances, particularly in relieving pain and quieting the overaction of the bowels. In prescribing it to infants, not only the question of age, but also the size of the child, the complaint from which it is suffering, and the degree of exhaustion present, must be borne in mind. It is obvious that the dose of opium suitable for a strong, well-nourished infant of 6 months of age, suffering from colic, might be unsafe if given to an infant of 18 months in the last stages of gastro-intestinal atrophy. Infants in the last stages of diarrhœa, atrophy, and pneumonia are exceedingly sensitive to opium, and caution should be observed in giving it to them. Moreover, such infants pass sometimes into a comatose state before death, not unlike the condition produced by opium poisoning, and under these circumstances the immediate cause of death might be attributed to opium. As a general rule, and presuming the infant is a well-nourished one, $\frac{1}{2}$ grain of Dover's powder or $\frac{1}{2}$ minim ($\frac{1}{220}$ grain) of liq. morphinæ hydrochlor. may be given to an infant of 6 months, and repeated in four hours if necessary. Larger doses may be given with safety if the infant can be watched, and indeed, if the infant is suffering from acute colic or intussusception, twice or even four times the dose named may be given. In one case coming under our observation $\frac{1}{32}$ grain of acetate of morphia was given to a strong infant of 4 months of age suffering from acute abdominal pain; the infant became drowsy, the pupils were semi-contracted, it remained in a semi-comatose state with sighing respiration for two or three hours, when it woke up perfectly well. It was evident, however, that the limit of safety had been passed. Three grains of pulv. kino co. were given to an infant of 6 months, who was much wasted and

suffering from diarrhœa, at intervals of four hours, three doses being given in all. The second dose made it drowsy; it died a few hours after the third dose with all the symptoms of opium poisoning. It had taken in all nearly $\frac{1}{2}$ grain of opium. One grain of Dover's powder or a minim (= $\frac{1}{110}$ grain) of liq. morphinæ hydrochlor. is an average dose for an infant a year old, and may be repeated in two or four hours if necessary. 2 or 3 grains of Dover's powder or 2 or 3 minims of liq. morphinæ hydrochlor. may be given to children between 2 and 4 years of age. Children over 6 years of age are much less sensitive to opium than younger children, and $\frac{1}{4}$–$\frac{1}{2}$ grain of opium may be given if necessary to relieve pain in peritonitis or other diseases. It must be borne in mind that idiosyncrasies may be met with, and infants may be found exceedingly sensitive to opium, or, on the other hand, very tolerant.

Subcutaneous injections of morphia should be given with great care to infants under a year, and are not often required for young children; $\frac{1}{50}$–$\frac{1}{100}$ grain would be the dose for an infant of a year. These injections have been given with some success in infantile convulsions.

Codeine is of some value in relieving pain in children, especially in connection with the alimentary system. It may be given in syrup of orange or Virginian prune, in doses of $\frac{1}{12}$–$\frac{1}{6}$ grain to infants and young children, and $\frac{1}{6}$–$\frac{1}{4}$ grain to older children. It is useful in colic, diarrhœa with tenesmus, and irritative cough—in the latter perhaps not so good as morphia.

Chloral hydrate.—Chloral is soluble in water, and may be given in doses of 2 or $2\frac{1}{2}$ grains to the drachm of cinnamon water, sweetened with syrup of orange. Infants and children tolerate chloral well; its principal use, combined with bromide, is in convulsions and to procure sleep. It is useful in relieving the pain of colic. $2\frac{1}{2}$–5 grains may be given to infants from 6 months to 2 years old. 5–10 grains may be given to older children. Very much larger doses have been given to procure anæsthesia (Bouchut).

Bromide of potassium.—An average dose for a child 1 year old is 2–$2\frac{1}{2}$ grains to the drachm of water sweetened with syrup of orange or lemon, and spirit of chloroform. The liquid extract of liquorice hides the taste fairly well. 3–5 grains may be given to children from a few weeks to 2 years of age, and repeated every two hours if necessary. 20–60 grains a day may be given to older children who are suffering from cerebral excitement or fits. There is little risk in an overdose; children well under the influence of bromides are lethargic, speak with a slow drawling tone, and suffer from acne (see p. 836).

Antipyrin acts as a sedative in small doses in infants and young children. $\frac{1}{2}$–1 grain may be given to infants suffering from colic or painful dentition.

Belladonna and **atropine** are much used in whooping cough, incontinence of urine, and as external applications. Children are tolerant of these drugs, and larger proportional doses than those given to adults may be prescribed if they are carefully watched. Children of 1 to 2 years of age may be given 2-4 minims of the tincture ('B. P.,' 1899) or succus every four hours; older children 5–15 minims or more; though it is wiser to begin with minimum doses and gradually increase the dose. Atropine is more dangerous, and is best avoided in young children. Children 5 years old and upwards may be given minim doses ($\frac{1}{110}$ grain) of the liquor, cautiously increased. Temporary excitement and dilated pupils are the result of an overdose.

Cannabis indica.—Children bear this drug well; it is usefully added to bromide of potassium in $2\frac{1}{2}$-minim to 10-minim doses of the tincture in whooping cough.

Hyoscyamus.—Tincture or succus of hyoscyamus is used as an anodyne in place of opium. Its nauseous taste is one objection to it; it may be given in 5-minim doses to an infant a year old, 10–30 minims to older children.

Hyoscyamine sulphate is frequently substituted for the tincture, but, like atropine, it must be used cautiously, or not given at all to infants. $\frac{1}{200}$ gr., cautiously increased to $\frac{1}{100}$ gr., may be given to older children ; larger doses have been given.

Hyoscine may be given with caution in the same doses as the above, but is said to be more active.

Fluid extract of Rhus aromatica has been given successfully by Freyberger in incontinence of urine. 10 minims in syrup or sp. chloroformi and water may be given three times a day and continued for a month.

Bromoform is given in whooping cough, in some cases with success. It is a remedy which requires care, and alarming symptoms have been produced by an overdose. In these cases the drug has been made up with mucilage, and the bottle not well agitated before taking, so that the last few doses have contained an excessive dose of the drug. It is best given in capsules or in drops on sugar, 1–3 minims on sugar every four hours, the patient being carefully watched.

PURGATIVES AND LAXATIVES

Mercury and **chalk** by itself, or in combination with rhubarb and soda, is very frequently given as a laxative for infants a few months old, or when the stools indicate some irritative matters in the bowels. For this purpose $\frac{1}{2}$–2 grs. may be given twice a day for a few days, or for two or three successive nights.

Calomel is preferable for older children on account of the smaller dose required ; it may be given with soda, euonymin, rhubarb, scammony, or jalapin. A grain may be given with white sugar to a child of 1 to 3 years, half a grain to an infant of 6 months, as a purgative. Half the quantity may be given with other drugs, thus—calomel gr. $\frac{1}{2}$, scammony resin gr. $\frac{1}{2}$; calomel gr. $\frac{1}{2}$, pulv. rhei gr. $\frac{1}{2}$, sodii bicarb. gr. $\frac{1}{2}$; calomel gr. $\frac{1}{2}$, euonymin gr. $\frac{1}{2}$. Small pilules made of calomel gr. $\frac{1}{4}$, ex. colocynth. co. gr. $\frac{3}{4}$; calomel gr. $\frac{1}{4}$, ex. rhei gr. $\frac{3}{4}$, answer very well. Some prefer to give small doses of this drug, as gr. $\frac{1}{6}$, repeated every hour till the bowels act.

Rhubarb forms a safe and non-irritative purgative, and is especially useful in combination with soda when a laxative and stomachic is required. It unfortunately has a nauseous taste, best covered by syrup of orange or spirits of nutmeg. Tabloids of rhubarb and soda, or rhubarb and mag. carb., are very convenient.

The syrup is a good preparation, especially in combination with an equal quantity of syrup of senna, of which half to one teaspoonful is a dose. 'Mist. rhei co.' is much used as a laxative, given two or three times a day, especially in infants when the stools are 'putty-like' and sour-smelling ; thus, syrup. rhei ℥xx, sodii bicarb. gr. j, aq. menth. pip. ʒj.

Inf. rhei with sodii bicarb. and sp. ammon. aromat. forms a useful carminative for infants—such as sp. ammon. aromat. ℥iij, sodii bicarb. gr. ij, syrup. zingib. ℥xx, inf. rhei ad ʒj ; sp. ammon. aromat. ℥ijss., syrup. zingib. ℥xx, inf. rhei ℥xv, inf. gent. co. ad ʒj.

Aloes.—Much used for constipation, either in the form of the aqueous extract or aloin in pilules. Small pilules containing $\frac{1}{2}$ grain of aqueous extract of aloes are readily swallowed by children, or they can be divided with a knife and given in jam. Aloin is useful in treating the constipation of infants and young children ; 'anticonstipation' tabloids of Burroughs & Wellcome, containing aloin gr. $\frac{1}{5}$, belladonnæ ext. gr. $\frac{1}{8}$, strychnine gr. $\frac{1}{60}$, ipecac. gr. $\frac{1}{16}$, may be used, half a one being given to infants once or twice a day, mixed with a little white sugar.

Senna.—Mostly given in the form of the compound liquorice powder, syrup, or infusion. The former is much used as a household medicine, half to two teaspoonfuls being given mixed with a little water. The syrup is pleasanter to take, being free

from any grittiness ; a teaspoonful is the usual dose ; it is most effective when given with an equal quantity of syrup of rhubarb. The infusion is given in constipation with some bitter, as strychnine or calumba, such as liq. strychniæ ♏ss, glycerine ♏x, inf. sennæ ♏xx, inf. calumbæ ad ʒj, b. or t. d. s. *Old* preparations of senna are apt to gripe.

Cascara sagrada is of much value in habitual constipation in infants and children. It may be given in syrup or some of the elixirs, chocolate bonbons (Ferris & Co.), or lozenges. Some chemists prepare an extract from which the bitter principle has been removed. This drug is best given in small doses three times a day, rather than in a single full dose.

Podophyllum resin may be given in powder or tabloid form to infants and children suffering from constipation, beginning with $\frac{1}{20}$ gr. to $\frac{1}{10}$ gr. two or three times a day. Liq. podophylli (gr. $\frac{1}{4}$ ad ʒj), made by some chemists, is a useful preparation, and may be prescribed with strychnine, bitters, acids, or alkalies.

Rubinat, Hunyadi János, Carlsbad mineral waters—a tablespoonful or more in warm water or milk, given before breakfast—are very useful purgatives for children over 4 years of age.

SALINES AND ALKALIES

Effervescing **Citrate** of **Potash** and **Lithia, Sulphate** of **Magnesia, Phosphate** of **Soda,** are useful when a hepatic stimulant and laxative is required. They are more appropriate for children over 6 or 7 years of age than for younger children.

Chlorate of **Potash** is a specific for ulcerative stomatitis, and is of but little use for other affections of the mouth, though often given. It is poisonous and requires care in its administration, especially in young children. In a fatal case coming under notice, a child of 14 months had been given by her friends about 5 grains of chlorate of potash, three times a day ; at the end of three weeks, the child when seen had a much enlarged liver and spleen, marked anæmia, the urine was of a brownish colour, the gums very spongy, brownish-coloured blood oozing away. Death followed a day or two after from cardiac syncope.

EMETICS

Pulv. ipecac. is the best and safest emetic for children. It may be kept in the form of powder or the 5-grain tabloids. 5 grains may be given, and repeated every ten minutes till vomiting is produced, to infants and young children. 10 grains may be given in one dose to older children, and repeated in ten minutes or a quarter of an hour. There is great difference in children with regard to the ease with which they are made to vomit. In the later stages of croup or pneumonia, when the face and lips are pale or bluish, it is difficult to excite vomiting ; indeed at this stage emetics are useless.

Apomorphine hydrochloride may be given in doses of $\frac{1}{15}$–$\frac{1}{5}$ gr. as an emetic by the mouth.

Alum.—Half a teaspoonful in honey or syrup is useful in whooping cough.

EXPECTORANTS AND DIAPHORETICS

Ipecacuanha is usually given in the form of vinum ipecac. in doses of ♏ijss–♏v to infants up to a year old, ♏v–♏xv to older children, repeated every two to four hours. It may be given with ♏v–♏x of aq. laurocerasi and ♏x of glycerine to the drachm of water ; or syrup. pruni virgin. may be added. Vin. ipecac. is apt to lose its strength by keeping.

Pulv. ipecac. co. is a useful expectorant (see Opiates).

Antimony.—Mostly given as vinum antimonialis, in the same doses as vin. ipecac.; often prescribed with mist. amygdalæ. Both ipecac. and antimony are better given in small doses, frequently repeated, than in increasing doses. In acute bronchitis or laryngitis it is often useful to push either ipecac. or antimony freely till sickness is produced, then to lessen the dose. Both these drugs are given in the early stage of bronchitis when rhonchi and sibilus are heard.

Apomorphine hydrochloride is a useful expectorant in bronchitis or catarrhal pneumonia in doses for children of $\frac{1}{50}$–$\frac{1}{20}$ gr.; in larger doses it is apt to produce nausea. It may be prescribed with syrup. limonis or pruni virgin.

Emetin.—Dose $\frac{1}{100}$–$\frac{1}{10}$ gr.; not often prescribed.

Liq. ammon. citratis or **liq. ammon. acet.** is often combined with vin. ipecac. or vin. antimon. in doses of ♏xv–♏xx for infants up to a year, ʒss to ʒj for older children, well diluted, with syrup. tolu., aurant., or pruni virgin. to cover the taste.

Sp. ammon. aromat.—Dose ♏ij–♏iij in a drachm of syrup or glycerine and water for infants; ♏iv–♏x, well diluted, for older children.

Ammon. carbonate or **chloride.**—Dose: gr. jss–gr. v, well diluted and disguised as far as possible by syrup. aurant. or tolu.

Squills.—Useful as a stimulating expectorant in bronchitis, when the secretion is free, fluid râles being heard in the chest, and but little being coughed up. *Tincture*: doses ♏ij–♏iij for an infant up to a year old; ♏iij–♏v for older children, repeated every four hours. *Syrup* or *oxymel*: ♏x–ʒss. The syrup is often combined with ipecac. or small doses of an opiate or codeia. The syrup being acid is incompatible with carbonate of ammonia or other alkali.

Terebene.—Often useful as a stimulating expectorant; not often given internally to infants. ♏ij–♏v may be given on sugar to older children, or suspended in mucilage and syrup of lemon.

ANTACIDS AND CARMINATIVES

Alkalies and aromatics are frequently required in the dyspepsias of infancy. Of the former, sodii bicarb. gr. ijss, magnesii carb. gr. iij, combined with syrup. zingib. and aq. anisi ad ʒj, is useful; or sodii bicarb. gr. ijss, tr. nucis vomicæ ♏$\frac{1}{2}$, tr. cardamom. co. ♏v, sp. chloroformi ♏ijss, aq. anethi ad ʒj, given occasionally.

TONICS

Cod-liver oil takes the first place. It is best given after meals and in the form of an emulsion. Some emulsions are to be obtained combined with lime salts. ♏x–♏xx of the oil twice or three times a day is the dose for infants; ʒss to ʒj may be given to older children. Dyspepsia, catarrh of the intestines, and diarrhœa should be treated before cod-liver oil is given. Inunctions of warm cod-liver oil are often useful; the oil is applied on a sponge and the child clothed in a flannel nightdress.

Acids.—Dilute nitric acid (♏jss–♏ij, aq. ad ʒj) is often of much service during convalescence. It may be combined with tr. cinchonæ co., or decoc. cinchonæ and syrup. limonis.

Iron.—Often given as vinum ferri ♏x–ʒj, syrup. ferri phos. co. ♏x–ʒj, or tr. ferri perchlorid. ♏j–♏ij, in a wineglass of water at meal times. Ferri et ammon. cit. may be combined with alkalies and nux vomica.

Strychnine.—Mostly used as a cardiac and nerve tonic; ♏j–♏ij of the liquor may be given to a child of 6 years every four hours. Caution is required, as some children are very sensitive to this alkaloid, and muscular spasms are readily produced.

STIMULANTS

Alcohol necessarily takes the first place in the list, and is beyond all question of value in treating acute disease when there is evidence of a flagging heart. It is not a matter of much importance what form of alcohol is selected, presuming it is of good quality. Brandy in the form of mist. sp. vini gallici is the one perhaps most generally useful. In hospital whisky frequently takes the place of brandy for the sake of economy. Curaçoa, champagne, port wine, more or less diluted according to circumstances, may be used. Alcoholic stimulants are called for in the adynamic forms of scarlet fever, diphtheria, broncho-pneumonia, acute diarrhœa, and other allied conditions. The pulse is the best guide: a feeble, irregular, intermittent pulse calls for alcohol, mere rapidity of pulse does not. Drowsiness, if it does not contra-indicate alcohol, at least calls for caution in its administration, as overdosing with alcohol is apt to make the drowsiness more pronounced, especially that form due to a hypervenous condition of blood. Delirium is often made worse by alcohol, especially if there is evidence of cerebral congestion, the conjunctival vessels being injected as in the early days of scarlet fever. In such cases opium or bromide answers better. Vomiting is a signal for discontinuing alcohol, for a while at least. Unfortunately champagne, so useful as a rapidly diffusible stimulant, is apt to produce sickness. The amount of alcohol given necessarily depends upon circumstances: drachm doses of brandy, or even more, every hour, may be given with advantage even to young children in some cases of scarlet fever or broncho-pneumonia with great cardiac depression. In infants alcohol is principally of value in colic and acute diarrhœa, and may be given well diluted with barley water, arrowroot, or milk. Port wine sometimes seems to agree better than spirit. In chronic disease alcohol is of less value than in acute illnesses, as the long-continued administration of it certainly has its evils, and is apt to produce dyspepsia and sluggish liver. In anæmia, scrofulosis, and tuberculosis, the wine of St. Raphael, port wine, or porter may sometimes be given with advantage.

FERMENTS

Taka-diastase is the most active of the class of ferments which act on starch, converting the latter into maltose; it will continue its action in the presence of small quantities of HCl, and is consequently suitable for giving internally in cases of starch dyspepsia. The chocolate tablets of taka-diastase (P. D. & Co.) are readily taken by children.

Malt extracts in various forms are useful for mixing with starchy foods, such as gruels, puddings, porridge, just before taking.

Pepsin combined with acids is of value in the dyspepsias of infants and children.

FORCED FEEDING, GAVAGE

Difficulties sometimes arise in feeding immature infants and those with cleft palates, the infant being too weak to suck; or the conformation of the mouth may render this impossible. In such cases an 'eye-dropper' may be used to feed the infant with, only a few drops being taken at a time. In diphtheria, when the tonsils are enlarged and painful, or in paralysis of the pharynx, 'forced feeding' may have to be resorted to. For weakly infants the 'fountain' feeding bottles have been devised, and the 'biberons pompes' of the French; there is, however, no difficulty in feeding a weakly infant by means of the ordinary boat-shaped feeder if held slightly inclined. Infants with cleft palates may have to be fed by spoon or by means of the 'Scott-Battams method'—namely, a piece of indiarubber tubing attached to a glass syringe.

In difficulty of swallowing from any cause this last method is the most generally useful. An ordinary glass syringe is taken and filled with milk, beef-tea, or other liquid nourishment, a piece of indiarubber tubing a few inches long is attached, the latter is passed into the mouth to the back of the tongue, and the piston of the syringe slowly pressed off and on, so that small quantities of fluid are swallowed from time to time. The tube need not be passed between the teeth ; if the latter are clenched the tube may be passed between the cheek and the jaws. In cases where the pharynx is completely paralysed a medium-sized indiarubber catheter must be passed through the *nose* into the pharynx and œsophagus, and food introduced into the stomach.

Forced feeding has also been used by Dr. Kerley of New York in cases of persistent vomiting in young infants, his experience being that food introduced directly into the stomach by a tube and funnel is less readily rejected than if swallowed in the ordinary way. His method is as follows : The infant is held in a half-reclining posture on the nurse's right arm ; a soft indiarubber catheter, attached to a funnel of three or four oz. capacity by a rubber tube two and a half feet long, is rapidly introduced into the stomach, a half to two and a half ounces of liquid food introduced into the funnel ; the latter is then raised, and when empty rapidly withdrawn. This method of forced feeding appears to be more successful in infants than in older children. A preliminary stomach washing should precede the first forced feeding.

STOMACH WASHING

Washing out the stomach is often a highly beneficial proceeding in the dyspepsias of infants, especially when vomiting of decomposing curd is a prominent symptom. The removal of curd which may have remained in the stomach for some days, as well as the acid mucus, is certain to be beneficial. The method of carrying it out is the same in infants as in adults. An indiarubber catheter as large as possible is passed down the pharynx into the stomach, and connected by means of an indiarubber tube, two or three feet in length, with a funnel. One or two ounces of warm 2 per cent. solution of borax is introduced into the funnel ; the latter is raised so that the fluid flows into the stomach, and then lowered and inverted so as to allow of the return of the fluid contents of the stomach. This proceeding is repeated till the returning fluid is clean and sweet. Curdy material often escapes by the side of the tube.

Stomach washing is useful not only in the chronic dyspepsia of infancy, but also in the vomiting of acute gastric catarrh and other forms of vomiting.

ENEMATA

Enemata are required for various purposes during infancy and childhood. A simple enema may be required to unload the bowels and clear away scybala which have collected in the large bowel ; or they may be given for other purposes, such as that of applying local treatment to the mucous membrane of the colon, to replace an invagination, or to destroy oxyurides which are present there. Rectal injections are also resorted to as a means of administering drugs or nutriment.

Purgative enemata are generally given with a Higginson's syringe, and at a temperature of about 100°. They may consist of soap and water with the addition of olive oil, castor oil, or turpentine. When the latter is used a teaspoonful of sp. terebinth., two teaspoonfuls of olive oil, and the yolk of an egg may be shaken up with four or five ounces of water for a child of 2 or 3 years. A larger quantity of fluid may be injected if required to reach the upper part of the large bowel. Some care is necessary, in giving an injection, to do it slowly, avoiding all force. If it is required simply to unload the lower bowel, an injection of a teaspoonful of glycerine

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is sufficient. Enemata for the destruction of the oxyurides are best given after a sharp purgative has been administered, in order to drive the parasites as much as possible into the lower part of the intestines. For this purpose the turpentine injection referred to above answers very well, or half a pint to a pint of perchloride of mercury (1 to 2,000) may be used. Repeated 'irrigation' of the large bowel has been much practised on the Continent (Monti, Baginsky) in various diseased conditions, such as dysenteric diarrhœa, catarrh of the large bowel, &c. Large quantities of water or various solutions are injected by means of an indiarubber tube, with a nozzle to fit in the rectum, and a funnel. The forcing of a large quantity of fluid into the colon, especially in young children, is not always easy, on account of the straining and struggling which it is apt to produce, and forcible injection of fluid by means of raising the funnel with tube attached is not free from danger. In irritable conditions of the colon warm mucilaginous fluids, such as a decoction of arrowroot, two to four ounces, with ten to fourteen minims of opium, is soothing, and relieves tenesmus. The sub-nitrate or oxide of bismuth, suspended in mucilage, and three or four ounces injected, is also useful. In more chronic cases, alum, zinc sulphate, or nitrate of silver may be used. On the whole, opiates are the most comforting to the patient.

Nutrient enemata may be given of peptonised beef-tea, or milk with brandy, or some other form of alcohol.

DIRECTIONS FOR USE OF DISINFECTANTS

Solution A.—Chloride of lime, eight ounces; soft water, one gallon.

Solution B.—Liq. sodæ chlorinatæ, one part; soft water, five parts.

Solution C.—Perchloride of mercury, four ounces; permanganate of potash, one drachm; soft water, one gallon.

Stock bottles to be kept locked up, and labelled 'POISON.'

For use: One fluid ounce to be mixed with one gallon of water.

Use of A.—For the disinfection of excreta: Mix well with each stool half a pint of solution A, and allow it to stand for ten minutes before emptying it into the closet. Treat the vomit of fever patients similarly, and keep the sputa-cups of phthisical patients half full of the same solution.

Use of B.—(1) For the washing of hands and the cleansing of spatulas, thermometers, and other infected instruments; (2) for the thermometers to be kept in; (3) for the sponging of those dying of fever, previous to their removal to the mortuary; (4) *diluted with four times its bulk of water*, for the daily sponging of fever patients.

Use of C.—For the disinfection of clothes: The clothes to be soaked in the solution for two hours, in an earthenware vessel, before being sent to the wash.

To disinfect a room.—Tightly close all windows, fireplaces, and ventilators. Moistened powdered sulphur with spirit, place it in a shallow iron pan supported on a couple of bricks in a bowl of water; light it, and keep the room closed for ten hours. Three pounds of sulphur must be used for each 1,000 cubic feet of air space. N.B.—5 lbs. is necessary for each special ward. Then open all windows, &c., and wash the floors, walls, furniture, &c., with the following solution: Solution C, four fluid ounces, water one gallon, taking especial care to thoroughly wash out all dust from window-ledges, corners, &c. Allow free ventilation for twenty-four hours.

LOEFFLER'S D-BACILLUS

A small piece of membrane, exudation, or mucus is broken up or smeared over a cover-glass, and the latter dried by passing it several times through the flame of a

spirit lamp, taking care not to overheat. A few drops of a solution of Loeffler's potash-methylene blue are run on to the dried exudation for five minutes; the cover-glass is then again dried, a drop of balsam placed on it; it is then mounted on a glass slide and examined with a $\frac{1}{12}$ oil immersion. The D-bacilli may usually be recognised by the characters already given (p. 301). It must be admitted, however, that their morphological characters are not always decisive; but we believe that a skilled microscopist may obtain important information useful in diagnosis by this method, which only takes a few minutes.

Wherever opportunity occurs, cultivations of the organisms present in the secretions should be made on solidified hydrocele fluid in doubtful cases.

TABLE OF AVERAGE HEIGHTS AND WEIGHTS FROM BIRTH TO FOURTEEN YEARS. (Rotch.)

Boys		Age	Girls	
Height	Weight		Height	Weight
inches	lbs.		inches	lbs.
19·75	7·15	Birth	19·28	6·93
24·75	14·30	5 months	23·25	13·86
29·53	20·98	1 year	29·67	19·8
33·82	30·36	2 years	32·94	29·28
37·06	34·98	3 ,,	36·31	33·15
39·31	37·99	4 ,,	38·80	36·36
41·37	41	5 ,,	41·29	39·57
43·75	45·07	6 ,,	43·35	43·18
45·74	48·97	7 ,,	45·52	47·30
47·76	53·81	8 ,,	47·58	51·56
49·69	59	9 ,,	49·37	57
51·68	65·16	10 ,,	51·34	62·23
53·33	70·04	11 ,,	53·42	68·7
55·11	76·75	12 ,,	55·88	78·16
57·21	84·67	13 ,,	58·16	88·46
59·83	94·49	14 ,,	59·94	98·23

N.B.—The weights during first three years are without clothes; after third year in ordinary indoor clothes.

A PHYSIOLOGICAL ALPHABET (Wyllie)

I.—Vowels

y—i e a o u—w

These should be pronounced in the Latin manner, as *ēē*, *eh*, *ah*, *oh*, *oo*. *y* and *w* are consonants, not vowels, but they have very close relationship to the vowels ; initial *y* is very closely related to *i*, and initial *w* to *u*.

II.—Consonants

—	Voiceless Oral Consonants	Voiced Oral Consonants	Voiced Nasal Resonants
Labials (1st Stop Position)	*P* (W)	*B* W	M
Labio-Dentals	F	V	
Linguo-Dentals	Th^1 S	Th^2 Z	
Anterior Linguo-Palatals (2nd Stop Position)	Sh *T* (L)	Zh *D* L R	N
Posterior Linguo-Palatals (3rd Stop Position)	*K* H or Ch	*G* Y (R)	Ng

The voiceless *W* and the voiceless *L* have been given above within brackets, the former being now almost confined to Scotland, and the latter being peculiar to Wales. The burring or uvular *R* is also given within brackets.

ILLUSTRATIVE SENTENCES

I.—Vowels

Eels ail amid ocean ooze

This sentence represents only long vowels. Their short equivalents can be represented, as shown by Mr. Pitman, by attaching the letter *t* to each vowel, thus :

ĕĕt, it, et, at, ut, ot, ŏŏt

II.—Consonants

—
Peter Brown made *wh*ite wax
Fine villages
Thinkest thou so, zealot ?
She lei*s*urely took down nine large roses
Can Gilbert bri*ng* Lo*ch* Hourn youths ?

VOWELS

Wyllie points out that the vowels are best arranged in the order of gradual transition, from the narrowest and tightest shape of the resonating chamber, that is *ēē*, on to the largest shape, that is *oo*. The order thus becomes i e a o u (*ēē*, *eh*, *ah*, *oh*, *oo*). The English *i* is really *ai*, and the English *u* is *yu*.

CONSONANTS

The horizontal columns represent the groups of consonants according to the position in the mouth in which they are produced, the three most important being the three stop positions :—

1st Stop Position (Labials).—The stop is produced by the lips. The voiceless *P* is produced by closing the lips and then bursting them open by air compressed in the cavity of the mouth. *B* is produced in the same way, with the addition of voice produced by the vocal cords ; *M* by closing the lips, sounding the voice as in *B*, but letting the air escape through the nose ; *W* as in wax, by making an *oo* sound, partially closing the lips and letting the air escape through the opening.

2nd Stop Position (Anterior Linguo-Palatals).—The stop is effected by placing the tip of the tongue in contact with the anterior part of the roof of the mouth ; *T*, *D*, and *N* are produced in a similar way to *P*, *B*, *M*. *Sh*, as in *she*, is produced by the stop being incomplete, air being allowed to pass ; *Zh*, as in *treasure*, in the same way, but with the help of the voice. *R* is produced partly by the voice, partly by the air passing over the vibrating tip of the tongue in the 2nd Stop Position ; *L* partly by voice, partly by the air passing over the sides of the tongue in this position.

3rd Stop Position (Posterior Linguo-Palatals).—The stop is effected by applying the upper surface of the back of the tongue to the roof of the mouth. *K*, *G*, *Ng* are produced like *P*, *B*, *M*, only in this position ; *H* by incomplete closure of the stop, and *Y* in the same way aided by the voice.

Labio-Dentals.—*F* and *V* are produced by the passage of air between the upper teeth and lower lip, the one being voiceless, the other being voiced.

Linguo-Dentals.—The tip of the tongue in contact with the upper teeth allows of the production of the voiceless *Th*, as in *thin*, and the voiced as in *thine*, and, applied to the roof of the palate behind the teeth, allows of the production of the voiceless *S* and its voiced equivalent *Z*.

In the three vertical columns, the first contains the voiceless consonants *P*, *F*, *T*, &c., the sound being produced in the cavity of the mouth only. In the second and third the consonants are produced by the help of the voice supplied by the larynx. In the nasal resonants the mouth is closed, the voice passing through the nose.

In the Physiological Alphabet, *c* is represented by *s* or *k* ; *q* is of no value by itself ; *qu* is equivalent to *kw* ; *x* is equivalent to *ks* ; soft *g* and *j* equal *dzh*.

FORMULÆ

The doses given are suitable for an infant of a year old unless otherwise stated

DISORDERS OF DENTITION, p. 61

(1)

Potass. bromid.	gr. iiss
Tr. hyoscyami	ɱv
Ex. glycyrrh. liq.	ɱx
Aquæ	ad ʒj

Every two or three hours for an infant of 7 months.

(1a)

Chloral hydrat.	gr. ij
Potassii bromid.	gr. ij
Sp. ammon. aromat.	ɱij
Syrup. pruni virg.	ɱx
Aquæ	ad ʒj

Every two or three hours.

(2)

Calomel	gr. ½
Euonymin	gr. ½
Sacchar. alb.	gr. ½

The powder at night.

(3)

Boracis	ʒss
Tr. myrrhæ	ʒss
Glycerini	ʒj
Aq. rosæ	℥j

To be painted on the gums or aphthous patches.

STOMATITIS, pp. 65-68

(4)

Potass. chloratis	gr. j
Syrup. aurantii	ɱxv
Aquæ	ad ʒj

Three times a day.

(4a)

Potass. chloratis	gr. j
Ex. cinchonæ liq.	ɱv
Elixir simplicis	ɱv
Aquæ	ad ʒj

Three times a day.

(5)

Acidi borici	gr. x
Sp. thymol (1–10)	ɱv
Glycerini	ʒss
Aquæ	ad ℥j

To be painted on the aphthous patches.

(6)

Sodii bicarb.	ʒj
Sp. thymol (1–10)	ʒj
Glycerini	ʒij
Aquæ	ad ℥viij

As a mouth wash for children.

ACUTE TONSILLITIS, p. 74

(7)

Tr. aconiti	♏j
Liq. ammon. citratis	ʒss
Syrupi aurantii	♏xx
Aquæ	ad ʒij

Every three hours for a child of 5 years.

(8)

Sodii salicylatis	gr. v
Potass. citratis	gr. v
Syrupi pruni virgin.	♏xx
Aquæ	ad ʒij

Every three hours for a child of 5 or 6 years.

(9)

Iodi	gr. iij
Potass. iodidi	ʒss
Glycerini	ad ʒj

Pigment for enlarged tonsils.

(10)

Aluminis	ʒij
Tannin	ʒss
Glycerini	ʒss
Aquæ rosæ	ad ʒij

Pigment for enlarged tonsils.

FLATULENCE AND COLIC, p. 86

(11)

Magnesii carb.	gr. iiss
Pulv. rhei	gr. ¼
Syrup. zingib.	♏v
Aq. menth. pip. dil.	ad ʒj

Every two hours for an infant 3 or 4 months old.

(♏½–♏j of nepenthe may be added to each dose if the infant is under close observation.)

(12)

Chloral hydrat.	gr. iiss
Aq. laurocerasi	♏x
Syrup. pruni virgin.	♏x
Aquæ	ad ʒj

Every three hours.

(13)

Sodii bicarb.	gr. iiss
Sp. ammon. fœtid.	♏ij
Sp. chloroformi	♏j
Aquæ anethi	ad ʒj

Occasionally.

(14)

Hyd. c. cret.	gr. ½
Pulv. Doveri	gr. ½
Sacchar. alb.	gr. ½

Ft. pulv.

Every four hours.

VOMITING, p. 87

(15)

Sodii bicarb.	gr. iiss
Aq. laurocerasi	♏x
Sp. chloroformi	♏j
Aq. anethi	ad ʒj

Every four hours.

(16)

Liq. bismuthi et ammon. citr.	♏v
Tr. nucis vomicæ	♏ss
Glycerini	♏x
Aq. carui	ad ʒj

Every four hours.

SIMPLE DIARRHŒA, p. 90

(17)

Ol. ricini	♏xv
Pulv. acaciæ	gr. v
Syrup. zingib.	♏v
Aq. menth. pip. dil.	ad ʒj

Every two hours.

(18)

Sodii bicarb.	gr. ij
Bismuthi carb.	gr. iss
Pulv. tragacanth. co.	gr. j
Sp. chloroformi	♏iiss
Aq. cinnamomi	ad ʒj

Every four hours.

(19)

Zinci oxidi	gr. iiss
Pulv. tragacanth. co.	gr. j
Sp. chloroformi	♏j
Glycerini	♏xv
Aq. anethi	ad ʒj

Every four hours.

(20)

Acidi nitrici dil.	♏j
Syrup. aurant.	♏x
Decoc. granati radicis	ad ʒj

Every four hours.

(21)

Acidi nitrohydrochlorici dil.	♏j
Liq. peptici	♏xx
Sp. chloroformi	♏j
Aq. aurant. flor.	ad ʒj

Three times a day.

CONSTIPATION, p. 92

(22)

Acidi sulph. aromat.	♏j
Magnesii sulphat.	ʒss
Ferri sulph.	gr. ½
Sp. chloroformi	♏v
Aquæ	ad ʒss

Two or three times a day before meals for a child of 10 or 12 years.

(23)

Podophylli	gr. ¼
Euonymin	gr. ¼
Ex. cascaræ sagradæ	gr. j

In Palatinoids (Oppenheimer) *one or two a day for a child of 6 to 12 years.*

(24)

Tr. belladonnæ	♏v
Tr. nucis vomicæ	♏½
Syrup. sennæ	♏x
Inf. gentian. co.	ad ʒj

Three times a day for a child of 3 or 4 years. (Eustace Smith.)

(25)

Aloin	gr. ¼
Strychninæ	gr. 1/60
Ex. belladonnæ	gr. ⅛

One pill daily.

ACUTE GASTRIC CATARRH, p. 93

(26)

Acidi hydrocyan. dil.	♏j
Sp. chloroformi	♏j
Aq. aurant. flor.	ad ʒj

Every three hours.

(27)

Sodii bicarb.	gr. x
Aq. laurocerasi	♏xv
Aq. aurant. flor.	ʒss
Acidi citrici	gr. v
Aquæ	ad ʒij

The alkaline and acid mixtures to be taken effervescing every four hours, for a child of 10 or 12 years. (Burney Yeo.)

ZYMOTIC DIARRHŒA, p. 100

(28)

Sodii salicylatis	gr. j
Ol. ricini	♏xv
Pulv. acaciæ	gr. v
Syrup. zingib.	♏v
Aq. menth. pip.	ad ʒj

Every two hours.

(29)

Moschi	gr. ½
Pulv. acaciæ	gr. v
Elixir simplicis	♏v
Aq. rosæ	ad ʒj

Every two hours.

(30)

Bismuthi salicylatis	gr. j
Sp. ammon. aromat.	♏ij
Pulv. tragacanth. co.	gr. j
Sp. chloroformi	♏j
Aq. carui	ad ʒj

Every three hours.

(31)

Salol	gr. j
Pulv. tragacanth. co.	gr. j
Elixir simplicis	♏v
Aquæ	ad ʒj

Every two hours.

CHRONIC DIARRHŒA, p. 112

(32)

Extracti hæmatoxyli	gr. iiss
Tr. catechu	♏v
Syrup. tolu.	♏x
Aq. cinnamomi	ad ʒj

Every four hours.

(33)

Argenti nitratis	gr. v
Aquæ	Oss

To be used as an enema.

CHRONIC GASTRO-INTESTINAL CATARRH, p. 113

(34)

Sodii bicarb.	gr. ij
Pepsini	gr. j
Sacchar. alb.	gr. j

Half an hour after meals.

(35)

Sodii bicarb.	gr. ½
Hyd. c. cret.	gr. ¼
Pulv. rhei co.	gr. ½
Sacchar. alb.	gr. j

Half an hour after meals.

(36)

Acid. nitrici dil.	♏iij
Liq. helalin et pepsin co.	ʒss
Sp. chloroformi	♏ij
Aq. aurant. flor.	ad ʒiij

Three times a day.

(37)

Acid. hydrochlor. dil.	♏iij
Liq. euonymin et peps. co. (*Oppenheimer*)	ʒss
Elixir simplicis	♏xv
Aquæ	ad ʒiij

Three times a day.

(*For children of 7 to 10 years.*)

(38)

Sodii bicarb.	gr. v
Inf. rhei	ʒj
Elixir simplicis	♏xv
Aquæ	ad ʒiij

Three times a day before meals.

(39)

Pot. bicarb.	gr. v
Tr. nucis vomicæ	♏j
Aq. laurocerasi	♏xv
Elixir simplicis	♏xv
Aquæ	ad ʒiij

Three times a day before meals.

(*For children of 7 to 10 years.*)

(40)

Acid. nitrici dil.	♏iij
Ex. cinch. liq.	♏v
Syrup. aurant.	ʒss
Aquæ	ad ʒiij

Three times a day after meals, for children of 7 to 10 years.

TUBERCULOUS ULCERATION OF THE BOWELS, p. 157

(41)

Hyd. c. cret. . . . . gr. j
Pulv. Doveri . . . . . gr. ij

Every night, for a child of 5 years.

(42)

Pulv. kino co. . . . gr. i–iij
Sacchar. alb. . . . gr. ij

Every night, for a child of 5 to 7 years.

(43)

Emuls. ol. morrhuæ B.P.C.

One to three teaspoonfuls three times a day.

(44)

'Bynol' (*Allen & Hanbury*).

One to three teaspoonfuls three times a day.

(45)

Byno-hypophosphites (*Allen & Hanbury*)

One to three teaspoonfuls three times a day

SCARLET FEVER, p. 283

(46)

Potass. citratis . . . gr. v
Ex. cinchon. liq. . . . ♏v
Elixir simplicis . . . ♏xv
Aquæ . . . . ad ʒiij

Every four hours, for a child of 5 to 8 years.

(47)

Ammon. carb. . . . gr. v
Ex. cinchon. liq. . . . ♏v
Tr. digitalis . . . ♏v
Syrup. aurant. . . . ♏xx
Aquæ . . . . ad ʒiij

Every four hours, for a child of 5 to 7 years.

MEASLES, p. 292

(48)

Potass. ant. tart. . . . gr. $\frac{1}{30}$
Liq. ammon. acet. . . . ♏xx
Syrup. tolu. . . . . ♏xv
Aquæ . . . . ad ʒj

Every four hours, for a child of 5 years.

(49)

Tr. aconiti . . . . ♏j
Liq. ammon. citrat. . . ♏xx
Elixir simplicis . . . ♏x
Aquæ . . . . ad ʒij

Every four hours, for a child of 5 years.

INFLUENZA, p. 315

(50)

Antipyrin . . . . gr. iii–v
Sp. chloroformi . . . ♏iij
Elixir simplicis . . . ♏x
Aquæ . . . . ad ʒiij

Every six hours, for a child of 6 years.

(51)

Sodii salicylat. . . . gr. v
Liq. ammon. acet. . . ʒss
Syrupi tolut. . . . . ʒss
Aquæ . . . . ad ʒiij

Every six hours, for a child of 6 to 8 years.

WHOOPING COUGH, p. 339

(52)

Tr. belladonnæ . . . ♏v–xv
Extr. cannabis ind. . . . gr. ¼
Glycerini . . . . ♏xv
Aquæ . . . . ad ʒij

Every six hours, for a child of 3 to 5 years.

(53)

Antipyrin . . . . gr. iij
Elixir simplicis . . . ♏x
Aquæ . . . . ad ʒij

Every six hours, for a child of 3 to 5 years.

(54)

Potass. bromidi . . . gr. v
Liq. morphinæ hydrochlor. . ♏j
Syrup. scillæ . . . . ♏xx
Aq. aurant. flor. . . ad ʒij

Every six hours, for a child of 6 to 8 years.

(55)

Bromoform.

Two or three drops in a teaspoonful of water or on sugar every four hours.

For a child of 3 to 5 years.

CATARRHAL LARYNGITIS, p. 353

(56)

Potass. antimon. tart. . . gr. 1/20
Liq. ammon. citr. . . . ♏x
Elixir simplicis . . . ♏v
Aquæ . . . . ad ʒj

Every four hours, for a child of 2 to 3 years.

(57)

Apomorphinæ hydrochlor. . gr. 1/20
Vin. ipecac. . . . . ♏ij
Elixir simplicis . . . ♏v
Aquæ . . . . ad ʒj

Every four hours, for a child of 2 to 3 years.

BRONCHITIS AND BRONCHO-PNEUMONIA, p. 386

(58)

Codeinæ . . . . . gr. ⅛
Elixir rubri . . . . ♏v
Aquæ . . . . ad ʒj

Occasionally, for a child of 5 or 6 years.

(59)

Liq. morphinæ hydrochlor. . ♏ij
Acid. nitr. dil. . . . ♏j
Syrup. aurant. . . . ♏xx
Aquæ . . . . ad ʒj

Occasionally, for a child of 8 to 10 years.

(60)

Ammon. carb. . . . gr. j
Tr. digitalis . . . . ♏j
Syrup. pruni virgin. . . ♏xx
Aq. anethi . . . ad ʒj

Every four hours.

(61)

Ol. sinapis . . . . ♏x
Ol. camph. . . . . ʒj

To be rubbed on the affected part.

(62)

Tr. capsici . . . . ℥ss
Lin. saponis . . . . ℥ss

To be applied to the affected part.

(63)

Pulv. capsici . . . . ʒj
Ung. lanolini . . . . ℥j

To be applied to the affected part.

(64)

Vini ipecac.	♏ij
Liq. ammon. citratis	♏x
Syrup. tolu.	♏x
Aquæ	ad ʒj

Every four hours.

(65)

Antim. tart.	gr. $\frac{1}{20}$
Liq. morphinæ hydrochlor.	♏j
Aq. laurocerasi	♏x
Elixir simplicis	♏x
Aquæ	ad ʒij

Every four hours, for a child of 5 to 6 years.

(66)

Potass. bicarb.	gr. j
Potass. iodidi	gr. $\frac{1}{2}$
Ex. cinch. liq.	♏ij
Syrup. scillæ	♏x
Aquæ	ad ʒj

Three times a day.

(67)

Sodii bicarb.	gr. x
Glyc. acid. carbolici	ʒj
Aquæ	ad ℥j

To be used with Siegle's steam spray.
(Burney Yeo.)

ACUTE PNEUMONIA, p. 395

(68)

Liq. strychninæ	♏ $\frac{1}{2}$
Tr. digitalis	♏ij
Sp. chloroformi	♏j
Aq. aurant. flor.	ad ʒj

Every four hours, for a child of 2 or 4 years.

(69)

Tr. aconiti	♏j
Liq. ammon. acet.	♏xv
Aq. laurocerasi	♏x
Elixir simplicis	♏x
Aquæ	ad ʒij

Every four hours, for a child of 2 to 5 years.

BRONCHIAL ASTHMA, p. 410

(70)

Antim. tart.	gr. $\frac{1}{20}$
Liq. morphinæ hydrochlor.	♏ij
Potass. iodidi	gr. ij
Sp. chloroformi	♏ij
Aquæ	ad ʒij

With an equal quantity of water every three hours, for a child of 5 or 6 years.
(Burney Yeo.)

(71)

Potass. iodidi	gr. iiss
Ext. stramonii	gr. $\frac{1}{12}$
Sp. chlorof.	♏v
Sp. ammon. aromat.	♏v
Aquæ	ad ℥ss

Three times a day, for a child of 10 years.
(Burney Yeo.)

TUBERCULOSIS OF LUNGS, p. 417

(72)

Ol. morrhuæ	
Extr. of malt	āā ʒj

Three times a day.

(73)

Ol. morrhuæ	ʒj
Creosoti	♏ $\frac{1}{2}$

Three times a day after food. (*Very nauseous.*)

(74)

Liq. iodi fort.	℥ss
Glycerini	ʒij
Aquæ	ad ℥iss

To be painted over the affected part.

PERICARDITIS, p. 441

(75)

Potass. bicarb.	gr. x
Tr. aconiti	♏ij
Sp. chloroformi	♏v
Aq. aurant. flor.	ad ℥ss

Every six hours, for a child of 8 to 10 years.

(76)

Sodii salicylatis	gr. x
Liq. ammon. acet.	ʒss
Syrup. aurant.	ʒss
Aquæ	ad ℥ss

Every six hours, for a child of 8 to 10 years.

CARDIAC TONICS, p. 441

(77)

Tr. ferri perchlor.	♏v
Tr. digitalis	♏v
Sp. chloroformi	♏v
Aquæ	ad ℥ss

Three times a day, for a child of 8 to 12 years.

(78)

Ferri et ammon. citr.	gr. v
Liq. strychninæ	♏ij
Sp. chloroformi	♏v
Glycerini	♏xv
Aquæ	ad ℥ss

Three times a day, for a child of 8 to 12 years.

DIURETICS IN CARDIAC DROPSY, p. 442

(79)

Potass. acetatis	gr. x
Succi scoparii	ʒss
Tr. digitalis	♏v
Sp. chloroformi	♏v
Inf. senegæ	ad ℥ss

Three times a day, for a child of 8 to 12 years.

(80)

Potass. iodidi	gr. ij
Tr. scillæ	♏x
Tr. strophanthi	♏v
Sp. chloroformi	♏v
Aquæ	ad ℥ss

Three times a day, for a child of 8 to 11 years.

CARDIAC STIMULANTS, p. 441

(81)

Sp. ætheris co.	♏x
Tr. nucis vom.	♏v
Tr. lavandulæ co.	♏v
Aq. carui	ad ℥ss

Every four hours, or as required, for a child of 8 to 12 years. (Burney Yeo.)

(82)

Liq. strychninæ	♏ij
Ex. cocæ liq.	♏xv
Sp. chloroformi	♏v
Aq. cinnamomi	ad ℥ss

Every four hours, for a child of 8 to 12 years. (Burney Yeo.)

RHEUMATISM, p. 485

(83)

Sodii salicylatis	gr. x
Potass. bicarb.	gr. x
Syrup. aurant.	ʒss
Aquæ	ad ℥ss

Every four hours, for a child of 10 years.

(84)

Potass. citratis	gr. x
Syrup. limonis	ʒss
Aquæ	ad ℥ss

Every four hours, for a child of 10 years.

EPILEPSY AND CONVULSIONS, pp. 555 and 561

(85)

Potass. bromid.	gr. vij
Tr. belladonnæ	♏x
Sp. ammon. aromat.	♏x
Syrup. aurant.	ʒss
Aquæ	ad ℥ss

Three times a day, for a child of 8 years.

(86)

Potass. bromid.	gr. v
Sodii bicarb.	gr. v
Pulv. rhei	gr. ½
Sp. chloroformi	♏v
Aquæ	ad ℥ss

Three times a day, for a child of 8 years.

(87)

Sodii bromid.	gr. v
Syrup. casc. aromat.	♏x
Sp. ammon. aromat.	♏x
Aquæ	ad ℥ss

Three times a day, for a child of 8 years.

(88)

Potass. bromid.	gr. iij
Syrup. aurant.	♏x
Sp. chloroformi	♏j
Aquæ	ad ʒj

Every two hours, for an infant of 6 months.

(89)

Potass. bromid.	gr. iiss
Chloral hydratis	gr. iiss
Syrup. aurant.	♏xv
Aquæ	ad ʒj

For an infant a year old.

(90)

Chloral hydratis	gr. iiss
Nepenthe	♏½
Elixir simplicis	♏v
Aquæ	ad ʒj

For an infant a year old.

NEPHRITIS, pp. 285 and 640

(91)

Potass. citratis	gr. xv.
Syrupi limonis	♏xx
Aquæ	ad ℥ss

Every four hours, for a child of 6 to 10 years.

(92)

Potass. tart.	ʒss
Syrup. aurant.	ʒss
Aquæ	ad ℥ss

Every four hours, for a child of 6 to 10 years.

(93)

Liq. ammon. acet.	ʒss
Tr. digitalis	♏v
Sp. chloroformi	♏v
Aquæ	ad ℥ss

Every four hours, for a child of 6 to 10 years.

(94)

Tr. ferri perchlor.	♏v
Acid. acet. dil.	♏ij
Liq. ammon. acet.	ʒss
Sp. chloroformi	♏v
Aquæ	ad ℥ss

Every four hours, for a child of 6 to 10 years.

ECZEMA AND IMPETIGO, p. 828

(95)

Hydrarg. subchlor.	gr. ¼
Euonymin	gr. ¼
Sacchar. alb.	gr. j

Every other night, for an infant 6 months old.

(96)

Hydrarg. c. cret.	gr. ½
Pulv. rhei co.	gr. ½
Sacchar. alb.	gr. j

(97)

Ol. morrhuæ	℥ij
Liq. arsenicalis	℥j
Mucilaginis	q.s.
Syrup. aurant.	℥j
Aquæ	ad ℥iv

One teaspoonful three times a day, after food.

(98)

Ichthyol	℥ss
Carron oil	Oss

To be applied on lint.

(99)

Calamin. opt.	℥ij
Zinci oxidi	℥ss
Ol. oliv.	℥j
Aq. calcis	℥j

(Crocker.)

(100)

Liq. plumb. subacet. fort.	℥ss
Tr. opii	℥ij
Aquæ	ad ℥vj

(101)

Acidi borici	℥j
Ol. amygdalæ	℥x
Ceræ alb.	℥j
Cetacei	℥j
Aq. rosæ	℥x

(102)

Zinci oxidi	℥ss
Acid. carbolici	gr. xx
Olei rosæ	♏ss
Ung. paraffini	℥j

(103)

Acid. salicylici	gr. xx
Zinci oxidi	℥ss
Amyli	℥ss
Vaselini	℥j

(Lassar.)

(104)

Sulphur. præcip.	gr. xx
Zinci oxidi	℥ij
Amyli	℥ij
Lanolini	℥ij
Vaselini	℥ij

(Ihle.)

(105)

Ung. hydrarg. ox. flav.	℥j

Five per cent. ex Vaselini.

(106)

Ung. hydrarg. ox. rubri	℥ss
Ung. zinci	℥j
Ung. paraffini	℥j

(107)

Glyc. plumb. acet.	℥ij
Liq. carbonis deterg.	℥ij
Aq. rosæ	℥vj

(108)

Sulphur. præcip.	℥ss
Camphor.	gr. xv
Zinci oxidi	℥ij
Amyli	℥ij
Ung. paraffini	℥j

PSORIASIS, p. 834

(109)

Ol. cadini	℥ss
Ung. hydrarg. ammon.	℥ij
Ung. simplicis	℥j

(110)

Chrysarobin	℥j
Gutta-percha	℥j
Chloroform	℥x

To be applied to the affected parts.

TINEA, pp. 837 and 839

(111)

Sulphur. præcip.	ʒj
Hydrarg. ammon.	ʒss
Thymol	gr. x
Vaselini	ʒj
Ung. simplicis	℥iv

(112)

Pulv. boracis	ʒj
Tr. camph.	ʒj
Glycerini	ʒij
Aq. aurant. flor.	℥iv

To be used as a hairwash.

(113)

Tr. cantharidis	ʒij
Tr. capsici	ʒij
Tr. nucis vomicæ	℥ss
Ol. ricini	ʒij
Eau de Cologne	ad ℥iv

To be used as a hairwash.

(114)

Tr. cantharid.	℥ss
Tr. capsici	℥ss
Ol. ricini	℥ss
Sp. vini rect.	℥iv

To be used as a hairwash.

SCABIES, p. 840

(115)

Sulphuris	ʒj
Balsami peruv.	ʒss
Ung. simplicis	℥j

(116)

Storacis	℥ss
Ung. simplicis	℥ij

(117)

Naphthol	ʒj
Ung. simplicis	℥j

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