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OF

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A TREATISE

ON THE

DISEASES

OF

INFANCY AND CHILDHOOD.

BY

J. LEWIS SMITH, M.D.,

CLINICAL PROFESSOR OF DISEASES OF CHILDREN IN BELLEVUE HOSPITAL MEDICAL COLLEGE; PHYSICIAN TO THE NEW YORK FOUNDLING ASYLUM, AND TO THE NEW YORK INFANT ASYLUM; CONSULTING PHYSICIAN TO THE CHILDREN'S CLASS IN THE BUREAU FOR THE RELIEF OF THE OUT-DOOR POOR; PHYSICIAN TO CHARITY HOSPITAL, ETC. ETC.

FOURTH EDITION, THOROUGHLY REVISED,

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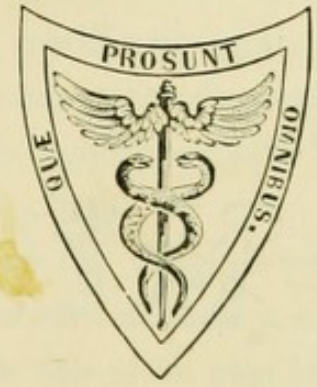

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PREFACE TO THE FOURTH EDITION.

THE last twenty-five years have witnessed marvellous progress in our knowledge of the nature of children's diseases, and of their therapeutic requirements. The closer study of symptoms, the more general recording and publishing of clinical facts, and post-mortem appearances, the discussions in medical societies, which have awakened keen interest, the recent translation into our tongue of treatises, written by masters of the profession on the Continent, the activity of the medical journals, which immediately inform us of all valuable discoveries in medicine, whether at home or abroad, are some of the more conspicuous agencies which have effected so desirable a result. Of the ample material thus placed within reach, I have sedulously endeavored to make use.

Since I was informed a year ago, that a fourth edition of this treatise would be called for, I have employed almost every leisure moment, which could be spared from necessary professional duties, in revising the text, and incorporating in it whatever was new and useful, so that it might fairly and fully represent the present state of our knowledge. I have therefore entirely rewritten several of the chapters, and have made corrections and additions on nearly every page; yet, by the adoption of a somewhat closer type, these additions have been accommodated with but little increase in the bulk of the volume.

During these late years the changes which have been made in the therapeutics of children's diseases are numerous. Depressing medicines have been for the most part laid aside, and those substituted which fulfil the indications, while they sustain or do not reduce the strength. New and valuable medicines have been added to our pharmacopœia, as the bromides, and hydrate of chlo-

ral. Certain heretofore unknown or vaguely known effects of old remedies have been demonstrated and accepted, as of quinine and digitalis, so that these are used for purposes for which, till recently, more depressing, and therefore objectionable agents, were employed. Moreover, the need felt of making prescriptions for children as little nauseous as possible—stimulated to a certain extent by the fact that a system has spread through the community, whose one merit was that the medicines which it employed were readily taken by the youngest child—has led to many changes in the form of the remedies employed, and in the modes of prescribing. Aiding in this object, of rendering medicines palatable for children, pharmaceutical chemistry has in these recent times furnished many preparations, which are much more readily administered than the cruder and more bulky substances formerly employed. In view of these changes in our materia medica I have found it necessary to rewrite a large proportion of the prescriptions contained in the text, nearly all of which have been sufficiently tested either in my private practice, or in the institutions with which I have an official connection.

I esteem it a very great privilege, and one which greatly enhances the value of this book, that I am connected with three of the large charities of New York in which children are treated, and which afford unsurpassed opportunities for observation. In one of these about 8000 children are treated annually. To the Sisters, and my colleagues of the N. Y. Foundling Asylum, to Dr. Angell of the N. Y. Infant Asylum, and to my colleagues in the Bureau for the Relief of the Out-Door Poor, I am under many obligations for their generous and earnest co-operation in the study of such cases as demanded minute and daily examinations.

No. 227 W. Forty-ninth Street, N. Y.

February, 1879.

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THE

DISEASES OF CHILDREN.

PART I.

CHAPTER I.

INFANCY AND CHILDHOOD.

INFANCY and childhood are in certain respects the most important and interesting periods of life. To the physiologist they are especially interesting, because they are the periods of development and of greatest functional activity; to the pathologist, because in them many diseases occur which are rarely or never observed in the other periods, or which present in these periods peculiar features; to the physician and vital statistician, because in them there is the greatest amount of sickness, and largest number of deaths.

INFANCY extends from birth to the age of two and a half years, or till the completion of first dentition. In infancy the organs are delicately organized, containing a large proportion of water, and hence are easily injured. In this period the brain is rapidly developed—more so than any other organ; animal matter predominates in the bones; the arteries are relatively large, the muscles small; the superficial veins are small. Fat is absent from the interior of the body, but abundant, in well-nourished infants, underneath the integument. The skin is delicate, and its temperature not much below that of the blood. At birth it has a reddish hue, and is covered with soft fine hairs (lanugo). The reddish hue gradually fades into the healthy tint of infancy, and the hairs fall out. In the first two months the sweat-glands have little functional activity, sensible perspiration being quite rare. Subsequently perspiration is freer, and in certain diseased states (rachitis, etc.) is abundant. The sebaceous glands in the first half of infancy are active, particularly upon the scalp, producing often a pale yellow incrustation, consisting of sebaceous matter and epidermic cells.

The secretions from the mucous surfaces commence at an early period. At birth the surface of the digestive tube is covered with more or less

mucus, often in considerable quantity. The meconium is not considered, as formerly, to be a product of intestinal secretion. It consists of flat epithelial cells, fine hairs, oil-globules, crystals of cholesterin, and brownish or yellowish masses of coloring matter, probably from the liver. It is supposed that, with the exception of the coloring matter, the meconium is derived mainly from the amniotic fluid which the fœtus has swallowed.

The most wonderful change occurring in the system at birth, through the exigencies of the new life, is that in the circulation. The flow of blood being interrupted, thrombi form in the umbilical vein, and arteries, and in the ductus arteriosus, and ductus venosus, and these vessels gradually atrophy, becoming finally shrivelled but permanent cords. I have many times at autopsies removed the plug from the ductus arteriosus when death had occurred as late as the third week. The foramen ovale closes slowly. I have ordinarily found it open till near the end of the first half year, but the valve closes fully the aperture, so that there is no detriment to the circulation. Both the pulse and respiration are more frequent during infancy than childhood, and are more readily accelerated by moral and physical causes.

The stomach is less elongated and emesis more readily produced than in the adult. The liver is large, occupying at birth nearly half of the abdominal cavity, but it grows smaller in successive months. The appetite is good and digestion active, so that hunger, when appeased, soon returns. The thymus gland, at birth about the size of an unexpanded lung, slowly atrophies, but it does not totally disappear till after infancy.

The kidneys, distinctly lobulated at birth, gradually change their form, so as to present in the last part of infancy nearly the shape of the organ in the adult. The renal secretion commences early, even before birth. The kidneys seldom undergo degenerative changes as in the adult, but they are liable to congestions and inflammations. During the first month, and especially the first fortnight, crystals of uric acid, and the urates, are often found in the urine, in a state of apparent health, causing more or less fretfulness in their elimination, staining the diaper, and not infrequently being arrested in the tubules of the pyramids, where they can be seen as pink-colored spots or lines (uric acid infarction). These deposits of uric acid and the urates may even occur in the fœtus, producing obstruction and inflammation of the renal tubes. Congenital cystic degeneration of the kidneys is, in the opinion of Virchow, due to them. In early infancy the senses are imperfectly developed, the eyes being attracted only by bright objects, and the sense of hearing affected only by loud noises. Sleep is the normal state in the first weeks of life; as the age of the infant increases, less and less sleep is required; but the oldest *infants* need more than children, and several hours more than adults.

The new-born infant is apparently destitute of mental faculties. It seeks the breast by instinct, and it exhibits no perception or reflection.

The loud cries with which it commences its existence are not from anger or suffering; they appear to be normal, like the act of nursing, and providentially designed in order to expand the lungs. It is not till the close, or near the close, of the first month, that the gray substance of the brain begins to appear—the probable seat of the mind, and the source of all mental phenomena. Perception and curiosity are early manifested. The infant, as Edmund Burke has remarked, is constantly seeking new objects for its amusement, rejecting old playthings for such as possess more novelty. Reflection, a higher faculty of the mind, appears at a later period. The mind and the bodily organs in infancy are, in a high degree, impressionable. Anger is excited by trivial causes, but is easily appeased; and the various functions in the system are disturbed by agencies which in youth or manhood would have no appreciable effect.

Childhood extends from infancy to the age of fifteen years or puberty. It is a period of great physical activity, and of rapid growth. The functions of the various organs are performed with more moderation than in infancy, and are less frequently deranged. The volume of the brain continues to increase rapidly, and it becomes firmer than in infancy. It is estimated that by the seventh year the weight of this organ has doubled. The mind now exerts a controlling influence over the actions of the individual. The digestive organs have changed, so that solid food is required. Most of the glandular organs are less active than in the greater part of infancy, and some of them, as the liver, are relatively smaller. The pulse and respiration gradually become less frequent as the child advances in age.

CHAPTER II.

CARE OF THE MOTHER IN PREGNANCY.

The frequency of miscarriages and still-births, and the large number of ill-formed and puny infants, born to a precarious and short existence, render imperative, on the part of the mother, a strict observance of the laws of health, and an avoidance of all exciting or perturbating influences during the time when the fœtus is being developed. The diet should be plain and easily digested, but nutritious. There is often a craving in pregnancy for unusual articles of food. These may sometimes be allowed within certain limits, provided that they are such as do not derange the stomach. Meats and animal broths, together with vegetables and farinaceous food, should constitute the ordinary diet, and should be taken at regular intervals.

Daily exercise, never violent, but moderate and gentle, is requisite. No

exercise is better, none safer and more likely to contribute to cheerfulness and healthy functional activity of the organs, than the ordinary household duties. Lifting heavy weights, or work which, like washing and ironing, causes great and continued action of the abdominal muscles, should be avoided. Such exercise is highly injurious, and is apt to produce premature labor. Exercise in the open air, on foot, or by an easy conveyance, conduces to the health of the mother and the growth and development of the fœtus. On the other hand, rapid riding over rough roads is one of the most dangerous modes of exercise. It has been known to destroy the fœtus, which up to that time had been apparently vigorous. When such a result occurs, there is probably more or less detachment of the placenta.

It being a matter of the utmost importance that the health of the mother should continue good during gestation, any disease which she may have in this period, and which affects her nutrition or the character of her blood, should be promptly cured if practicable, and with the least possible reduction of the vital powers. Intermittent fever, occurring during gestation, should never be allowed to continue. It seriously retards fœtal development, and may produce miscarriage. Unless it is controlled by proper measures, the offspring, though born at term, is puny and emaciated. Syphilis, in the pregnant woman, also requires treatment. This disease, readily transmitted from the mother to the fœtus through the ovum or the uterine circulation, may be eradicated by anti-syphilitic treatment of the mother, or at least so modified that the infant is born vigorous and healthy.

The pregnant woman should avoid all causes of undue mental excitement. This is almost as necessary as the avoidance of great physical exertion. There is, during pregnancy, unusual susceptibility to mental impressions, and this should be borne in mind not only by the woman herself, but by those who associate with her.

Strong emotions, whether of joy, sorrow, or anger, affect primarily the nervous system, but indirectly most of the organs of the body. Observations have long established the fact, that such emotions influence the state and functions not only of the digestive and glandular, but muscular organs, as the heart and uterus. Physicians are familiar with cases in which vivid mental impressions produced uterine contractions, and even miscarriage, or have disturbed the catamenial function. Therefore, the associations and cares of pregnant women should be such as conduce to cheerfulness and equanimity.

It is the popular belief, and the belief of many physicians, that vivid mental impressions sometimes have a direct effect on the development of the fœtus. Many cases are on record in which infants were born with marks or deformities, corresponding in character with objects which had been seen and had made a strong impression on the maternal mind at some period of gestation. Whether the mind of the mother exerts a controlling influence on the form and color of the fœtus, is a subject of great

interest to the psychologist as well as physiologist and physician, since it involves no less a question than the power and scope of the human mind. Violent emotions, it is admitted, may affect directly most of the important organs in the system. They may derange the liver, causing jaundice, accelerate, or for a moment suspend, the heart's action, stimulate the kidneys, causing diuresis, or even the intestinal follicles, causing watery evacuations. But with all these organs the brain is connected by nerves which anatomy reveals. On the other hand, the mother and fœtus have a distinct existence as regards their nervous systems, and even their blood. Still, the multitude of facts which have accumulated justify the belief that deformity or other abnormal development of the fœtus is, sometimes, due to the emotions of the mother. Some of the cases related by Dr. Whitehead, in his work on hereditary diseases, are very striking and difficult to explain on the ground of coincidence. I have met the following cases. An Irish woman of strong emotions and superstitions was passing along a street in the first months of her gestation, when she was accosted by a beggar, who raised her hand, destitute of thumb and fingers, and in "God's name" asked for alms. The woman passed on; but reflecting in whose name money was asked, felt that she had committed a great sin in refusing assistance. She returned to the place where she had met the beggar, and on different days, but never afterwards saw her. Harassed by the thought of her imaginary sin, so that for weeks, according to her statement, she was made wretched by it, she approached her confinement. A female infant was born, otherwise perfect, but lacking the fingers and thumb of one hand. The deformed limb was on the same side, and it seemed to the mother to resemble precisely that of the beggar. In another case which I met, a very similar malformation was attributed by the mother of the child to an accident occurring to a near relative, which necessitated amputation during the time of her gestation. I examined both of these children with defective limbs, and have no doubt of the truthfulness of the parents. In May, 1868, I removed a supernumerary thumb from an infant, whose mother, a baker's wife, gave me the following history: No one of the family, and no ancestor, to her knowledge, presented this deformity. In the early months of her gestation she sold bread from the counter, and nearly every day a child with double thumb came in for a penny roll, presenting the penny between the thumb and the finger. After the third month she left the bakery, but the malformation was so impressed upon her mind, that she was not surprised to see it reproduced in her infant.

Professor William A. Hammond, of this city, in an interesting paper on the "Influence of the Maternal Mind," etc. (*Quarterly Journal of Psychological Medicine*, January, 1868), says: "The chances of these instances, and others which I have mentioned, being due to coincidence, are infinitesimally small, and though I am careful not to reason upon the

principle of POST HOC, ERGO PROPTER HOC, I cannot, nor do I think any other person can, no matter how logical may be his mind, reason fairly against the connection of cause and effect in such cases. The correctness of the facts can only be questioned; if these be accepted, the probabilities are thousands of millions to one, that the relation between the phenomena is direct." Professor Dalton also says (*Human Physiology*), "There is now little room for doubt that various deformities and deficiencies of the fœtus, conformably to the popular belief, do really originate in certain cases from nervous impressions, such as disgust, fear, or anger, experienced by the mother." The observations on which this belief is based relate both to man and the lower animals. A very strong argument in its support is, as Professor Hammond remarks, the popular opinion, which dates back to the time of Jacob (Genesis xxx). An almost universal sentiment, running through centuries, is rarely wholly fallacious. It has some truth for its foundation, especially when, as in this instance, the subject is one of observation.

If maternal emotions affect the development of the exterior of the fœtus, as observations show, and physiologists admit, the presumption is strong that they may affect also the proper development and adjustment of the parts of the brain, an organ so complex and delicate, and may therefore give rise to idiocy. Dr. Seguin (*Idiocy and its Treatment, etc.*, New York, 1866) thus remarks on this point: "Impressions will, sometimes, reach the fœtus, in its recess, cut off its legs or arms, or inflict large flesh wounds, before birth, . . . from which we surmise that idiocy holds unknown though certain relations to maternal impressions, as modifications to placental nutrition."

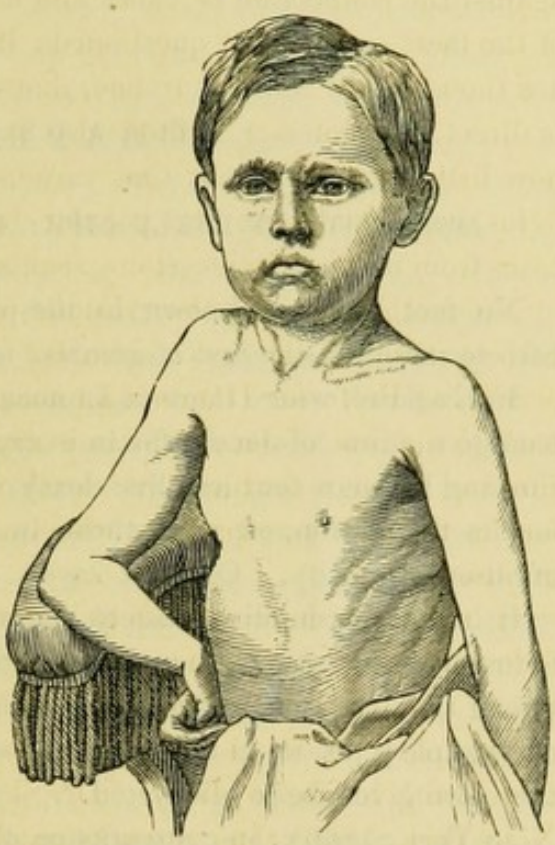
And it is an interesting fact that abnormalities of structure, occurring from whatever cause, are apt to be propagated to descendants. Dr. Carpenter and others relate instances among the lower animals, and similar instances of transmission have now and then been observed in the human race. Thus, in the issue of *Nature* for March 7th, 1878, it is stated on the authority of M. Lenglen, a physician of Arras, that a certain M. Gamelon in the last century had two great thumbs on each hand, and two great toes on each foot; this peculiarity did not appear in the son, but it reappeared in the three succeeding generations, so that some of the great-great-grandchildren possessed it in as marked a degree as their ancestors.

In view of such important facts, the duty of the pregnant woman is rendered the more imperative to avoid the presence of disagreeable and unsightly objects, as well as all causes of excitement, and to remove, as soon as possible, vivid and unpleasant impressions, by quiet diversion of the mind.

The disastrous results upon the fœtus of severe injuries received by the mother are well know to the profession, for premature labor and death of the child, or feebleness from its prematurity, are common results of such

accidents. In rare instances the child may be so injured as to be deformed for life, as in the following interesting case: Richard L., aged six years, came, in January, 1877, to the children's class in the Bureau for the relief of the Out-Door Poor. The following history was obtained: On November 27th, 1870, one month before the birth of Richard, the mother fell heavily on the ice when stepping from a city car. Uterine hemorrhage resulted, which continued more or less freely, producing marked pallor till her confinement, which occurred December 23d. The position of the child *in utero* was crosswise, but nothing untoward occurred in the delivery. Immediately after its birth, when it was being washed by the nurse, a blister, about one inch in diameter, was observed on the right side of the thorax, located about one inch below and two and a half inches externally to the nipple. A cicatrix resulted which now marks the site of the sore. When the blister healed, the child seemed entirely well, and nothing more was thought of the unusual occurrence of an intra-uterine vesication, till nearly half a year had elapsed, when the thorax below the nipple and at the site of the cicatrix was observed to be depressed, and the depression has continued to the extent indicated in the wood-cut.

Fig. 1.



The ribs at the point of depression are found to be widely separated; the rib below being pushed downward so as to form one side of the triangle, its cartilage the second side, and the rib above the hypothenuse. The distance of the perpendicular line passing from the costo-chondral articulation of the lower rib to the upper rib, or the hypothenuse, is two and a half inches by measurement. The depression in this triangular space evidently resulted gradually from the wide separation of the ribs, and the consequent loss of resiliency in the thoracic walls in the space destitute of bony support. The child lay crosswise *in utero*, and it seems probable that the injury was produced by the pressure of its arm against the ribs during the fall. Cases like the above, and the graver cases in which fœtal life is sacrificed, or the child is born to a puny and uncertain existence from prematurity, show the very great importance of a quiet and regular life on the part of one who is about to become a mother; for bodily injuries, like unpleasant sights, occur when least expected.

CHAPTER III.

MORTALITY OF EARLY LIFE: ITS CAUSES AND PREVENTION.

No fact is better known in the profession, than that the first years of life constitute the period of greatest mortality.

In England, where there is an accurate registration of births and deaths, statistics show fifteen deaths in every hundred infants in the first year of life, and between four and five deaths in the first month. Statistics on the continent correspond with those in England, as regards the periods of greatest mortality. Quételet says: . . . . "There die during the first month after birth, four times as many children as during the second month after birth, and almost as many as during the entirety of the two years that follow the first year, although even then the mortality is high. The tables of mortality prove, in fact, that one-tenth of children born die before the first month has been completed."

In this country, in consequence of deficient registration of births, the percentage of deaths to births cannot be accurately ascertained. In this city, 53 per cent. of the total number of deaths occur under the age of five years, and 26 per cent. under the age of one year. According to the census of 1865, there were in New York City 95,020 children under the age of five years, and during the five years ending with 1865, 49,000 children five years old and under had died. Therefore, according to these statistics, more than one-third of all the infants born in this city die under the age of five years. An error, however, occurs from the fact that, while the death statistics were complete, it is known there were more children in the city than were embraced in the census returns. Still it may, I think, be safely stated that one-fourth of the children born in this city die before the age of five years.

In less crowded cities and the rural districts, it is known that the percentage of deaths in the first years of life to the total number of deaths is considerably less than in New York City, but it is nevertheless large.

As the child advances towards puberty, the liability to sickness and death gradually diminishes, but even the last years of childhood present a considerably larger percentage of deaths to the population than does youth or manhood.

The causes of this great mortality of infants and children, and the means of diminishing it, deserve careful consideration.

Some of the causes which conspire to produce it are to a considerable

extent unavoidable. Such are congenital vices of formation of internal organs. Many of the internal malformations necessarily occasion an early death. Cases of anencephalus, most cases of congenital hydrocephalus, of spina bifida, of cyanosis, are fatal before the close of infancy. These defects of formation we cannot detect before birth, and their causes are often obscure. Some of them seem to result from inflammation, believed to be, occasionally, syphilitic, developed at some period of fœtal existence. Other internal malformations are attributable to perturbating influences, operating temporarily on the mother during gestation. But in a large proportion of cases, we cannot assign the cause. Obviously, only partial success can attend our efforts, as regards prevention in these cases, and almost no success, as regards the use of remedial measures.

Another obvious cause of the great mortality of early life, is natural feebleness of system, especially in infancy. The younger the patient, prior to the middle period of life, the sooner are the vital powers exhausted by disease. Hence a larger proportion of infants succumb to the same malady than children, and a larger proportion of children than adults. This statement is true of infancy and childhood in general. It is a law in nature, and cannot be changed by art. But there are many infants born with hereditary disease, or a strong predisposition to disease, through a fault, which is, in a degree, curable, in the system of one or both parents, as, for example, the syphilitic, scrofulous, or tubercular diathesis. Parents seriously affected by such diseases cannot, without corrective treatment, have healthy offspring. Their children are among the first to droop and die, either directly from the inherited disease, or from feebleness of constitution, which such disease entails, and which renders them an easy prey to other diseases. The duty of the physician, as regards such parents, is obvious. He may, by therapeutic and hygienic measures, secure a more healthy progeny, and, so far as he can do this, he aids in diminishing the infantile mortality. He may sometimes, by timely measures directed to the infant, establish a better state of health.

The subject of hereditary disease is one of great interest and importance, especially as regards the city population. Inherited affections are less common in the country, but in the city they contribute largely to the number of deaths in early life.

Another important cause of the great mortality of children, is the fact that they are peculiarly liable to certain severe and fatal maladies. I allude particularly to the acute infectious diseases, which, as a rule, occur but once, and that in childhood. Some of them, as scarlet fever, greatly increase the number of deaths. They extend and become epidemic through the intercourse of children. We are constantly witnessing in New York the spread of the acute contagious diseases, especially of whooping-cough, measles, scarlet fever, and diphtheria, through the schools. Measures employed, thus far, by boards of health, or other local authorities, to pre-

vent the dissemination of these and kindred diseases, have been but partially successful except in regard to smallpox. In the large public schools especially these maladies are most frequently contracted, and from them they radiate over the school districts. For if, as is now common, at least in New York City, a child comes to school wearing clothes which at home are hanging in a room where a brother or sister lies sick with measles or scarlet fever; or if he enters the class with a mild pertussis or diphtheria, certain of his class-mates will probably return home infected with the virus of the disease. The same remarks are applicable, though with less force, to private schools. From both such schools I have over and over again witnessed the dissemination not only of the maladies mentioned, but also of the milder infectious diseases, as mumps and varicella. The Health Board of New York city have recently, by stringent enactments regulating the schools, accomplished much in suppressing this source of the infectious diseases.

In hospitals and asylums for children much can be done to prevent the occurrence of the infectious diseases by strict surveillance and prompt isolation of all suspicious cases. Without such care, scarcely a year passes in which these institutions are not scourged by one or more of these diseases. Much has been said of the crowding of families in tenement-houses so common in New York and other large cities, by which a large number of children are brought under one roof; of the uncleanliness of person and apartment to which it leads, and of the insufficient air and space which it allows to each. But one of the strongest objections, in my opinion, to the present plan of building and crowding tenement-houses is the facility which it affords to the spread of the contagious diseases of childhood; and it is in such houses, as shown by statistics, that these maladies are the most frequent and fatal. The much-needed enactments or regulations in relation to the construction and occupancy of such houses, would, among other salutary effects, greatly diminish the death-rate from the infectious maladies.

Over the most loathsome, and formerly the most fatal, malady of mankind, namely, smallpox, we now have, or can have, complete control by statutory enactments, enforcing vaccination. It is only by carelessness or the lack of sufficiently stringent regulations relating to the matter that smallpox is not "stamped out." Again, some of the most fatal inflammatory diseases of life occur chiefly in childhood, as croup and capillary bronchitis. These and kindred diseases can only be prevented by proper hygienic management on the part of families, and books, or other means calculated to educate families in reference to the management of children cannot fail to diminish the number of cases of such inflammations, and consequently of the deaths from them.

Another obvious and important cause of the mortality of early life, is

the anti-hygienic condition or state in which many children live in consequence of the poverty or gross negligence of parents.

Residence in insalubrious localities, personal and domiciliary uncleanliness, exposure without proper protection to vicissitudes of weather, are fertile causes of sickness and death. Hence one reason of the great infantile mortality among the city poor, who live in damp and dark alleys, and in crowded and filthy tenement-houses, breathing night and day an atmosphere loaded with noxious gases. All physicians are aware how the malignant diseases, such as Asiatic cholera, cholera infantum, diphtheria, and typhus fever, seek the quarters of the city poor, and what terrible havoc they make there. All are aware, also, what wonderful recoveries occur, when feeble and attenuated infants, gradually sinking with chronic diseases, induced in great measure by this malaria, are transferred from such localities to the pure air of the country.

Careless management of young children as regards dress increases greatly the liability to local diseases, such as commonly occur from exposure to cold. These are inflammatory affections, seated chiefly upon the mucous surfaces, but sometimes in parenchymatous organs. Adults, aware of the effect of sudden change of temperature from warm to cold, or of exposure to currents of air, protect themselves by additional clothing. Such precautionary measures are often lacking in the management of young children, and hence one cause of their great liability to local affections, both of the respiratory and digestive organs.

Routh, in his excellent treatise on *Infant Feeding*, says: "Among the most pernicious influences to young children, however, we may include cold; the change of temperature from 45° to 4° or 5° below zero, as before stated, producing an increase of mortality in London alone of three to five hundred. As out of one hundred deaths, however, from all specified causes, nearly twenty-four occur to children under one, and thirty-six to children under five; the great increase of mortality to children by cold is thus at once made obvious. Indeed, it is a household word amongst us, which takes its origin from the Registrar-General's returns, that a very cold week always increases the mortality of the very young and the very aged."

Lastly, a very important cause of mortality in early life is the use of improper food. In infants, artificial feeding in place of the aliment which nature has provided for them, and, in children, the use of innutritious or indigestible articles of diet, give rise to diarrhœal maladies, emaciation, and death in numerous instances. Sometimes, also, defective alimentation is the cause of scrofulous or tuberculous ailments, and sometimes it gives rise to a cachexia or feebleness of system, which, without engendering any positive disease, renders those thus affected less able to support disease induced by other causes. A committee, of which Prof. Austin Flint, Jr., was chairman, appointed in 1867 to revise the "dietary table of the Chil-

dren's Nurseries on Randall's Island," states, with much truth and force: "Children . . . . are not capable of resisting bad alimentation, either as regards quantity, quality, or variety. At that age the demands of the system for nourishment are in excess of the waste; the extra quantity being required for growth and development. If the proper quantity and variety of food be not provided, full development cannot take place, and the children grow up, if they survive, into puny men and women, incapable of the ordinary amount of labor, and liable to diseases of various kinds."

Improper feeding, like other causes of mortality, is much more injurious, much more frequently the cause of death, in the city than in country. Statistics in Europe, as well as this side of the Atlantic, establish this fact. It is in infancy, and especially in the first year, that the use of unwholesome food entails the most serious consequences. No artificially prepared food is a good substitute for the mother's milk, and hence artificial feeding of the infant, unless under the most favorable circumstances, results disastrously. In the country, where salubrious air and sunlight conspire to invigorate the system, and a robust constitution is inherited, and where cow's milk fresh and of the best quality is readily obtained, lactation is not so necessary for the wellbeing of the infant; but in the city its importance cannot be too strongly urged.

The foundlings of the cities afford the most striking and convincing proofs of the advantages of lactation. In some cities foundlings are wet-nursed, while in others they are dry-nursed, and the result is always greatly in favor of the former. Thus, on the continent, in Lyons and Parthenay, where foundlings are wet-nursed almost from the time that they are received, the deaths are 33.7 and 35 per cent. On the other hand, in Paris, Rheims, and Aix, where the foundlings are wholly dry-nursed, their deaths are 50.3, 63.9, and 80 per cent.

In this city the foundlings, amounting to several hundred a year, were formerly dry-nursed; and, incredible as it may appear, their mortality, with this mode of alimentation, nearly reached 100 per cent. Now wet-nurses are employed, for a part of the foundlings, with a much more favorable result.

These facts, to which others might be added from the experience of European cities, show the importance of lactation as a means of reducing infantile mortality in the cities. What has been stated as regards the result of artificial feeding of foundlings, is true, in great measure, in reference to all city infants. The ill effect of artificial feeding is well known in this city, and it is the common practice in families to employ a hired wet-nurse, if, for any reason, the mother's milk is insufficient.

When the infant has reached the age at which it is proper to wean it, the digestive organs are less frequently deranged by errors of diet. More substantial food, and considerable variety in it, may now be not only

safely allowed, but are required by the wants of the system. Still, the feeding of children in health, and much more in sickness, is a subject of great importance. Therefore lactation, and the diet of infancy and childhood, will occupy our attention in the following pages.

CHAPTER IV.

LACTATION.

It is desirable that the infant, as soon as it requires nutriment, should receive breast-milk. If it is fed, for a few days, with the bottle or spoon, it may be difficult finally to induce it to take the breast; therefore it is well to determine early whether the mother will be able to wet-nurse her infant, so that, if unable, suitable provision may be made.

The matter of determining, beforehand, the capability of the mother for wet-nursing has been investigated by Dr. Donné, of Paris, and in his treatise on Mothers and Infants he describes the mode in which it may be ascertained. The desired information, in his opinion, may be acquired by examining the colostrum, which is secreted in small quantity, in the last months of gestation, and which can be squeezed from the breast in sufficient quantity for inspection.

In some women, according to Dr. Donné, the colostrum is so scanty that only a drop, or half a drop, can be obtained from the nipple by careful pressure. This will be found by the microscope to contain but few milk-globules, ill-formed, and a few granular bodies, such as the colostrum ordinarily contains. Such women almost invariably furnish poor milk, and in small quantity. In other women the colostrum is abundant, but thin, resembling gum-water; it lacks the yellow streaks and viscous character of ordinary colostrum, and it flows readily from the nipple. The milk of such women is sometimes scanty, sometimes abundant, but it is watery and deficient in nutritive principles. In a third class of women, the colostrum is pretty abundant, and it contains yellowish streaks, of more or less consistence, which are found to be rich in milk-globules, of good size. Women furnishing such colostrum in the last weeks of gestation will have sufficient milk, and of good quality. These latter women make the best wet-nurses.

Hindrances to Lactation and Physical Conditions rendering it Improper.

The primipara often experiences difficulty in wet-nursing in consequence of a depressed state of the nipple. It is not sufficiently prominent to be

readily grasped by the mouth, and after ineffectual attempts the infant becomes fretful when applied to the breast, and perhaps for a time refuses it altogether. Multiparæ occasionally experience the same inconvenience, but it is not common when there has once been successful lactation. By calmness and perseverance on the part of the mother, the infant can usually be made to seize the nipple in the course of a week.

Depression of the nipple is, to a certain extent, the result of pressure upon it by the dress during gestation. The state of the nipples should, indeed, in those who have never suckled, receive early attention, even before the birth of the infant. Tightness of dress around the breast, as indeed upon every part of the body, should be avoided, and from time to time gentle traction should be made upon the nipple, if it is depressed. It may be drawn out by the fingers of the mother several times each day, or by a common breast-pump, or by suction with a tobacco pipe, the edge of the bowl having been smoothed. Occasionally, in these cases of deficient nipple, the mother, fatigued and discouraged by her frequent ineffectual attempts to induce the infant to nurse, becomes feverish and excited, so that the quantity of her milk is sensibly diminished. The physician should assure her, as he usually can with confidence, that in a few days, as the baby becomes a little stronger, there will be no difficulty in its nursing. Some women are unremitting in their endeavors to procure nursing. This should be forbidden, since the lack of sleep, and the nervousness which such constant attention produces, tend to defeat the object which they have in view, by diminishing the secretion of milk. The application of the infant to the breast once in an hour and a half to two hours is quite sufficient. In some cases, when practicable, the aid of another woman, whose infant is a little older, is invaluable. The exchange of infants for a few times may remedy the difficulty.

Occasionally lactation is rendered difficult and painful by too long delay before applying the infant to the breast. When the mother has rested a few hours after her confinement, about six in ordinary cases, lactation may commence. There is, at first, but very little milk, often only a few drops, but the secretion is promoted by nursing, so that the requisite amount is sooner obtained than when the infant is kept from the breast till the second or third day. If, as some physicians advise, suckling is deferred till the breasts are full and tender, and if, as is often the case with primiparæ, the nipples are also tender, many mothers lack the fortitude required to allow their infants to obtain a sufficient amount of milk. Excoriated and fissured nipples constitute a serious impediment to lactation. They are very sensitive on pressure, and are long in healing. They are fully described in works which relate to female diseases, and their treatment pointed out. Occasionally fissured nipples do harm to the infant by the blood which escapes and is swallowed with the milk. A case is related in which positive indigestion was caused in this way, the

infant vomiting, after each nursing, milk mixed with blood. The local hindrances to lactation described above can, in most instances, be relieved in the course of a few weeks.

There is, occasionally, a constitutional state of the mother which necessitates either the employment of a hired wet-nurse or weaning. This is the case when there is a strong tendency to tuberculosis. If the complexion is pallid, and the system at all emaciated, and suckling is attended by more or less exhaustion, and if with fair trial of wine and tonics there is no improvement, the physician is justified in forbidding farther attempts at wet-nursing. If there is, under such circumstances, an hereditary tendency to tuberculosis, it is his duty to interdict it positively. The opinion of the physician, in such a matter, should be formed after mature deliberation. There are many women who, suffering temporarily from depression, and discouraged, are ready at once to abandon their infants to the care of others, with the least encouragement on the part of the physician to do so, but who, by attention to their own health, and especially by taking more sleep, soon recover from their depression and become good wet-nurses. On the other hand, night-sweats, a cough, and progressive decline in health, show the need of immediate suspension of wet-nursing.

Sometimes women, prior to pregnancy, present indubitable evidence of tuberculosis, but by the improved general health which attends pregnancy, the disease is temporarily arrested. Such women should never suckle their infants. If they do, they soon lose all that was gained, and the disease advances rapidly. These objections to wet-nursing in such a state of health apply to the mother. There are also objections as regards the infant. The milk of those in decidedly infirm health, is deficient in nutritive principles. Their infants, therefore, are ill-nourished, and, if they have inherited a predisposition to tuberculosis, there is great danger that this disease will be developed in them; whereas with healthy wet-nursing, even a strong predisposition may remain latent. M. Donné relates the following instructive cases, which show the danger which sometimes attends suckling, and the imperative necessity which may arise of discontinuing it. "A very light-complexioned young mother, in very good health, and of a good constitution, though somewhat delicate, was nursing for the third time, and as regarded the child successfully. All at once this young woman experienced a feeling of exhaustion. Her skin became constantly hot; there were cough, oppression, night-sweats; her strength visibly declined, and in less than a fortnight she presented the ordinary symptoms of consumption. The nursing was immediately abandoned, and from the moment the secretion of milk had ceased, all the troubles disappeared." "A woman of forty years of age . . . . having lost, one after another, several children, all of whom she had put out to nurse, determined to nurse the last one herself. . . . . This woman, being vigorous and well-built, was eager for the work, and, filled with devotion and spirit, she gave herself up to the

nursing of her child with a sort of fury. At nine months, she still nursed him from fifteen to twenty times a day. Having become extremely emaciated, she fell all at once into a state of weakness, from which nothing could raise her, and two days after the poor woman died of exhaustion.

A very similar case recently occurred in my practice. A young and healthy woman from the country, suckling her second infant, on coming to the city, lived in a dark and very imperfectly ventilated room, on the first floor, and in the rear of a crowded tenement-house. She soon lost her appetite, but continued suckling for three months, when she became so anæmic and feeble that she was compelled to seek medical advice. She died without local disease, notwithstanding the most nutritious diet and the free use of stimulants and tonics.

Constitutional syphilis in the mother does not contraindicate lactation. It is probable that the infant also has it. The mother should take anti-syphilitic remedies, which will eradicate the disease in herself, and also, if it be present, in the infant. Febrile affections, also, do not in general contraindicate lactation. They may, however, for a time, diminish the quantity of milk, or impair its quality. If, however, the mother is in a critical state, or much reduced, whatever the disease, suckling should cease. Whether or not the infant should be taken from the breast, if the mother is suffering from one of the essential fevers, depends on the severity of the malady, and the degree of her exhaustion. Twice I have known newly born infants nurse their mothers through attacks of scarlet fever, without contracting it, but suffering immediately afterwards from severe and protracted eczema. In the country, where artificially fed infants as a rule do well, it might be best to wean if the mother is affected with such a disease, but in the city eczema is less dangerous than the diarrhœal affections which early weaning is apt to entail. In most cases of typhus or typhoid, weaning or procuring a wet-nurse is necessary, on account of the depression of the vital powers which this disease produces.

Inflammatory affections, unless of a dangerous character, do not ordinarily interfere with lactation, except that the quantity of milk may be somewhat diminished. In severe inflammation, it may be so necessary to husband the strength, or to keep the patient perfectly quiet, that suckling her infant would be injudicious. It should then be transferred to a wet-nurse or weaned. Inflammation of the breast often presents an impediment to lactation. It is a common and painful affection, suspending, or greatly diminishing the secretion of milk in the affected gland. Nursing should cease as soon as there are evident signs of inflammation, unless it is limited to a small part of the gland. General heat of the breast, with tenderness and induration extending over a considerable part of it, indicate the need of the immediate removal of the infant from it. Lactation must be restricted to the unaffected side. It is often the case that the volume of the inflamed gland is considerably increased from the afflux of

blood to it, and from the interstitial exudation, while it contains little or no milk, and attempts at lactation, under such circumstances, are injurious to the mother as well as to the infant. The cause of the swelling should be explained to the mother, who commonly attributes it to the accumulation of milk, and worries herself and the infant, by attempts to make it nurse. As the inflammation abates, by resolution, or more commonly by suppuration, and the normal secretion returns, the first milk, which is apt to be thick and stringy, should be rejected, after which the infant may nurse as usual. Occasionally, the abscess, which has formed in the breast, connects with a lactiferous tube, so that pus may, on suction, escape from the nipple. If this occur, of course lactation should be interdicted until pure milk is obtained. Pus in the milk can sometimes be detected by the naked eye. It presents a yellowish or greenish color, occurring in streaks, when not intimately mixed with the milk. When it is intimately mixed, and in small quantity, it cannot be detected by the naked eye, but the microscope reveals the pus-globules. M. Donné relates a case in which he discovered pus-globules by the microscope, although there were at first no other evidences of an abscess, and doubts were expressed in reference to the accuracy of his observation. Finally, an abscess pointed and discharged.

Sometimes, when the inflammation abates, the secretion does not return, and, worse still, occasionally the inflammation has occurred so near the nipple that the lactiferous tubes are permanently closed by it, so that, though milk forms in the breast, there is no escape for it. Thenceforth lactation must be entirely from one breast.

If erysipelas occur in the mother, the infant should be immediately taken from her breast and from her arms. If this disease should not be communicated to the infant through the milk, or through fissures in the nipple, of which there is danger, still the milk is apt to undergo such change in consequence of the erysipelas as to endanger the health of the child. Thus, one of the wet-nurses in the New York Infant Asylum sickened with severe facial erysipelas on the 24th of April, 1875, eight days after the death of her baby. She was wet-nursing a foundling, aged seven weeks, at the time of the commencement of the erysipelas, and as it was very important that her milk should be preserved for the coming hot months, it was deemed best to allow the nursing to continue, the infant being placed in a crib at a little distance as soon as it dropped the nipple. On the 27th diarrhœa commenced in the baby. April 28th its morning temperature was 101°, and that of the evening 103°, the diarrhœa continuing. It was now removed entirely from the breast, and was given artificial food. On the 29th there was a decided general icteric hue of the infant's surface, which continued till its death on May 1st. The stools numbered about eight daily till April 30th, when they ceased. The record which I preserved does not state whether there was vomiting, but

it had probably been slight on account of the speedy prostration. Death occurred from exhaustion. At the autopsy, from half an ounce to one ounce of pus was found in the peritoneal cavity, newly formed fibrin was observed upon the spleen and liver, and the peritoneum generally had lost much of its lustre; a careful microscopic examination of the liver and its ducts, made by Dr. Heitzmann, revealed no anatomical change which would explain the icteric hue, and it seemed probable that this was due to the altered state of the blood. The mucous membrane of the intestines exhibited vascular streaks, and its follicles were distinct. The lesions therefore indicated intestinal catarrh. Nothing unusual was observed in the heart and lungs of the infant. Its life had apparently been sacrificed by the unhealthy nursing.

Facts and Rules in reference to Lactation.

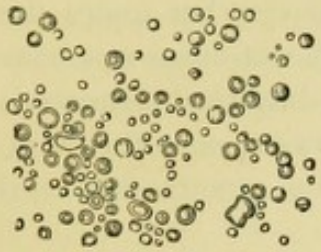
The new-born infant may nurse often, even every hour during the daytime, till it is two weeks old, after which it should take the breast quite regularly every second or third hour in the daytime, and every third or fourth hour at night. An infant in ordinary health and obtaining a sufficient quantity of good milk every second hour from its mother, does not require to nurse more than once or twice during the hours which the mother needs for sleep, and by a little perseverance its habits may be so established that it requires the breast no oftener. After the third or fourth month it is proper to allow a little artificial food in addition to the breast milk, as we will see hereafter. Many young mothers commence the duty of suckling with too much ardor. Exerting themselves to the utmost for the good of their offspring, they are awake, night after night, giving their breast at every cry, till they find that their strength is failing, and with it also their milk. Their self-devotion necessitates early weaning, whereas, had they exercised more regard for their own health, and learned to hear with composure the cries which often do not indicate any bodily want or distress, they might have continued to suckle the infants during the usual period.

The milk secreted during gestation, and immediately after the birth of the infant, differs in its gross appearance, as well as chemical and microscopical characters, from that which is ordinarily secreted during lactation. It is termed Colostrum. It has a turbid and yellowish appearance, and is somewhat viscid. It is decidedly alkaline, and undergoes lactic acid fermentation more readily than common milk, and it also contains more solid matter. It has an excess of fat, of salts, and, according to Simon, also of sugar. It appears, from Simon's analysis, that the solid matter of colostrum is about seventeen per cent., while that of the ordinary breast-milk is about eleven per cent.

Examined by the microscope, the colostrum is seen to contain oil-glob-

ules and a viscid substance, which often assumes an ovoid or globular form, but which also exists in irregular masses of considerable size. This substance has been thought by some to be mucus, but it is dissolved by acetic acid and potash, and is tinged yellow by a watery solution of iodine. It is, therefore, to be regarded as albuminous. Imbedded in this substance are oil-globules, which are for the most part of small size, while the free oil-globules of colostrum are larger than those occurring in

FIG. 2.



Milk-globules.

FIG. 3.

Colostrum-corpuscles.

healthy milk. This viscid substance, with the imprisoned oil-globules, constitutes what has been designated the "colostrum-corpuscles." Some have erroneously considered the "colostrum-corpuscles" to be compound granular cells. The compound granular cell, or corpuscle, is a cell which has undergone fatty degeneration. It is distended with oil-globules to perhaps twice or thrice its normal size. On the other hand, examination of the "colostrum-corpuscles" fails to detect a cell-wall, and the large and irregular size of some of these corpuscles negatives the idea that they are cells. The oil-globules contained in the viscid substance are more readily acted on by ether than are the free oil-globules.

The colostrum is replaced by milk of the normal character, in six to eight days: sometimes as early as the third or fourth day after delivery. In exceptional instances, the colostrum does not disappear for several weeks, and it may reappear at any time during lactation, as a consequence of derangement of the system, or from disease. It is assimilated with difficulty by the digestive organs of the infant, producing usually a laxative effect. It, therefore, aids in the removal of the meconium, and being a normal secretion in the first week of lactation, it is to be regarded as beneficial. Continuing longer than the first week, its effect is deleterious. It produces evident derangement of the digestive organs, and the infant that habitually nurses it never thrives. It has diarrhœa or vomiting, becomes more or less emaciated, and suffers from colicky pains. Sometimes an extreme degree of exhaustion is reached before the cause is suspected, for if the milk is pretty abundant, the admixture of colostrum with it cannot be detected by the naked eye. The microscope alone reveals it. The following is an interesting example of this fact. In 1868 an infant six

weeks old was brought to me, with the following history. The mother had for years been troubled more or less with dyspeptic symptoms, but had otherwise been in good health. The infant at birth was fleshy and strong, but after the first week it had never thriven like other infants. It nursed regularly, and the quantity of milk was apparently sufficient, but it vomited as soon as it ceased nursing; it was much emaciated, and the bowels were habitually constipated. The digestive organs of the infant had been in this unhealthy state, with little variation, from the first week, and it was very evident, from the emaciation and exhaustion, that it must soon perish, unless some change were effected. The milk of the mother presented the usual appearance to the naked eye, but under the microscope colostrum-corpuscles were observed. A wet-nurse was immediately obtained, and from that moment the gastro-intestinal symptoms disappeared with a rapid recovery. This case shows at once the evil effects of the colostrum, and the need of a microscopic examination of the milk whenever the nursling suffers from lactation.

Human Milk.

The specific gravity of human milk is about 1032. It has been carefully analyzed by different chemists, with nearly the same result. The following table, prepared by MM. Vernois and Becquerel, gives the proportion of the various ingredients in 1000 parts:—

Water	889.08
Sugar	43.64
Casein and extractive	39.24
Butter	26.66
Salts (ash)	1.38
	1000.00

Milk, being the sole food of early infancy, contains all the nutritive principles which are required for the growth and repair of the different tissues. The casein is an albuminous principle, the butter and sugar are combustible substances, and most of the salts which occur in the different tissues exist primarily in the milk. Phosphate of lime, phosphate of magnesia, phosphate of the peroxide of iron, chloride of potassium, chloride of sodium, and soda, known to exist in cow's milk, are believed to occur also in human milk. Epithelial cells are sometimes present, derived from the lining membrane of the lactiferous tubes.

Modification of the Milk in consequence of the Diet.

Fresh milk should give an alkaline reaction, but in certain states of ill health, or after the use of certain articles of food, the reaction is acid. Mothers are well aware of the ill effects, as regards the infant, which

follow their use of indigestible, or acescent food; and, if prudent, they avoid it. The milk, if the diet of the mother is improper, may become so strongly acid as to cause colicky pains and diarrhœa. The following observations in reference to cow's milk are instructive. We may infer from them that the regimen of the mother exerts a decided influence on the alkalinity of her milk. According to Routh (*Infant Feeding*, page 285), stall-fed cows almost always give acid milk. Dr. Mayer, of Berlin, examined the milk from a considerable number of cows, with the following result:—

(*a.*) Of cows fed with brewers' lees, red potatoes, rye bran, and wild hay, in five instances the milk was slightly acid; in one very much so.

(*b.*) Of forty cows fed with potato mash, barley husk, and clover and barley straw, in ten, which were examined, the milk was acid; in three very acid.

(*c.*) From among fifty cows fed on potato husks, barley husks, and wild hay, five were examined, and in all the fresh milk was acid.

(*d.*) From forty-two cows fed on potato mash, husks, wild hay, and rye straw, out of twelve selected for examination, the fresh milk of all was acid.

(*e.*) From six cows fed by a chief gardener on coarse beet-root, red potatoes, bran mash, and hay, the fresh milk was slightly acid.

(*f.*) From five cows fed by a cow-feeder on lukewarm bran mash and hay, in four the fresh milk was quite neutral, in one it was decidedly alkaline. (*Routh.*)

The above observations of Dr. Mayer were made in the winter season, and it is possible that the acidity may have been partly due to the confinement of the cows in stalls. But that it was mainly due to the food is evident from the fact that it was greater with some kinds of food than others. Cows' milk is not so alkaline as human milk, and is therefore more readily rendered acid. Still, what Dr. Mayer observed in reference to the cow exemplified a fact of general applicability, namely, that certain kinds of food may affect the alkalinity of the milk, whether human milk or that of animals.

The relative proportion of the different ingredients of the milk varies according to the diet. If the diet is poor, the amount of water increases, and that of butter and casein diminishes. Lehmann says (*Phys. Chemistry*, vol. ii. p. 65): "From experiments made on bitches, it would appear that a vegetable diet renders the milk richer in butter and sugar; while the solid constituents are augmented when a sufficient quantity of mixed food is given. Peligot found the milk of an ass most rich in casein when the animal had been fed on beet-root; whilst it was richest in butter when the food had consisted of oats and lucerne. Fat food increases the quantity of the butter. Boussingault found the milk of a cow richer in casein when the animal had been fed on potatoes than when other food

was taken. Reiset found that the milk of cows which were at grass was much richer in fat than when the animals had stood all night in their stall without food; but Playfair found, on the contrary, that the quantity of butter in the milk increased during the night as much as during their stall-feeding, but that the quantity of butter in the milk was considerably diminished by the motion of the animals in the fields."[1] Simon made the following analyses of the milk of a poor woman. She was suddenly, during the period of lactation, deprived of the means of support, so that her food was insufficient in quantity, and of poor quality. The amount of her milk was not diminished by privation, but the solid constituents were reduced to 86 parts in 1000. After this, for a time, her diet was nutritious and abundant, the quantity of milk was increased, and the solid constituents amounted to 119 parts in 1000. Her diet was again reduced, with a reduction of the solid elements to 98 in 1000, and, at a later period, the diet was again nutritious, with an increase of the solid elements to 126. The chief variation observed in the milk of this woman was in the amount of butter.

Modification of Milk from its retention in the Breast.

M. Peligot has clearly demonstrated, that the longer milk is retained in the breast the more watery it becomes. This is explained on the supposition that the solid portion is first absorbed. Therefore, the milk is richer the more frequently it is removed from the breast. A similar fact, which has the same explanation, has long been known, namely, that the first milk taken from the breast is thinnest, while that which flows last is richest. That first removed has remained longest in the gland, while that which comes last is but recently secreted.

A knowledge of this fact is of considerable practical importance. The milk, as M. Donné has shown, may be too rich, so as to cause indigestion, with more or less enteralgia, in the infant. Some nurslings, if the milk is too rich and abundant, reject a part of it by vomiting, but others do not, and suffer the consequence in derangement of the digestive organs. For such cases the remedy is, to give the breast less frequently, by which a less amount of milk is taken, and milk of a poorer quality. On the other hand, if there is poverty of the milk, and the infant is insufficiently nourished, the milk is more nutritious, if the nursing be at short intervals.

Modification of Milk by Age and by Mental Impressions.

The composition of the milk varies, also, according to the age of the infant. Simon analyzed the milk of a woman at intervals for the period

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[1] Animal Chem., Sydenham's Soc.'s Trans., vol. ii. p. 55.

of about six months. In this case the amount of casein at first was small, but the quantity increased during the two months succeeding delivery, after which it was nearly stationary. A similar increase was observed in reference to the saline substances. The sugar, on the other hand, diminished in quantity as the infant grew older, its maximum amount being in the first and second months. The quantity of butter in the milk varies from day to day more than the other elements.

Many observations have been published which show that the composition of the milk may be materially changed by mental impressions. The infant has died suddenly in the act of nursing, after his mother had been violently excited. Such a case is related by Tourtnal. The infant ceased nursing, gasped, and died in the mother's lap. In other cases convulsions have occurred. MM. Becquerel and Vernois made the chemical analysis of the milk of a woman in a state of nervous excitement, and found that the solid constituents were diminished to 91 parts in 1000, the most marked diminution being in the butter, which was only about 5 parts. In a case related by Parmentier and Deyeux the milk became watery and viscid, and remained so till the nervous attacks, from which the patient suffered, had ceased. Dairymen are well aware how ill-treatment and the separation of the calf from the cow diminishes the milk which she yields. A new milkman seldom obtains as much milk as one with whom the cow is familiar. Bouchut, alluding to the influence of the moral affections on the secretion of milk, makes the following remark, the truth of which most mothers will acknowledge: "It is also a fact, that the sight of the nursling, the idea of seeing it at the breast, and the joy which certain mothers thence experience, exercise a moral influence over the secretion of the milk entirely independent of their will. They feel the draught of milk as soon as they behold their child, or think of it too deeply; and in a woman who saw her child fall to the ground, the flow of milk ceased, and did not reappear until the child, having quite recovered, attempted to take the breast."

Modification of Milk by the Catamenial Function and Pregnancy.

The catamenia reappear in most women before the close of lactation, often by the fifth or sixth month after delivery. If this function is re-established in the normal manner, that is, without any derangement of the system, without pain or undue profuseness, no unfavorable result ordinarily occurs with the infant. On the other hand, if the mother suffer any disturbance of the system, or if the menses are profuse, the lacteal secretion may be so changed that the infant is injuriously affected by it. The symptoms produced are those of indigestion, such as abdominal pains, more or less vomiting, and diarrhœa. This result is, however, in my experience, quite exceptional. In rare instances, more dangerous symptoms

occur in the infant. A case has been reported to me in which, at each catamenial period, the nursling was seized with convulsions.

MM. Becquerel and Vernois have investigated the character of the milk during the catamenia in three cases. Their examinations showed a moderate increase in the solid constituents. The butter and casein were increased, while the sugar was diminished. The variation from normal milk was not, however, such as would be likely to cause any serious indisposition. If the menses reappear with regularity, when the infant has attained the age of ten or twelve months, they should be considered as designed to supersede the secretion of milk, which, indeed, usually begins to diminish. Weaning is then proper. If the menses return early in the period of lactation, and give rise to symptoms in the infant in consequence of the altered quality of the milk, it is advisable to allow but little nursing during the catamenia, and to employ artificial feeding instead, till the flow of blood ceases.

The change produced in the milk by pregnancy is, in general, more injurious to the nursling than that caused by the reappearance of the menses. The milk of the pregnant woman is apt to contain more or less of that viscid substance which characterizes colostrum. Still, the milk of pregnancy does not, ordinarily, derange the digestive function as much as colostrum, in the first weeks of lactation, for pregnancy rarely occurs till after the infant is five or six months old, when the organs of digestion are less readily disturbed. The injurious effect of pregnancy on the infant is shown by vomiting or diarrhœa, by restlessness and occasional abdominal pains, in fine, by symptoms of indigestion. In many cases, however, these symptoms do not occur, and the infant, though nursing regularly, continues to thrive. No doubt, as a rule, the infant should be weaned when there are clear evidences of pregnancy, but under certain circumstances weaning is injudicious. I have, on different occasions, been called to infants, in midsummer, dangerously sick with diarrhœal attacks induced by this cause. These infants were, perhaps, doing well, or suffering but little from indigestion, when the mothers, suspecting themselves pregnant, at once withdrew them from the breast, and cholera infantum or a kindred disease was the result. No infant in the city should be weaned in the hot months. It is much safer, though there are indubitable signs of pregnancy, that it continue nursing till the cold weather. The better method is, however, under such circumstances, to employ a wet-nurse, or to remove the infant to the country, and wean it there. In cold weather, it is usually safe to wean an infant in the city after it has reached the age of five or six months.

The milk frequently contains other ingredients in addition to those which have been mentioned. Thus a large number of medicinal substances, taken by the mother, may enter the milk, so as to produce their characteristic effect on the infant. It is a well-known fact, that the pecu-

liar flavor of certain vegetables, taken as food, may be noticed in the milk. It is admitted, also, that the specific virus of the contagious diseases, at least certain of them, may enter the milk, so as to give rise to the same diseases in the infant.

Quantity of Breast Milk required by the Infant.

In a paper published by Dr. W. H. Cumming, in the *American Journal of the Medical Sciences*, July, 1858, it is estimated that the amount of milk secreted per day by a healthy woman is one and a half to two quarts, and double the quantity if two infants are suckled. Routh (*Infant Feeding*, page 87) believes that this is a somewhat exaggerated statement. He estimates the amount at a quart to a quart and a half daily. "A three months' child," says he, "generally thrives very well on four or, at the most, five meals a day, the quantity taken each time amounting to a half pint. This would fix the quantity at two pounds to two and a half, *i. e.*, thirty-two to forty fluidounces. . . . A younger child, one to two months, may need to take his meals more frequently; it may be every two hours, except when asleep; but then the quantity consumed does not exceed, as a rule, as I have often assured myself, two wineglasses or three ounces every meal. This would raise the quantity taken in twenty-four hours to thirty-six ounces, a quart and a quarter. A child above three months may take about forty-eight ounces daily."

Dr. Cumming, in consequence of his high estimate of the amount of milk which an infant requires, naturally concludes that few mothers can long endure the excessive drain upon their systems; and, therefore, in order to prevent their exhaustion and to satisfy the appetite of their infants, it is necessary, at an early period, to aid by artificial feeding. This opinion may do harm, since artificial feeding of the young infant, especially in the cities, is apt to give rise to indigestion, followed by vomiting and diarrhœa. The mother in good health, and furnishing an average quantity of milk, is competent to give all the nutriment which the infant requires until it has reached the age of four months, and most are till the age of six months. Drs. Merei and Whitehead examined 952 mothers in the Children's Hospital at Manchester, in reference to their physical condition. Of these 629, or 66 per cent., were in a healthy and robust state. Of this number, namely 629, 420 furnished sufficient milk till six months after delivery, and some till two years.

Differences in Suckling Women as regards Quantity and Quality of Milk.

There is, however, a great difference, in different women, as regards the quantity and quality of their milk, and even the mode in which it is

secreted. The best wet-nurses are usually robust without being corpulent. Their appetite is good, and their breasts are distended from the number and large size of the bloodvessels and milk-ducts. There is but a moderate amount of fat around the gland, and tortuous veins are observed passing over it. Such nurses do not experience a feeling of exhaustion and do not suffer from lactation.

The nutriment which they consume is equally expended in their own sustenance and the supply of milk. There are other good wet-nurses who have the physical condition which I have described, but whose breasts are small. Still, the infant continues to nurse till it is satisfied, and it thrives. The milk is of good quality, and it appears to be secreted, mainly, during the time of suckling. Other mothers evidently decline in health during the time of lactation. They furnish milk of good quality and in abundance, and their infants thrive, but it is at their own expense. They themselves say, and with truth, that what they eat goes to milk. They become thinner and paler, are perhaps troubled with palpitation, and are easily exhausted. They often find it necessary to wean before the end of the usual period of lactation. There is another class whose health is habitually poor, but who furnish the usual quantity of milk without the exhaustion experienced by the class which I have just described. The milk of these women is of poor quality. It is abundant, but watery. Their infants are pallid, having soft and flabby fibre. All these kinds of wet-nurses are met in practice.

Occasionally, a considerable part of the milk is lost by oozing from the breast. This sometimes occurs in robust women, but it is more frequently associated with weakness. It is then due to a relaxed state of the orifices of the milk-ducts. Galactorrhœa, as the excessive secretion and flow of milk is designated, is said to be often associated with a menorrhagic diathesis; that is, women whose menses have been profuse are apt to have too abundant a flow of milk corresponding with the menorrhagia. It is said that galactorrhœa is also apt to occur in those who are subject to discharges from parts which sustain no immediate relation to the breast, as in cases of hæmorrhoidal flux, diabetes insipidus, etc. Excitement, or irritation of the uterus or ovaries, may serve as an exciting cause of galactorrhœa in those predisposed to it, and excessive suckling may have the same effect.

Scantiness of Milk; its Causes and Treatment.

Though the amount of breast-milk which the infant requires is less than was estimated by Cumming, still insufficiency of this secretion is not uncommon, especially in the cities. According to the statistics of Drs. Merei and Whitehead, among healthy mothers there is insufficiency in 16.5 per cent., while among mothers in feeble health the percentage is

46.6. In treating of this subject in the following pages, reference is not had to those cases in which there is temporary diminution of milk from acute disease or other perturbating causes, but to those cases in which there is habitual scantiness.

One cause of scanty secretion of milk is a life of privation or of daily work, which necessitates separation from the infant. Insufficient food may render the milk more watery, as has already been stated, or it may cause diminution in its quantity. The mother thus situated is pallid. She is subject to palpitation and attacks of faintness. Her condition, indeed, is that of anæmia. Working women have scantiness of milk, not only in consequence of hardships, but also because they are usually separated for hours from their infants. Age is also a cause of scantiness of milk. Mothers at the age of forty years ordinarily furnish less milk than between twenty and thirty. And those who have not borne children till late in life, and whose mammary glands have therefore long been inactive, have less milk than those who commence bearing children at the usual period.

Routh speaks of hyperæmia as a cause of defective lactation. "This is a variety," says he, "which I have chiefly observed among hired wet-nurses, selected from the poorer classes, and admitted into wealthier families. . . . . When feeding at the expense of a master or mistress, the amount they devour often surpasses all moderate imagination. They, in fact, gormandize. If in such instances a wet-nurse is given all she asks for, she will be found often to eat quite as much as any two men with large appetites; and, as a result, she becomes gross, turgid, often covered with blotches or pimples, and generally too plethoric to fulfil the duties of her position. The plethora, as first induced, is of the sthenic variety, but it soon assumes an asthenic character, and, as the immediate result, the breast no longer secretes its quantum of milk. There may be good milk secreted, but it is in small quantity, and this quantity diminishes daily. The breast may also enlarge, but it is from a deposition of fatty tissue in and about it, as in other parts of the body. The veins on the surface become less apparent, always a bad feature in a suckling breast, till finally the flow of milk ceases altogether."

Atrophy of the breast from the employment of iodine, or from long disuse, is also a cause of insufficiency of milk.

It is so necessary for the health and development of the infant that the milk should be in proper quantity as well as quality, that it is proper in a work of this kind to consider the treatment of insufficient secretion, and, on the other hand, of excessive secretion and loss of milk, or galactorrhœa. And first of insufficient or scanty secretion.

The most efficient mode of increasing the lacteal secretion is that which is also natural, namely, suction from the nipple. There are many cases on record in which this has produced the flow of milk in women who have

never borne children, and even in men. Baudelocque mentions the case of a girl, eight years old, who suckled her brother for a month, and cases at the opposite extreme of life have been reported; one of a woman of seventy years, who wet-nursed a grandchild twenty years after her last confinement.

The following case, which was under my observation, is interesting in this connection: Lizzie S. was confined with her first child on May 30, 1876. When the baby was a few days old, and before she had left the bed, she had inflammatory symptoms which proved to be due to pelvic cellulitis. Its course was tedious; her milk diminished, and its secretion soon ceased. On or about the first of August she began to sit up, and on August 11th she was admitted into the Sixty-first Street branch of the Infant Asylum, pale and wasted, but with returning appetite. She had had no mammary secretion for eleven weeks, and her breasts were small and flabby. She had two fistulous openings, one vaginal, and the other low down in the back, near the lower end of the sacrum or the coccyx. The baby was in a fair condition, having been suckled by other women. Experiences in this and other institutions show that infants having breast milk do far better and are much more apt to live than those without breast milk, and the mother was therefore advised by one of the managers—himself a physician—to suckle her baby, although there was not a drop of milk in her breast, and nursing had been suspended eleven weeks. To the surprise of the mother, and of the nurses in the house—to whom the procedure seemed very ridiculous—milk began to appear in a few days. The mother left the institution October 8th; but before her departure she was able to furnish, perhaps, two-thirds the quantity of milk which her infant required. This case affords practical illustration of the fact that frequent nursing is the most efficient galactagogue. Mothers sometimes, having little breast milk, suckle their babies at long intervals, and finally, discouraged at the unproductive state of their breasts, resort to weaning, when, by patience and more frequent lactation, they might become good wet-nurses. In the cities, and during the summer season, in which breast milk is so much required, the history of cases like the above, and the more remarkable cases in which men and grandparents have had secretion of milk and have suckled infants, should induce the physician to withhold his consent to premature weaning, which the disheartened mother is apt to suggest, unless indeed he perceive other reasons for weaning apart from scantiness of milk.

Travellers among barbarous nations or tribes have often observed these cases of unnatural lactation. Humboldt saw a man, thirty-two years old, who gave the breast to his child for five months, and Captain Franklin, in the Arctic regions, met a similar case. Dr. Livingstone, in his African travels, says that he has examined several cases in which a grandchild has been suckled by a grandmother, and equally remarkable instances of lac-

tation occur among the negroes of the Southern and Middle States. Professor Hall presented to his class in Baltimore a male negro fifty-five years old who wet-nursed all the children of his mistress. In these cases of abnormal lactation, so far as we have accurate records of them, it is ascertained that the breasts were torpid, and even sometimes, as in old people, atrophied till the nursing commenced. Titillation, or pressing of the nipple, caused an afflux of blood to the gland, and developed its functional activity, so that milk was produced for the sustenance of the nursling. Therefore, in case of scanty secretion of milk, the mother may increase the quantity by applying the infant often to the breast. If, dissatisfied with the small amount of nutriment which it receives, it refuses to make the necessary suction, any other mode of gentle traction or pressure may be employed in addition. The occasional employment of another infant, or a pup, milking the breast with the thumb and fingers, or the gentle suction of a breast-pump, aids in stimulating the secretion. One of the best breast-pumps kept in the shops is that to which the name The Mother's Blessing has been applied. Forcible rubbing or traction of the breast defeats the purpose for which it is employed. It produces too much irritation and tenderness. The best mode of stimulation is by nursing, as it is the natural mode, and the moral effect of the infant at the breast aids in promoting the secretion.

Another mode of increasing the functional activity of the mammary glands is by the electrical current. The fact is established by physiological experiments, that glandular organs can be made to secrete more actively by the stimulus of electricity, and, accordingly, this agent has been successfully employed to promote the secretion of milk. In Routh's *Infant Feeding* several cases are related which show the beneficial effects of this agent (page 149 et seq.). Among them are six reported by Dr. Skinner, of Liverpool. In all these, one or two applications of the electrical current sufficed to restore the secretion. The following is Dr. Skinner's mode of employing this treatment:—

"1. *Direct.*—Both poles must terminate in cylinders, with sponges well moistened in tepid water. The positive pole is pressed deep into the axilla, while the negative is lightly applied to the nipple and the areola; the current being no stronger than is agreeable to the patient's feelings. The poles are kept in this position for about two minutes.

"2. *Intramammary.*—The poles are to be, as it were, imbedded in the mamma, and moved about, raising and depressing both poles at once in and around the organ for the space of another two minutes. The same is to be done to both breasts daily, until the secretion is properly established. Hitherto one or two sittings have always sufficed in my hands." (*Communication of Dr. Skinner to Dr. Routh.*)

In all cases of scanty secretion of milk, the regimen of the mother is a matter of importance. Personal and domiciliary cleanliness is essential

for successful wet-nursing. A certain amount of exercise in the open air is conducive to the health of the mother, and to the secretion of abundant and healthy milk. A case is related to show the effect of fresh air and outdoor exercise on the lacteal secretion. A lady of cleanly habits, living in London, had a very scanty supply of milk. She removed to the pure air of the seashore, and immediately the quantity became abundant, and continued so for months. Such cases are not unfrequent. A mode of life that contributes to the general health of the mother will not fail to augment the quantity of her milk, if it is scanty, and to improve its quality.

Much has been written in reference to the diet of women who suckle. It is a popular belief that certain articles of food promote the secretion of milk much more than other articles, though equally nutritious. No doubt, writers have erred in recommending exclusively this or that kind of food, as most likely to produce milk. The exact kind of food which is preferable, in a certain case, depends partly on the physique of the individual, and partly on the character of the food to which she has been accustomed. A mixed diet contributes most to the sustenance of the mother, and to an abundant secretion of milk. Animal substances which furnish a due supply of nitrogenous aliment should be given with the farinaceous. Mothers pallid, and inclining to an anæmic condition, require a larger proportion of animal diet than those in good general health. On the other hand, plethoric women, such as Routh describes, who with excellent appetite consume large quantities of food, and who become more and more full-blooded and corpulent while the milk diminishes, require a more restricted animal diet, in connection with more exercise, especially in the open air.

There are certain kinds of food which do appear to have a galactogogue effect with most wet-nurses. Oatmeal gruel is one of these. Wet-nurses often remark, after taking a bowl of this, that they feel the flow of milk. Cow's milk with some has a similar effect. Porter or ale, taken once or twice a day, also promotes the secretion of milk, especially in those who have poor appetite, and whose systems are somewhat reduced.

A great variety of medicines have been used for their supposed galactogogue effect. Medicines which improve the general health are, no doubt, sometimes useful for this purpose, such as the vegetable and ferruginous tonics and, perhaps, cod-liver oil. But there are other medicines which it is claimed have a specific effect on the mammary gland, promoting its secretion. Lettuce, winter-green, fennel, the broom tops (scoparius), and marsh-mallow, have been used for this purpose. There can be no doubt that the aromatic stimulants, as fennel, anise, and caraway seeds, given in soups, sometimes stimulate the lacteal secretion. Another medicine which of late has been recommended to the profession, as a galactogogue, is castor oil and the plant from which it is derived.

The galactogogue effect of the leaves of the castor oil plant has been long known to the Spaniards in South America. At least as long ago as the commencement of the last century the ricinus communis was applied by them externally to the breast to promote the secretion of milk. It is now about twenty years since this use of the plant was brought prominently to the notice of the profession in this country and in Europe. In the London *Journal of Medicine*, 1857, Dr. Tyler Smith relates the results of his experiments with the castor oil plant. He applied the bruised leaves over the breasts, and witnessed, as he thinks, an evident galactogogue effect. Dr. Routh has also made pretty extensive use of the plant, both externally and internally. He was led, he says, to employ it internally, from noticing in suckling women an increase of milk after taking a dose of castor oil. He prescribed a decoction of the leaves and stalks, and says: "I have not been disappointed. The flow has been remarkably increased. Four objections against its use, however, should be mentioned." These are, first, a peculiar sensation in the eyes, with dimness of sight, an effect which he has observed only in weak women; secondly, the necessity of increasing the dose as the patient becomes accustomed to it; thirdly, scarcity of the plant; fourthly, an occasional diuretic, sometimes without galactogogue effect, and sometimes with it. The cases in which diuresis occurred were in the practice of other physicians, and Dr. Routh conjectures that this effect was produced by not keeping the breast warm during the time that the decoction was being employed. The breasts should, at the time of its use, be covered with a fomentation of leaves, or an extract of the leaves should be rubbed over the breasts in the same way in which extract of belladonna is used, and over this a warm poultice applied of the ordinary material. Dr. Routh remarks: "When the castor oil leaves are given as an infusion to women who are not suckling, I have observed two effects, both of which seem to denote its specific action. First, it produces internal pain in the breasts, which lasts for three or four days. Then, secondly, a copious leucorrhœal discharge takes place, after which the effect on the breasts entirely disappears."

Dr. Gilfillan, of Brooklyn, has also employed the ricinus communis successfully as a galactogogue. He employed a poultice of the pulverized leaves, and gave internally the fluid extract of the leaves, a teaspoonful three times daily. The patient had been confined the year before with her first child, but had no milk for it, though her health was good, and measures were employed, as friction and fomentations, to stimulate the secretion. The ricinus was prescribed the fourth day after her confinement with the second child, when there were no signs of secretion, and the breasts were small. "About two hours after the poultice was applied, and the first dose taken, she experienced a strange sensation in the breasts, and this increased after each dose of the medicine. The poultice was not

renewed, but the extract was continued for three days, after which lactation was perfectly successful." So far then observations appear to show that ricinus is one of the most efficient galactogogues which we possess among medicinal agents; but all other modes of increasing the milk are probably less effectual than that which is natural, namely, suckling.

In the treatment of galactorrhœa the object to be attained should be kept in view. There are medicines which cure this affection by diminishing the amount of milk. Belladonna, iodide of potassium, and colchicum are antigalactics. It is proper to use them in case of weaning or of death of the infant. They not only reduce the quantity of milk, but, continued, may prevent its secretion. They are employed not to benefit the infant, but the mother.

On the other hand, if it is our purpose to prevent the oozing of milk in order to save it for the infant, or, if it is abundant and watery, to diminish somewhat its quantity and improve its quality, the treatment should be different. Iron, in cases of galactorrhœa, in which the condition of the system appears to indicate the need of it, will diminish the quantity of milk and render it richer. It is by many regarded as an antigalactic, and given long it might reduce too much the amount of the secretion, and even necessitate weaning. Its use should be discontinued if no more than the normal amount of milk is secreted.

In most cases of true galactorrhœa the pathological state is that of weakness and relaxation of the tissues. The fault is not excessive secretion of milk so much as its non-retention, and the medicines which are the most useful to correct this state of the system and of the breasts are the vegetable tonics and astringents. If galactorrhœa occur in those who have an habitual discharge, and it appears to be due to the same cause which produces that discharge, and there are no evidences of weakness, laxative medicines and other derivatives may be employed. But such cases are not common. Nux vomica has been recommended in galactorrhœa, in the belief that it diminishes the relaxation of the orifices of the lactiferous tubes.

Local treatment in this affection is important. A cloth wrung out of cold water should be occasionally applied around the nipple, and removed as it becomes warm. Solutions of tannin or alum are likewise useful. Collodion applied around the nipple, by the contraction which it produces, diminishes the orifices of the ducts, and thus aids in the retention of the milk.

CHAPTER V.

SELECTION OF A WET-NURSE.

In the cities cases are frequent in which mothers, with all possible care or endeavor, find themselves unable to suckle their infants. Their health is too poor, or the milk possesses the properties of colostrum, or it is no longer secreted, on account of nervous excitement, or exhaustion, or inflammation of the breasts. The number of such cases in the city would surprise physicians who are familiar only with the healthy and robust mothers of the country. The infant thus deprived of the mother's milk should, if practicable, be furnished a wet-nurse.

The selection of a wet-nurse often devolves upon the physician, and is a duty of great responsibility. It is better to select one between the ages of twenty and thirty years, and one who has suckled an infant previously. A wet-nurse between the ages of twenty and thirty is usually more active, cheerful, and conciliatory than one of a more advanced age, and her milk is more apt to be abundant and nutritious. Those who have previously suckled and had charge of infants are obviously more competent to serve as wet-nurse than are primiparæ. The milk of a wet-nurse, whose infant is under the age of six months, will ordinarily agree with a new-born infant. If above that age, it sometimes agrees, but often does not.

The most difficult and responsible task imposed on the physician in the selection of a nurse, is to ascertain the exact condition of her health, and the quantity and quality of her milk. Constitutional syphilis is common in the class of women who present themselves for wet-nursing; it is often latent, or its symptoms are easily concealed, and it is communicable by lactation. The virus may be received by the infant from fissures or excoriations of the nipple. The nursling tainted by syphilis may, on the other hand, communicate the disease to the nurse through the same source. It is not fully ascertained whether the syphilitic virus may be conveyed to the infant by the milk. But the cases which have accumulated in the records of medicine are numerous, in which infants born of healthy parents have been fully syphilized by lactation from diseased nurses (see article Syphilis). These infants have sometimes led a short and miserable existence, and have occasionally increased the misery of the household by imparting the disease to others. The duty is, therefore, imperative on the part of the physician to examine carefully the wet-nurse, in reference to

any evidences of the syphilitic taint. Acquainted with the symptoms of syphilis, he may usually, by shrewd questioning and by careful examination of the present appearance and condition of the woman, ascertain with considerable certainty whether her system has ever been infected. References should also be obtained and consulted, and, if practicable, the physician who has attended her be communicated with.

There are, also, among the women who present themselves for wet-nursing in the cities, many of a scrofulous habit, and many who possess an hereditary tendency to tuberculosis, if indeed they do not already have the incipient disease. Such applicants should be rejected, on account of the poverty of their milk and the probability that they will not be able to endure the debilitating effect of lactation.

The milk should be examined, in order to ascertain its richness and quantity, and whether it contains colostrum. If there is colostrum after the eighth day, it is probable that there is some fault in the health or digestion of the wet-nurse, and that her milk may disagree with the infant. It is not necessary that the breast should be large, in order to furnish a sufficient quantity of milk, since, as has been already stated, in some the secretory function is active during the time of each nursing, so that, although the breasts are of moderate size, a sufficient amount of milk is furnished. The nipples should be well formed and prominent, and preference is to be given to those wet-nurses in whom bloodvessels are seen ramifying over the breasts.

By examination of the milk, its degree of richness can be readily ascertained. A quantity of it should be placed in a test-tube, and the cream, which rises to the top, indicates, approximately, the character of the milk. Good milk furnishes three per cent. of cream, and the caseum and sugar usually correspond in quantity with the cream. An instrument has been invented, called the lactometer, by which the exact amount of the cream can be ascertained. It is simply a tube graded into 100 divisions. It is placed upright, and filled with milk, and the number of divisions occupied by the cream indicates its proportion in 100 parts. The lactoscope is another instrument employed for the purpose of ascertaining the richness of the milk. It consists of two concentric tubes, which move upon each other. Milk which we wish to examine is poured within the tubes sufficient to obscure a light viewed through it, three feet distant. The column of milk is then diminished, till the light begins to be visible. The size of the column indicates the degree of opacity and the richness. The lactoscope was invented by M. Donné, and is described by him.

Dr. Minchin recommends a simple mode of determining the richness of cow's milk, and it would equally answer for the breast-milk. A vessel holding about one ounce, and containing a graduated enamel slab, passing diagonally from above downwards, is filled with milk. It is then covered with a glass slide carried over it in such a way as to exclude bubbles.

The number of degrees which can be read, indicates the character of the milk, as regards its richness.

Examination of the milk with the microscope not only enables us to determine whether there are abnormal corpuscles or granular elements, but also its richness. It should be examined before the cream has separated. Oil-globules of small size, and few, indicate poverty of the milk ; very large oil-globules are said to indicate milk which is apt to be indigestible, especially in feeble infants. Such are the free globules of the colostrum. Numerous oil-globules of medium size indicate nutritious milk. Vogel, in 1850, made the discovery of vibriones in human milk. The fact is established that these animalcules may be generated in the milk within the breast, though such cases are not frequent. Dr. Gibb describes a case which he met. (*Ranking's Abstract*, vol. xxxiv.) An infant, 7 weeks old, wet-nursed by its mother, who had the appearance of perfect health, was, nevertheless, ill-nourished and emaciated. It had no diarrhœa or other apparent disease, and the milk was therefore examined. Vibriones baculi were found in the milk immediately after it was obtained from the breast. The milk had the usual amount of cream, and seemed to the naked eye of good quality. According to Dr. Gibb, two genera of microscopic organisms occur in the milk, namely, vibriones and monads. It is believed that the monads occur in consequence of fermentation of the sugar and the production of lactic acid. Vogel also attributed the production of the vibriones to fermentation occurring in consequence of heat and congestion of the breast, connected with sexual excitement. This explanation is probably not correct, because vibriones sometimes occur when there is no unusual heat of breast, and no evidence of fermentation. The fact that such organisms may occur in milk which seems of good quality to the naked eye, affords additional proof of the usefulness of the microscope in the selection of a wet-nurse.

Many wet-nurses have a return of the menses as early as the fourth or fifth month after delivery. The re-establishment of this function in some women impairs the quality of the milk, so as to render it less nutritious, and perhaps less digestible ; in other women it does not sensibly affect the character of the fluid or its quantity. In the selection of a wet-nurse, then, preference should be given to one who does not have the periodical sickness, but if she is already employed, and gives satisfaction, the reappearance of the catamenia does not indicate the need of the change of nurse, unless the digestion of the infant is disordered, or its nutrition is impaired.

In the selection of a wet-nurse attention should also be given to her mental and moral traits. Cheerfulness, affection, veracity, and a proper appreciation of the responsibility of her situation, enhance greatly the value of a wet-nurse. Not less important are habits of temperance and cleanliness. I could cite cases of the most melancholy results from

the absence of these traits. In one case idiocy resulted from an infant falling upon the pavement from the arms of a reckless or intemperate wet-nurse.

In most cases the mode of examination indicated above suffices to show the character of a wet-nurse, so far as her health and milk are concerned. It should be borne in mind, however, that the microscope does not always reveal deleterious properties in the milk. Elements which are in a state of solution, and are invisible, may occur in excess, so as to impair the quality of the milk and render it indigestible. The following case, in which the saline ingredients seem to have been in excess, is related by Dr. Hartmann (*British and Foreign Medical Review*, vol. xii.): "An infant, whose mother was in good health and had borne several children, exhibited a healthy appearance for the first five weeks after birth. The alvine evacuations then became copious, fluid, and discolored, and the child lost flesh and strength. After the usual remedies had been vainly administered for a fortnight, the mother remarked that the child did not take the right breast willingly, and so much did the unwillingness increase, that at length the mere application of the nipple to the child's lips occasioned loud crying. On examination it was found that the milk of the right breast had a distinctly saline taste; whereas the milk of the opposite breast was of the ordinary sweetness; no difference of consistence or color was discoverable. From that time the child was only allowed to nurse the left breast, and in a few days all diarrhœa and sickliness of appearance vanished." In this case there was no appreciable disease of the breast, although its secretion was perverted. The deleterious character of the milk was discovered, not by any change in its appearance, but by the taste.

CHAPTER VI.

COURSE OF LACTATION—WEANING.

Regularity in nursing is required. During the first week or two after birth the infant may be applied very often to the breast, when awake, but subsequently, it should nurse about every two hours during the day, and every three or four hours during the night. Still, as M. Donné has said, mathematical exactness in this matter would be ridiculous. Quiet, natural sleep of a well-nourished infant should not be interrupted in order to give it the breast, unless the sleep be unusually protracted. It will usually awaken when the system requires more nutriment. Ill-nourished infants, according to my observations, sleep but little until they become

much prostrated, when they are drowsy, in consequence of passive congestion of the brain. This drowsiness is evidently a pathological symptom. It shows the need of increased nutrition. It is due to scantiness of milk, or milk of poor quality, and the infant should be aroused frequently for the purpose of giving it nutriment or even stimulants.

As the infant grows older the stomach receives a larger amount of milk, and it should nurse less frequently. The breast-milk is sufficient for its nutrition till the age of six or eight months, provided it is abundant and of good quality. If the mother be strong, and experience no exhaustion from suckling, the infant, therefore, need receive no other nutriment till that age.

Many mothers, however, by the third or fourth month of lactation, find that they have not sufficient milk to meet the wants of the infant. The constant drain upon their systems sensibly impairs their health. In such cases it is proper to commence with a little feeding from the spoon or bottle, and increase the quantity given as the infant grows older. Great care is, however, requisite in the preparation of food for so young an infant, whose digestive organs are still feeble and easily deranged. In the country, where diarrhœal affections and the so-called gastric derangements are not frequent, the danger from artificial feeding is less than in the city, and in the cool months in the city the danger is less than in the summer season. Infants of the city, between the months of May and October, have a strong predisposition to diarrhœal attacks, the result of anti-hygienic influences which surround them. Errors of diet in their case readily provoke disease or derangement of the digestive organs, often of a severe and dangerous form. Moreover, experience has shown that these infants, if fed with the bottle, however carefully, during the period when nature designed that they should be nourished by lactation, very commonly are affected in the hot months with more or less vomiting and diarrhœa, followed by emaciation and other evidences of mal-nutrition. Therefore, an exception must be made, in case of the city infant, as regards the commencement of artificial feeding. If it is under the age of one year, it should be nourished exclusively, or almost exclusively, at the breast during the hot months, when practicable, even if the mother suffers somewhat in her health from the constant drain upon her system. The infant should, however, receive the amount of nutriment which it requires, and, if there is not sufficient breast-milk, it will be necessary to supply the deficiency by artificial feeding. The reader is referred to Chapter VII. for facts relating to the subjects of artificial feeding.

No fixed rule can be stated in regard to the time when it is proper to allow artificial food in addition to the breast-milk. While robust mothers with abundant milk can satisfy their infants till the age of six or seven months, many begin to feel the drain upon their systems and have an insufficient supply by the third or fourth month, and it is necessary to

supplement the nursing by the use of artificial food, a smaller or larger quantity as the case may require. The deficiency may be supplied by the use of cow's or goat's milk, Liebig's food especially for young infants, barley, or rice flour, Ridge's food, or wheat flour prepared by long boiling, as recommended in Chapter VII. At six months also, or even at four or five months, if the infant appear anæmic and ill-nourished, it may be allowed occasionally one or two teaspoonfuls of beef-juice expressed from slightly boiled beef two or three times daily. At the age of eight months semi-liquid food may be given. Pap, prepared with stale bread or a rolled soda-cracker, may also be given once or twice daily, between the times of nursing, and occasionally beef-tea or chicken-broth, thickened with cracker or bread, is taken with relish, and if well prepared and given no oftener than once or twice a day, it is commonly readily digested while it is highly nutritious. If the quantity of breast-milk diminishes, as it often does, towards the close of the first year, artificial food should be given oftener, so as to supply the deficiency. Solid food requires considerable development of the digestive organs for its ready assimilation. It should not, therefore, be given till the close, or near the close, of the first year.

Weaning ought to take place, as a rule, between the ages of twelve and fifteen months. It is well, if the mother's health is good and her milk is sufficient, to defer weaning till the canine teeth appear. The infant then, possessing sixteen teeth, is able to masticate the softer kinds of solid food. Weaning should be gradual. Mothers often speak of weaning on a certain day. They have given but little artificial food, and have suckled at regular intervals, till at a fixed time they have denied the breast altogether. This abrupt change of diet should be discouraged. It should only be recommended under peculiar circumstances. It is apt to derange the digestive organs, and it causes fretfulness and sleeplessness on the part of the infant for a week or more. Weaning should commence by feeding with the spoon, a little oftener through the day, and nursing less, and by discontinuing the practice of suckling at night. The infant tolerates this gradual change of diet, while it rebels against sudden weaning, and by its fretfulness increases greatly the care and trouble of the mother. The infant in the city should not be weaned in warm weather, nor within a month immediately preceding it. If the mother's health fail, or her milk become deficient in the summer months, so that she cannot continue suckling, the infant should be sent immediately to the country, or a wet-nurse be employed. Many infants are sacrificed in consequence of ignorance of the danger of weaning under the circumstances mentioned. Severe diarrhœa, inflammatory or non-inflammatory, is apt to result. This subject will be considered elsewhere.

CHAPTER VII.

ARTIFICIAL FEEDING.

Occasionally the mother is unable to suckle her infant, and a hired wet-nurse cannot be or is not obtained. Artificial feeding is then necessary. In the large cities, if I may judge from our New York experience, this mode of alimentation for young infants should always be discouraged. It generally ends in death, preceded by evidences of faulty nutrition. A considerable proportion of those nourished in this manner thrive during the cool months, but on the approach of the warm season they are the first to be affected with diarrhœa and other symptoms indicating derangement of the digestive function. In my opinion, based on a pretty extended observation, more than half of the New York spoon-fed infants, who enter the summer months, die before the return of cool weather, unless saved by removal to the country. In the country, and in the small inland cities, the results of artificial feeding are much more favorable. The majority live, and in elevated farming sections on account of the salubrity of the air, and the facility with which milk, fresh and of the best quality, is obtained, artificial feeding appears to be nearly as favorable as wet-nursing.

Young infants, fed by the hand, obviously require food prepared so as to resemble as closely as possible the human milk. The basis of such food must, therefore, be the milk of some animal. The following table, prepared by MM. Vernois and Becquerel, gives the proportion of the ingredients of human milk, and the milk of the four domestic animals which is most easily obtained and most frequently employed as food :—

Composition of Milk.

	Specific gravity.	100 parts contain		The solid components consist of			
		Fluids.	Solids.	Sugar.	Butter.	Casein and extractive matters.	Salts.
Man. . . .	1032.67	889.08	110.92	43.64	26.66	39.24	1.38
Cow	1033.38	864.06	135.94	38.03	36.12	55.15	6.64
Ass	1034.57	890.12	109.88	50.46	18.53	35.65	5.24
Goat . . .	1033.53	844.90	155.10	36.91	56.87	55.14	6.18
Ewe	1040.98	832.32	167.68	39.43	54.31	69.78	7.16

Cow's milk is most readily obtained, and is commonly used as a substitute for human milk, compared with which it contains less water and sugar, but more butter, casein, and salts. Its composition, however, varies considerably according to the food of the cow and other circumstances. The variations in the milk of the cow, according to the nature of its food, have been considered in a preceding chapter. It has been stated, also, that the milk first obtained in milking is most watery, since it is longer secreted than the last milk, or the "stripping." The stall-fed cow gives acid milk, while the cow grazing in a pasture gives milk that is alkaline. Again, the milk in the first months after calving is richer than after the lapse of several months.

It is obvious from the above facts that the analysis of different specimens of cow's milk must differ greatly, and the same is true of the milk of the goat and ass, and probably of the ewe. In fact, different samples of the milk of the same animal may differ more from each other, in their chemical character, than the average milk of one animal from that of another.

The milk of the goat and that of the ass have been recommended as food for infants in preference to cow's milk, on the ground, as is alleged, that they more nearly resemble human milk. But by reference to the foregoing table it will be seen that more importance has been attached to this supposed resemblance than the facts justified. Neither the milk of the ass nor goat, so far as its chemical character is concerned, would seem to possess any advantages over cow's milk. The ass's milk is procured with difficulty, and is seldom used. An objection to goat's milk is the unpleasant odor which it often possesses, due to the presence of hircic acid. It is stated, however, by Parmentier, that this odor is only noticed in the milk of goats that have horns. An important advantage, in the city, in the use of goat's milk, is that the animal can be kept at little expense, so that even poor families who are not able to purchase and feed a cow, can generally possess a goat from which fresh milk can be obtained at any time. Preference is to be given to goat's milk, when fresh, over cow's milk brought from the country, perhaps watered on the way, and several hours old when received. If, however, as both chemical analysis and experience show, goat's milk is no better as food for infants than cow's milk when fresh and from healthy cows, the latter must continue in common use for this purpose.

Milk used for infants should always be alkaline. If it is acid, as shown by the proper test, it should be rejected; or, if there is none better, should be rendered alkaline by the addition of lime-water or carbonate of soda. The nurse should test the milk at different periods through the day, and be taught to make the necessary addition. M. Donné prefers the first milking, when it is possible to obtain it. This contains a smaller proportion of solid elements than the average milk, bears a closer resemblance

in its chemical character to human milk, and requires but little dilution. The upper third of the milk, after it has stood two or three hours, is also preferable, as the casein, which is digested with more difficulty than the other elements, has a high specific gravity, and tends to settle towards the bottom. If the infant is under the age of two or three months, the milk should be diluted with one-fourth its quantity of water. After the age of four months it requires no dilution. It should always be given at a uniform temperature, namely, a little warmer than the body. Employed habitually too hot or too cold, it is apt to cause stomatitis, if not more serious disease of the digestive organs.

A little pulverized sugar of milk, which is now kept in the shops of the city, and is slowly soluble, may be dissolved in water, and added to the milk. One drachm of the sugar is sufficient for five or six ounces of the milk. An alkali taken with cow's milk retards the coagulation of casein in the stomach, and tends to prevent the formation of large and thick curds in this organ, which are with difficulty digested, and are apt to give rise to gastric or gastro-intestinal derangement. If, therefore, the child vomits such curds, or passes fragments of them in the stools, or if the stools are acid, lime-water may be added, or the carbonate of soda, as recommended by Vogel, who dissolves one drachm of the carbonate in six ounces of water, and adds a teaspoonful to the milk at each meal.

It has been customary in families to give bottle-fed infants various kinds of farinaceous food, as arrowroot, wheat, rice, and barley-flour in addition to the milk. But infants, prior to the age of four months, are able to digest only a small quantity of starch, for the glands which secrete the fluid by which starch is digested, namely, the salivary and pancreatic, are very small, almost rudimentary prior to the fourth month. Certain glands, whose functions are important in the life of the individual, are small, and have but little activity in the first weeks or months of life. Such are the lachrymal and intestinal glands in addition to the salivary and pancreatic. After the third month tears appear, and the quantity of saliva which previously was very small is more abundant, and it increases as the child grows older. After the third or fourth month not only is there a more rapid growth of the salivary glands and pancreas than previously, but also probably a greater functional activity. In a recent monograph relating to *Infant Diet*, written by Prof. A. Jacobi, and revised, enlarged, and adapted to popular reading by Dr. Mary Putnam Jacobi, it is stated that the parotid glands which combined weigh, at fifteen months, 80 grains, and 120 at two years, weigh but 34 grains at the age of one month. In several instances we weighed the pancreas taken from the bodies of infants who had died under the age of six months in the New York Infant Asylum. The weight was very different in those whose ages were about the same; in several under the age of four months it was less than one drachm, and in some more than one drachm; but in no instance did it reach two

drachms. Now it is evident, since the parotids and pancreas chiefly secrete the liquid by which starch is digested, for the submaxillary and sublingual glands are comparatively insignificant, that those kinds of food which consist largely of starch are innutritious, and therefore unsuitable for very young babies (see paper by Sonsino, of Pisa, in *London Practitioner*, Sept. 1872).

If, however, we convert the starch, or a considerable part of it, into grape-sugar, or glucose, and dextrin, we have a food which is more easily digested, so that it can safely be given to infants under the age of three months. The late Baron Liebig, who devoted considerable time in the last years of his life to the study of the food of infants, prepared such an article, widely and favorably known in both continents as Liebig's food. Hawley's Liebig's food, made by Dr. Hawley, of Brooklyn, has been in the shops for some years. More recently, Liebig's food made by Mr. Horlick, of Chicago, and that by Mr. Mellin, of London, which are nearly identical, have come into use. Being carefully prepared, according to Liebig's formula, by chemists fully competent, they possess certain advantages, such as quick and easy preparation and a pleasant flavor, and are, therefore, highly esteemed by those who have employed them.

The accompanying statements show us the nature of Liebig's food, and the way in which it is made. Starch is transformed into sugar and dextrin, a change which, when farinaceous substances are used in the usual way, is effected in the stomach, and thus this organ is relieved from a part of the burden of digestion.

"The following is the best way of preparing this food: Half an ounce of wheaten flour, and an equal quantity of malt flour, seven grains and a quarter of bicarbonate of potash, and one ounce of water are to be well mixed; five ounces of cow's milk are then to be added, and the whole put on a gentle fire. When the mixture begins to thicken, it is removed from the fire; stirred during five minutes; heated and stirred again, till it becomes quite fluid, and finally made to boil. After the separation of the bran by a sieve, it is ready for use. By boiling it for a few minutes, it loses all taste of the flour." (*Lancet*, January 7, 1865; *Braithwaite's Retrospect*, July, 1865.)

This food, according to Liebig, furnishes double the amount of nutriment contained in milk, or as he expresses it, is a "double concentration" of that secretion.

Dr. Hassell, in a communication in reference to this food to the London *Lancet* for July 29, 1865, says: "It appears to me that the great merit of Liebig's preparation consists in the use of malt flour as a constituent of the food; this, from the diastase contained in it, exercises, when the fluid food or soup is properly prepared, a most remarkable influence upon the starch, quickly transforming it into dextrin and sugar, so that in the course

of a few minutes the food, from being thick and sugarless, becomes comparatively thin and sweet."

. . . "Correct and ingenious as are the principles upon which this food has been designed, yet the directions given for its preparations are certainly open to considerable improvement. Thus, Liebig directs that the malt should be ground in a common coffee-mill, and the coarse powder passed through a sieve. This necessitates the subsequent straining of the food, a tedious operation, in order to remove the bran and remaining particles of husk. And further, that the food should be put upon a gentle fire previous to its being finally boiled. Now, a gentle heat may mean almost any temperature nearly up to the boiling-point; and since the action of the diastase is destroyed at about 150° F., the temperature should never be allowed to exceed that degree.

"I recommend, therefore, that the malt should be well freed from husk, and finely ground; that the wheat flour should be lightly baked; and finally, that a thermometer should be employed in the preparation of the food. Indeed, in some samples recently submitted to me by Messrs. Savory and Moore, I find that the first two points have been attended to, and that they use malt freed from husk and finely ground, and the wheat flour baked.

"The effect of baking the wheat flour is to partially cook the starch entering into its composition, so that less heat is required in the preparation of the liquid food. I find that a temperature ranging between 140° and 148° is amply sufficient to effect the complete transformation and solution of the starch-corpuscles, and, indeed, to cook the food sufficiently."

Dr. James S. Hawley, who has given much attention to the preparation of Liebig's food, and who now furnishes the market with it, says: "The principal objection which has been urged against Liebig's food is the difficulty of its preparation. This objection certainly did lie against the process recommended by its author, and against many of the directions since proposed. But . . . the simplest form of cooking is all that is requisite. This consists in mixing the dry food, properly compounded, with milk or water (better milk), and slowly bringing it to a boil with frequent stirring; or heating it until it begins to thicken, then remove it from the fire and stir until it grows thin, and repeat this process two or three times. At the close of the process it will be quite thin and sweet. No food can be cooked in a simpler manner than this. This dissolving of the thick hydrated starch is itself the evidence of the transformation of amylum into glucose. It is not claimed, that by this simple method, *all the starch* is converted, but that its percentage is very greatly diminished, sufficiently so to afford abundant assimilable nutriment to the infant, and also to avoid the dangers and inconveniences arising from the presence of indigestible matter in the intestines."

In Ridge's food, although the manner in which it is made is kept secret,

I suspect that a partial change of the starch into glucose has been effected. We are informed that it is made from wheat flour, and it certainly agrees with young infants, as I have many times observed. It contains, however, considerable starch, as is shown by the iodine test. Again, if we crowd snugly in a small muslin bag one to two pounds of the best wheat flour, boil it forty-eight hours in water sufficient to cover it, and then when it dries grate the flour from it, we obtain what closely resembles Ridge's food. These kinds of flour have been employed in the New York Infant Asylum with a satisfactory result, but the preference is given to Ridge's food, which seems to agree with the largest number. But for infants under the age of three or four months, Liebig's food is obviously to be preferred for the physiological reason stated above.

In the first half year it is most convenient and is otherwise preferable to employ the nursing-bottle, after which the infant may be fed with a spoon, or taught to drink from a cup. The bottle and tip, when not in use, should be placed in a bowl of cold water containing a little bicarbonate of soda, one teaspoonful to the pint.

The physician should positively forbid the use of sugar teats and various sweetened admixtures which nurses are so apt to employ, as they tend to produce the common forms of stomatitis, and, if much employed, even indigestion and diarrhœa.

Between the ages of one and two years the teeth have become sufficiently developed for the mastication of light food. Tender and finely cut meat, potato baked and mashed, bread and butter, and even certain fruits carefully selected, may then be allowed. After the age of two years less rigid surveillance of the food is required, but the variety is sufficient if all dishes except the most bland and unirritating are excluded till after the first years of childhood.

CHAPTER VIII.

BATHS—CLOTHING.

Daily ablution of the infant conduces to its comfort and health. If under the age of two months, it should be bathed daily in water of about the temperature of 92°. As it grows older the temperature should be gradually reduced, a bath at 88° to 90° being proper for an infant between the ages of three and six months, and one at 86° for an infant between six and twelve months. In the second and third years the temperature of the bath should be about 84°. After the bath, which should continue from five to ten minutes, the surface should be gently rubbed

with a soft towel to produce reaction and a glow of the skin, which would prevent danger of taking cold.

The clothing of children, especially in our variable climate of the north, is a matter of importance, and one in regard to which the parents often require instruction. It may be stated, as a rule, that the chest and abdomen of the infant should be so covered with flannel that there is no danger of producing chilliness by a sudden reduction of the external temperature or exposure to a current of air. By this precaution many cases of laryngitis, bronchitis, and diarrhœal affections, now so common in infancy, might be avoided. In winter the flannel should be thick, and in the summer thin. Even in the hottest weather the abdomen should have a light flannel covering, which increases the comfort, if the surface is in the normal state. If lichen, which is not uncommon in the warm months, appear upon the surface, I would not remove the flannel, but place under it linen or soft muslin.

The popular idea that children may be hardened by exposure to the weather in scanty clothing, and by being bathed, even at the most tender age, in water at so low a temperature as to produce chilliness, cannot be too strongly combated. The hygienic management of the child should always be such as insures present comfort. If it do not, if it is regarded with aversion and dread by the child, the method is wrong.

The dress should always be so loose as to allow free movements, and not embarrass in the least any of the functions. This is a matter which is left too much to the discretion and intelligence of the nurse, who is usually so ignorant of the important facts in physiology that she unwittingly, and with the best intentions, injures her charge. I have often interposed to loosen the dress of the new-born, which was so tight as to sensibly embarrass respiration; and one case has been reported to me in which it appeared that death resulted from this cause. Infants, especially, who are so liable to pulmonary collapse and intestinal hernias, should have loose covering of both chest and abdomen.

The feet of children should always be warm. Infants require flannel stockings, thick or thin, according to the season. Care should be taken that the shoes produce no compression, and they should be exchanged for those of a larger size as often as is required by the growth of the feet. Deformity of the feet or toes, ingrowing toe-nail, and induration of the skin, can sometimes be traced back to tightness of a shoe in childhood.

Physicians are so well aware of the importance of domiciliary cleanliness and ventilation, of the free admission into the nursery of solar light, and of the importance of outdoor exercise as a means of invigorating the system and promoting healthy functional activity, that nothing need be stated in reference to these subjects in this connection.

CHAPTER IX.

ACCIDENTS AND AILMENTS INCIDENTAL TO THE BIRTH OF THE INFANT, AND DETACHMENT OF THE CORD.

Apnœa (Asphyxia) Neonatorum.

In the healthy infant, born under favorable circumstances, the two important functions of life, respiration and circulation, are established within the first minute. But it not infrequently happens, in consequence of some unfavorable circumstance, that the heart and lungs cease to act, and the infant lies motionless as one dead. Sometimes in these cases an occasional pulsation of the heart can be detected when the fingers press under the left ribs, but there is no respiration. According to the nature of the cause, the surface is exsanguine or cyanotic and livid.

Causes.—These are various. The fault may be partly in the infant; it may be feeble in its development; but the common causes are compression of the cord during birth, from breech presentation or otherwise, powerful, frequent, and long-continued uterine contractions, often induced by ergot, but sometimes occurring normally, which compress the placenta, and consequently obstruct the fœtal circulation; detachment of the placenta before birth, and protracted labor, from pelvic malformation or otherwise, even when there is no unusual severity of the pains.

Treatment.—Obviously the treatment must be prompt. Mucus should be removed from the mouth and fauces with the finger, and except in those cases in which there has been placental hemorrhage or anæmia from other causes, as exhibited by pallor of the surface, a few drops of blood should be allowed to run from the cut extremity of the cord. The flow induced aids in establishing the circulation, and, in the large proportion of cases in which there is congestion of the internal organs, gives partial relief to it. Brisk rubbing of the body, slapping the buttocks, blowing in the face, sprinkling water upon it, alternately transferring the body from a tub of hot to cold water, may be tried in quick succession, and, if there are no signs of returning animation, no time should be lost in resorting to artificial respiration.

The child should be placed on its side upon the edge of a table, with a blanket underneath it, and the head in such a position that the epiglottis falls forward; a towel or napkin should be placed over its face, having a hole of sufficient size to blow through corresponding with its mouth. The physician compressing firmly the epigastrium with his thumb, blows a

full breath through the hole. A little of the air, notwithstanding the compression, enters the stomach, some may escape by the nostrils, and the rest enters the lungs. Immediately, the hand passing from the epigastrium to the thorax, compresses it gently though with sufficient force to produce expiration. This should be repeated six or eight times per minute. The action of the heart, previously slow, becomes quicker by the artificial respiration. I have been able to produce pulsations by this method when the heart had ceased to beat for a considerable time, and death, to all appearance, had occurred. Some recommend placing the infant on the right side, on account of the position of the valve between the auricles, but I think it is better to change it from one side to the other, in order to prevent congestions, which are so apt to occur when the circulation is imperfect. The circulation always commences sooner than respiration. The first respirations are mere gasps, not more than one or two per minute in cases of decided asphyxia, but as they become more frequent they are also deeper.

Artificial respiration should be continued fifteen or twenty minutes in cases in which no action of the heart can be detected by pressing the fingers under the ribs, when, if there are no signs of returning animation, the case is hopeless. If there is any pulsation, however feeble, we should not cease in the attempt at resuscitation. Some prefer insufflation through a tube (as the segment of a catheter) introduced into the larynx, and pressure upon the thyroid cartilage so as to close the pharynx, instead of upon the epigastrium. The principle of treatment is similar, but the mode which I have recommended above I have found successful beyond expectation. Thus, in one case in my practice in which pulsation in the umbilical cord had ceased from ten to fifteen minutes before birth in consequence of its prolapse, I employed artificial respiration nearly a quarter of an hour before there was any appreciable pulsation, but by perseverance the circulatory and respiratory functions were fully re-established, and the child lived and was vigorous. When respiration commences insufflation may cease, but it is proper to aid the respiratory movements a little longer by compressing the thorax after each inspiration. Still, the physician may be disappointed in the result. In not a small proportion of cases the respiration continues gasping, and after a few hours, perhaps even a day, death ensues. I have made post-mortem examinations of several infants who have died under such circumstances, chiefly in the Nursery and Child's Hospital, about six from recollection, and have found considerable uniformity in the appearance of the viscera. Only a small portion of the lungs, sometimes almost none at all, was found inflated, even when the cries had for a time been strong, and extravasated blood usually in considerable quantity lay upon the surface of the brain, evidently having escaped from the meningeal vessels, which were in a state of extreme congestion in consequence of the protracted or difficult birth. Meningeal

apoplexy therefore seems to me the chief cause of the ill-success attending our efforts to save those who are so far resuscitated as to be able to breathe.

Recently, Prof. H. L. Byrd, of Baltimore, has recommended a simple mode of resuscitation. The physician places his hands under the middle portion of the back of the child, with their ulnar borders in contact, and at right angles to the spine. Extending his thumbs, he carries forward the two extremities of the trunk by gentle but firm pressure, so that they form with each other an angle of about 45° in the diaphragmatic region. Then the angle is reversed by carrying backward the shoulders and the nates. An assistant may aid by supporting the head. By alternating these movements, Prof. Byrd has succeeded in effecting resuscitation when other methods had failed, and when so much time had elapsed that the case would seem hopeless to most practitioners. The name and position of Dr. Byrd commend this method to consideration and trial. (American Supplement of *Obstet. Journ. of Great Britain and Ireland*, 1873.)

Caput Succedaneum—Cephalæmatoma.

During the birth of the child, extravasation of blood not infrequently occurs in the part of the scalp which presents. This results from the passive congestion, more or less intense according to the duration of labor and severity of the labor-pains, which occurs in the presenting part, whether scalp, arm, or breech. CAPUT SUCCEDANEUM is the term employed to designate the swelling thus caused. Its seat is the loose connective tissue of the scalp external to the pericranium. The tumor is soft, painless, and usually located upon the occiput. It consists partly of extravasated blood, but largely of serum which has transuded from the congested vessels before that degree of congestion was reached, required to effect the transudation of the corpuscles. I have repeatedly had an opportunity to examine this tumor in stillborn infants brought from the lying-in wards attached to the Nursery and Child's Hospital, and have found when it was slight that it consisted almost entirely of serum, but ordinarily when dissected it presented the appearance of a bruise, with a large proportion of serum, the blood and serum infiltrating the scalp to a greater or less distance beyond the appreciable limits of the tumor. Caput succedaneum requires no treatment. As it lies in the loose connective tissue of the scalp, its liquid permeates the open connective tissue in every direction, and is rapidly absorbed, while the tumor disappears. The subsidence of the swelling is usually complete within forty-eight hours.

Occasionally blood is extravasated under the pericranium, detaching it from the bone. This occurs in connection with caput succedaneum, and is observed when the latter declines. The tumor thus produced is designated cephalæmatoma. It is situated upon the occipital or parietal bone, near the posterior fontanelle. Its base corresponding with the denuded

bone is circular or oval, and it rarely crosses a suture. In rare instances two cephalæmatomata occur, located upon the occipital and one parietal or upon both parietal bones. The liquid, being surrounded by the firmly attached pericranium, does not escape into the surrounding tissues, as occurs in caput succedaneum, and is therefore more permanent. The tumor flattens slowly, and does not disappear till after several weeks. At the age of six months a slight prominence can sometimes be detected, indicating the seat of the tumor. As the pericranium elevated by the blood does not lose its vitality, it soon begins to produce bone, so that after some days a ring of new bone can be detected by the finger surrounding the base of the tumor, and on the inside of the detached membrane a layer of bone is produced, thin at first and flexible, but gradually approximating the old bone, and becoming firmer as absorption occurs.

Some time since, a specimen was presented by me to the New York Pathological Society, showing this accident and the mode of cure. The child died about two months after birth, and the blood constituting the tumor, which had been in great part absorbed, was completely incased by the old bone below and the new thin formation above. The cavity at length becomes obliterated, and there only remains some thickening of that part of the cranium which corresponds with the location of the tumor.

CHAPTER X.

OPHTHALMIA NEONATORUM.

This disease occurs in two forms, namely, the catarrhal and blenorrhœal, and there are many cases which are intermediate.

Causes.—These are not the same in all cases. Exposure of the infant's eyes soon after birth to a bright light, catching cold, the introduction of a little of the vernix caseosa under the eyelids in the first washing, smoke, dust, and irritating gases, coming in contact with the eyes are recognized causes. Infants living in ill-ventilated and dirty apartments, having untidy clothing, with faces and bodies seldom properly washed, and attended by dirty nurses, are more frequently affected than those in the better walks of life, and better cared for. The disease is more prevalent in asylums than in private practice, for in the former the anti-hygienic conditions which conduce to it more frequently abound.

Blennorrhœal ophthalmia has been known to occur during epidemics of puerperal fever, probably from the epidemic influence, but a common cause is the introduction of a particle of blennorrhœal matter under the lids, during birth, or subsequently by careless handling. But blennorrhœal

ophthalmia is in a considerable proportion of cases produced by the action of those common non-infectious causes, which have been mentioned above, and which in other cases produce a simple catarrhal inflammation. Why there is this difference in the effects of these non-specific causes is not known. In most cases ophthalmia neonatorum begins soon after birth, namely, by the third or fourth day, but it may not begin till in the second or third week.

Symptoms. *Blennorrhœal Form.*—In the beginning the palpebral conjunctiva is observed to be red, a little swollen, and its cutaneous surface presenting a faint reddish tinge. The light appears to be painful, and the child is fretful and sleeps but little; but the eye itself has its normal appearance. The progress of the disease, however, is rapid, and in twenty-four or thirty-six hours there is so much tumefaction that the upper lid extends over the lower, and it may be impossible to separate them sufficiently to obtain a view of the eye. The tumefaction is due to œdematous infiltration. The conjunctiva, both palpebral and ocular, now presents a deep red hue, is thickened and swollen, and numerous fine granulations appear upon it; occasionally also flakes of very delicate pseudo-membrane can be observed in addition. There is an abundant production of pus of a creamy appearance, sometimes tinged with blood, which oozes out when the lids are separated. A critical period has now arrived, one which may involve the destruction of the cornea unless the case is promptly and judiciously treated. Indeed, the gravity of the disease relates chiefly to the state of the cornea, which up to the present time, notwithstanding the severity of the inflammation and the amount of surrounding infiltration, has remained transparent and apparently unaffected. But within another twenty-four hours the cornea may lose its polish, and grayish, opaque spots of softening appear upon it. Soon perforation occurs, the aqueous humor escapes, and the iris falls forward, closing the aperture and preventing further loss of the liquids of the eye.

I have observed destruction of the cornea and loss of sight chiefly, first, in cases of true gonorrhœal infection, in which there is the maximum amount of inflammation and tumefaction, extending even over the malar bone and supraorbital ridge, with marked redness and elevation of temperature of the lids: and, secondly, with a less degree of inflammation in those who were highly scrofulous. Attention then to the cornea is all-important, since it can usually be saved with proper treatment, although there may be so much purulent discharge and œdema that it may be impossible to see it for several days. Occasionally the cornea, instead of sloughing, becomes infiltrated to a greater or less extent, and ulcerates, but without perforation. As the patient recovers, cicatrization occurs.

The inflammation soon begins to decline. The swelling, heat, and redness of the lids and conjunctiva, and the granulations, gradually disap-

pear, and recovery is complete, except so far as the cornea may have been injured.

Catarrhal Form.—The inflammation is from the first of a mild grade, pertaining chiefly to the palpebral conjunctiva, with but a slight discharge of purulent matter, and with little swelling or increase of heat in the lids. Attention is directed to the complaint chiefly by the secretion which collects in the angles of the lids or upon their border. There may be slight intolerance of light, and ordinarily minute granulations appear upon the inflamed mucous surface. This form of the disease may disappear within a few days, or it may be protracted.

Ophthalmia of the new-born is contagious, sometimes highly so. It commences on one side, and, without precautions, commonly within a few days extends to the other.

Treatment.—As soon as the inflammation occurs, the opposite sound eye should be covered with a compress, kept in place by strips of adhesive plaster. This eye should be examined, however, once or twice daily, in order to detect the commencement of inflammation, and the bandage reapplied.

Catarrhal ophthalmia requires very simple treatment. Frequently bathing the lids with lukewarm water, or milk and water, so as to remove the secretion from between the lids, suffices in a large proportion of cases. In the severer cases, lead-water constantly or frequently applied to the exterior of the lids is useful. Among the poor, mothers ordinarily bathe the lids with breast-milk, and by this simple treatment effect a cure. If the inflammation should not abate soon by this treatment, a mild collyrium of one-fourth grain of nitrate of silver to one ounce of water should be applied between the lids and allowed to run under them.

Blennorrhœal ophthalmia, on the other hand, requires prompt and judicious management. There is scarcely a disease in which delay is more disastrous.

The frequent removing of the pus is very important, which is confined in large quantity underneath the closely compressed lids, and by its pressure and irritation increases greatly the danger of destruction of the cornea. Therefore the lids during the height of the inflammation should be pressed apart every hour, so as to allow the pus to escape, and the space between the lids be freed from pus by a camel-hair pencil or a pledget of finely picked lint. Occasionally warm water may be thrown under the lids by a small glass syringe, to wash away pus and any flakes of pseudomembrane. Probably two or three drops of carbolic acid to each ounce of water would be beneficial, from the known good effect of this agent on suppurating surfaces, but I have never employed it.

Medicinal applications to the inflamed conjunctiva should, in most cases, be mild, but should be frequently applied. It is known that Von Graefe recommended the application of nitrate of silver as a caustic; but this is

painful and sometimes difficult, for it requires eversion of the lids. I much prefer, in the treatment of purulent ophthalmia, the application of a weak solution of corrosive sublimate every three hours between and under the lids, the pus, so far as practicable, having been first removed by the brush and syringe. I employ the following formula, and the result has, in my practice, been so favorable that I have not felt justified in trying another:—

℞. Hyd. chlor. corros. gr. j;
Aquæ rosæ, ℥ij;
Aquæ, ℥vj. Misce.

Still the beneficial result which I have observed from this collyrium, was no doubt largely due to the frequent removal of the pus, the importance of which cannot in my opinion be too highly pressed. In blennorrhœal ophthalmia, during the active period of the inflammation, with hot and swollen lids, a single thickness or two thicknesses of linen, squeezed out of cool lead-water, and renewed every two or three minutes when they begin to warm, aids materially in subduing the inflammation, every moment of which when the lids are much swollen involves danger to the delicate cornea. This measure, therefore, which requires diligence on the part of the nurse, should be insisted on. As long as the cornea retains its transparency and polish, the eye is safe, but, as stated above, it is often difficult to obtain a view of it for some days.

The decline of the inflammation is gradual, but generally pretty rapid, yet several weeks may elapse before there is full restoration to the normal state. When the inflammation begins to abate, and the dangerous tumefaction has to a great extent subsided, a collyrium of one-fourth grain of nitrate of silver to the ounce will expedite the cure.

Occasionally granulations remain upon the lids. If they do not diminish and disappear when the purulent inflammation has ceased, I would not practice excision, as recommended by Vogel, but, having everted the lids, apply a solution of nitrate of silver, five or ten grains to the ounce, to the granulations, each second day, and immediately wash away the solution by a camel-hair pencil with lukewarm water, and apply a little sweet oil before the lid is returned. If the granulations do not disappear with this treatment, they may be lightly touched with the smooth surface of a crystal of sulphate of copper, followed by the application of water and sweet oil. By this mode of treatment, employed from the commencement of the inflammation, a large proportion even of the severest cases do well.

CHAPTER XI.

DISEASES OF THE UMBILICUS.

When properly managed, the cord desiccates and falls off between the third and ninth days. The nurse should not be allowed to oil it, which she will sometimes do unless forbidden, as this retards desiccation. If the dressing of the cord is allowed to remain wet from the urine or otherwise, the cord does not desiccate, but decomposes. This is not infrequent in poor, intemperate, and slovenly families. The decaying cord is apt to produce inflammation of the navel. Some Southern physicians, prior to the late war, attributed the prevalence of trismus neonatorum among the slaves to the lesion of the navel produced by this cause, the trismus being then essentially traumatic.

Inflammation of the Umbilical Vein and Arteries.

When at birth the cord is ligated, if the child is in its normal state, clots form in the umbilical vessels from the navel inwards. Atrophy of the vessels follows, and by the twenty-fifth day they are represented by small, firm, fibrous cords. Sometimes, though rarely, a true phlebitis or arteritis occurs in these vessels in the first days after birth, due either to the low vitality of the child and decomposition of the fibrinous plugs and gelatinous substance of the cord, or the entrance into the vessels of purulent or decaying matter from the fossa of the umbilicus. We are sometimes able, by pressing along the abdominal walls toward the umbilicus, to squeeze out a few drops of the decaying and purulent substance. The navel itself is usually inflamed at the same time. This is a very serious disease. Pus, with particles of disintegrated fibrin, is apt to pass along the vessels and enter the circulation, and, being intercepted in distant parts, gives rise to embolismal inflammations. This seemed to be the cause of several subcutaneous inflammations, and points of embolismal pneumonitis in a new-born infant which I attended in 1868. The infant belonged to a family highly scrofulous and prone to scrofulous inflammations. Umbilical phlebitis and arteritis are said to occur most frequently in lying-in institutions during epidemics of puerperal fever.

Treatment.—In the manner already indicated we should attempt gently to press out any purulent and decomposing substance from the vessels, and the infant should be placed with its abdomen dependent so far as it can be done without rendering it uncomfortable, so as to aid in

the escape of the liquids by gravity. The umbilical fossa should be kept clean, and warm water containing a little carbolic acid may be dropped upon it several times daily. The abdomen should be covered with a soft and warm poultice.

Inflammation and Ulceration of Umbilicus.

Inflammation of the umbilicus sometimes occurs in the new-born about the time of the detachment of the cord, or soon after. It probably results from uncleanliness, or carelessness in the management of the cord, by which irritating and decomposing substances remain in the umbilical fossa. Sometimes decomposing particles from the cord are the probable irritant. This disease is also most apt to occur in cachectic infants, or those of scrofulous parentage, whose general condition renders them liable to inflammations. The umbilicus becomes red, slightly swollen, and moist by a secretion. Often the inflammation remains two or three days in this mild form, receiving no treatment except from the nurse, and disappearing by the use of the dusting-powder which she employs. In other instances, the inflammation extends over a radius of an inch or even more, the walls of the umbilicus become swollen and infiltrated, and ulceration succeeds. The ulcer is circular, occupying the site of the naval, and attended by a purulent discharge. The inflammation may now gradually abate, and the ulcer heal with a cicatrix in place of the umbilicus. But in other instances, especially if there is a decided cachexia, the ulcer extends in breadth and width, till finally, in the worst cases, the peritoneum becomes involved, and perforation or peritonitis occurs, with death.

Under unfavorable hygienic circumstances the blood of the infant being vitiated, the ulcer may become gangrenous, or the inflammation may terminate directly in mortification, without the formation of an ulcer. In either case the prognosis is unfavorable. If a dark-brown slough occupies the site of the umbilicus, and a sero-sanguineous discharge exudes from underneath, the common result is perforation, peritonitis, and death in from one to two weeks.

Treatment.—Inflammation of the umbilicus, if at all severe, and especially when attended by any destruction of the tissues involved, rapidly reduces the strength. In such cases four or five drops of brandy should be administered every hour to two hours in the breast-milk.

In the simple inflammation the navel should be bathed with lukewarm water three or four times daily, and the ointment of the oxide of zinc be constantly applied; or if there is little or no discharge, the navel may be dusted with the powdered oxide of zinc. In case of ulceration the navel should be gently washed three or four times daily with lukewarm water, to which carbolic acid is added—three or four drops to the ounce; and if there is much inflammation, a light poultice of pulverized slippery elm

should be applied in the interval, or if the inflammation is moderate, the balsam of Peru. If gangrene supervene, the parts should be frequently bathed with the carbolic-acid-water, and a cloth soaked with it be applied over it. The slough should be detached as soon as it is so far separated that its removal causes no hemorrhage, after which the treatment for ulceration is appropriate.

Umbilical Granulations or Fungus.

When the cord falls, granulations sometimes sprout out from the exposed raw surface, and complete cicatrization is impossible till they are removed. They form a rounded mass of a pale reddish hue, at the centre of the umbilical fossa, bleeding when rubbed, and causing constant moisture of the umbilicus. The largest which I have seen had perhaps twice the side of a large pea, and they may be of any smaller size.

Treatment.—By pressing upon the umbilical parietes the tumor rises from the fossa, so that a silk ligature can be applied around its base, when the mass can be readily removed with the scissors. If the granulations are small, they may be removed by the scissors, without the ligature, and hemorrhage prevented by touching the surface with lunar caustic.

CHAPTER XII.

UMBILICAL HEMORRHAGE.

The granulations which have been described above sometimes cause considerable hemorrhage when injured. The profuse and even fatal hemorrhage which occurs at birth, or soon after, from too loose a ligature of the umbilical cord, or from laceration or other injury, is so well known, and its cause so apparent, that it need only be alluded to in this connection. Bouchut details a case in which death occurred even before birth, from this form of hemorrhage. The child was attached to the placenta by a very short cord, which prevented delivery till it parted by the traction of the forceps; but the bleeding from the umbilical vessels was so profuse, that the child was pallid and lifeless when born.

There is another form of umbilical hemorrhage, cases of which have been from time to time observed for more than a century (one of the first on record was reported in the *Gentleman's Magazine*, April, 1752, by Mr. Watts, a physician in Kent, England), but little was done to elucidate its nature till three American physicians made it the subject of careful study, and the monographs which they have published upon it are the best which

the literature of the profession affords. Dr. Francis Minot read his paper, containing the statistics of 46 cases, before the Boston Society for Medical Improvement, in April, 1852. Prof. Stephen Smith prepared his paper, containing the statistics of 79 cases, for the New York Statistical Society, in 1855. It was published in the *New York Journal of Medicine* for that year. Dr. J. Foster Jenkins presented his monograph as a report to the United States Medical Association in 1858, and it was published in the *Transactions* of the Association for that year. This paper is very valuable on account of its statistics, as the writer succeeded in collecting the records of 178 cases, from medical journals, and gentlemen of the Association. These three papers contain nearly all that is known in reference to this disease.

Sex—Age.—Females are less liable than males to this hemorrhage. In Jenkins's cases, $34\frac{1}{4}$ per cent. were females, $65\frac{3}{4}$ males. The following table gives the age at which the hemorrhage commenced in 99 cases:—

Age.	Nos.
Under 1 day	5
Under 2 days	7
Under 3 "	6
Under 4 "	3
5 to 7 " (inclusive)	32
8 " 10 " "	25
11 " 15 " "	16
16 " 21 " "	4
56 "	1
	99

Ordinarily the hemorrhage commenced very soon after detachment of the cord, but in not a few the cord was still adherent.

Causes.—The common proximate cause is feeble coagulability of the blood. In the normal state, when the cord is ligated, the fibrin of the blood, which now ceases to flow in the umbilical vessels, forms coagula so firm that, by the time the cord is detached, hemorrhage is impossible. But in the majority of those affected with this disease, the clots are so soft and loose that they do not present any effectual barrier to the pressure of blood, which therefore oozes through them or presses them away. This lack of coagulability is easily demonstrated, for if a little blood, as it escapes, is caught in a vessel, it will be found to remain liquid a long time. This dyscrasia, or morbid state of the blood, which we therefore recognize as a chief cause of the hemorrhage, does not have the same origin in all cases. It is sometimes due to inherited syphilis. The infant affected with it may be plump, and appear well at birth, but in most instances, when the hemorrhage is to occur, it is puny and cachectic, exhibiting also local manifestations of the disease with which it is affected. Thus, in a case in my practice, the infant, puny, and apparently born

before term, was observed to have several blebs of pemphigus on the first day, from some of which blood soon began to ooze, but the fatal umbilical hemorrhage did not commence till after two weeks.

In about one-fifth of the cases ecchymoses or petechiæ have been observed upon various parts of the surface, affording additional proof of the general blood disease.

Jaundice is another cause of impoverishment of the blood in the newborn, and therefore of umbilical hemorrhage. The writers who have collected records of the hemorrhage, all remark the frequent occurrence of the icteric hue, both before and during the bleeding. It is not improbable that, in certain instances, the jaundice is hæmatogenous, arising from destruction of the red corpuscles and liberation of the hæmatin, a not unusual result of a profound dyscrasia, whether syphilitic or originating in some other cause. But in other, and probably most instances, the jaundice proceeds from the liver, and is the cause of the change in the blood. Thus, in five of Jenkins's cases, there was occlusion of the hepatic or common bile-ducts, and jaundice, from the presence of biliary acids in the blood, causes diminution in the amount of fibrin and red corpuscles. In the ordinary form of icterus neonatorum, the cause of which is found in the relative fulness of the capillaries and minute bile-ducts in the acini of the liver, the coagulability of the blood must evidently be impaired in proportion to the degree and duration of the jaundice.

Poor health of the mother, and impoverishment of her blood during gestation, whether from chronic disease, as tuberculosis, or anti-hygienic conditions, also cause impoverishment and diminished coagulability of the blood of the child, and are therefore causes of the hemorrhage. The excessive use of diluent drinks or alkalies by the mother is believed by some to have a similar effect.

In certain cases the hemorrhage is due to an inherited hemorrhagic diathesis. In nine of Jenkins's cases the mothers were subject to menorrhagia, and liable to bleed freely after parturition, and from injuries; and seventeen other mothers had each lost more than one infant from umbilical hemorrhage. Probably in those cases in which the hemorrhage commences before detachment of the cord, and external to its point of insertion, the hemorrhagic diathesis is the main cause of the flow.

Although the cause of umbilical hemorrhage in the majority of cases is the vitiated state of the blood itself, observers, among others the late Sir James Y. Simpson, have met cases in which the hemorrhage was referable to the state of the vessels. In order that the vessels be effectually closed by the fibrinous coagula, their walls should have their normal contractility, but this is in great part lost, by inflammation (arteritis or phlebitis) which sometimes occurs in these vessels, as we have already seen. Inflammation, whether of artery or vein, causes thickening and infiltration of its parietes, loss of tone on the part of the fibres of which they are composed,

and therefore a patulous state of the vessel. Moreover, the inflammation is apt to be suppurative, and the presence of pus in the vessel obviously hinders the formation of a firm and effective coagulum.

Symptoms.—Ordinarily umbilical hemorrhage occurs without any premonition, but sometimes it is preceded by jaundice. Jenkins ascertained that jaundice was a prodromic symptom in 41 out of 178 cases, and besides the icteric hue, constipation, clay-colored stools, deeply tinged urine, etc., were sometimes recorded. Rarely colicky pains and vomiting preceded the hemorrhage. The blood may be arterial or venous, or both. It oozes slowly or rapidly, rarely escaping in a jet, even when there is reason to believe that it is arterial.

Prognosis.—This is unfavorable. Statistics show that five in every six perish. The prognosis is most unfavorable when jaundice or purpura is present. Those are most likely to recover who have a healthy parentage, no obvious dyscrasia, and in whom the hemorrhage occurs late, and is not profuse. The average duration of the hemorrhage in 82 fatal cases in Jenkins's collection was three and a half days, the minimum being only three hours. After the arrest of the hemorrhage, death may occur from exhaustion or the dyscrasia.

Treatment.—The treatment should be both constitutional and local. It is important, so far as time will permit, to treat the dyscrasia, and as the stools are apt to be constipated, a laxative is ordinarily indicated. A laxative is not only useful for its effect on the hepatic circulation, but as a derivative. Both Smith and Jenkins recommend calomel for this purpose. The modes of treating the bleeding parts have been various. Those most deserving of mention are the following: Injecting a styptic into the open vessels, applying a styptic by compress or sponge to the navel, covering the navel with dry or wet plaster of Paris, constant pressure with the finger, which is tedious, but which maternal solicitude willingly provides, and lastly, the use of needles with ligature. All of these methods have been more or less successful in arresting the hemorrhage, but the last is most effectual, though painful. Two needles should be passed through the umbilicus at right angles, and a waxed thread wound around each in the form of the figure 8. In four or five days the needles should be removed, and a poultice or simple dressing applied.

CHAPTER XIII.

DIAGNOSIS OF INFANTILE DISEASES.

General Observations.

Diseases in early life differ in important particulars from those occurring in maturity. Some which are common in the former age are unknown or are rare in the latter, and those which occur equally at all ages often present peculiar symptoms and a peculiar clinical history in the young. Therefore physicians who are skilful in treating adults, may be unskilful in treating children. Excellence as a physician of children can only be achieved by special and continued study of their ailments.

Again, as regards the diseases of infancy, in which period there is a great amount of sickness and a large mortality, diagnosis must evidently be made from the objective symptoms; from examining the features, attitude, utterances, the pulse, respiration, etc., and inspecting the surfaces, so far as they are accessible to view, and the eliminated products. We lack for this age the important information which speech affords. Some general remarks, therefore, in reference to the appearances and functions of the system in early life, and the changes which they undergo in various pathological states, seem requisite, in order to a clearer appreciation of the symptoms, and more ready diagnosis of individual diseases.

Features, External Appearance of Head, Trunk, and Limbs in Disease.

In the new-born, as soon as respiration and the new circulation are established, the cutaneous capillaries become distended with blood, and the skin presents a congested appearance. By the close of the first week this external hyperæmia begins to abate, and is soon replaced by the normal capillary circulation.

Icterus is common in the first and second week. Bouchut attributes it to mild hepatitis. A much more plausible view of its causation, and probably the correct one, is that of Frerichs, who attributes it to the effect on the hepatic circulation of ligation of the umbilical cord. By ligation the current of blood through the umbilical vein to the liver ceases, the amount of blood in the hepatic capillaries, which connect with the branches of the vein, diminishes, and then, according to Frerichs, diversion occurs of a part of the bile from the hepatic cells into the capillaries, while the rest flows in the normal manner in the bile-ducts. The degree of jaundice is

proportionate to the amount of bile which enters the circulation. Icterus neonatorum is not a disease of importance. It subsides without medicine in the course of one or two weeks, when the circulation through the liver becomes equalized and regular.

The surface, or portions of the surface, of the new-born often present for a few hours a livid color, due to the mode of delivery. Protracted lividity occurs from atelectasis or malformation in the heart or great vessels; lividity induced by exertion or excitement, while the respiration is normal, indicates malformation of the heart or vessels; temporary lividity sometimes occurs in severe acute diseases, especially those of the respiratory organs; lividity, whether temporary or permanent, is a sign of imperfect decarbonization of the blood.

The cheeks of children are congested in febrile and inflammatory diseases, except in a cachectic or prostrated state of the system. Transient circumscribed congestion of the face, ears, or forehead constitutes a reliable sign of cerebral disease. Strabismus occurring in connection with febrile reaction, oscillation of iris, inequality of pupils, and drooping of upper eyelids, also denote cerebral disease. The pupils are contracted during sleep; evenly dilated in death.

Dilatation of the alæ nasi during inspiration, with contraction of the eyebrows and a countenance indicative of suffering, attends severe inflammation of the respiratory organs. Absence of tears during the act of crying shows a severe and probably fatal form of disease in infants over the age of four months.

Rapid wasting of the features, causing deep suborbital depressions, prominence and pointedness of the cheek-bones and chin, and hollowness of the cheeks, is a sign of a severe diarrhœal affection; the most striking examples of this sudden collapse of features are afforded by patients affected with cholera infantum. In severe cases of this disease the physiognomy, from a state of fulness and health, presents in a few hours such a wasted and senile appearance that the friends with difficulty recognize the features with which they are familiar. Muscular tonicity is also greatly impaired in this disease, that of the orbicular muscles of the lips and eyelids to such an extent that the mouth is open and eyeballs exposed during sleep. Great emaciation occurring gradually, is a symptom of subacute or chronic disease of a grave character, often of tuberculosis or chronic entero-colitis.

Strabismus sometimes occurs in children who have no serious disease. It is then due to simple paralysis of one or more of the motor muscles of the eye. But when supervening upon other symptoms of a neuropathic character, it is a grave symptom, indicating organic disease of the encephalon, as effusion, meningitis, etc. A permanently downward direction of the axes of the eyes, with smallness of the face and great expansion of the cranium, is a sign of congenital hydrocephalus. The scalp in this disease

is tense, bald, or sparingly covered with hair, the fontanelles and sutures open and enlarged, and the cranial bones yield to pressure. Great expansion of the cranium above the ears, while the frontal portion is not enlarged, or but slightly, denotes hypertrophy of the brain.

The appearance of the general cutaneous surface possesses much greater diagnostic value in the diseases of infancy and childhood than in those of adult life. The eruptive fevers so common in the young, and comparatively rare in the adult, reveal themselves to us in great part by the changes which they cause in the appearance of the integument. The peculiar color of the skin in constitutional syphilis, hereafter to be described, and which is more marked in infancy and early childhood than at any other age, is a diagnostic sign of great value in obscure cases. In the infant the cold stage of intermittent fever is manifested, not by muscular tremors, but by lividity, pallor, and the goose-skin appearance of the surface.

Bulbous enlargement of the fingers and incurvation of the nails are signs of cyanosis, and therefore of malformation at the centre of the circulatory apparatus, or of tuberculosis, or chronic pulmonary disease attended by malnutrition. Enlargement of the spongy portions of bones, causing prominences, softness, and bending of the bones, and consequent deformity of the limbs, patency of the fontanelles, a large and square shape of the head from calcareous deposit external to the cranium, are among the signs of rachitis.

In early infancy the glands of the skin and mucous surfaces, or which connect by their orifices with these surfaces, are slightly developed. Therefore sensible perspiration and lachrymation are rare under the age of three months. A thick Meibomian secretion of a puriform appearance collecting between the eyelids, is an unfavorable prognostic sign; it indicates a state of great depression; it is observed most frequently in cerebral and intestinal affections a little before death. Passive congestion of the vessels of the conjunctiva sometimes occurs under the same circumstances, due to feebleness of the heart's action, and imperfect capillary circulation. It indicates the near approach of death.

Attitude—Movements—The Voice.

A sharp, piercing cry, head firmly retracted, flexure of the limbs with a degree of rigidity, adduction of the great toe, clonic or tonic spasm of the muscles, irregular movements of one or more limbs, with consciousness impaired, or with mental hallucinations, are symptoms of grave disease of the cerebro-spinal system. Irregular muscular movements partly controlled by the will, and occurring during full consciousness, are symptoms of chorea, a disease nearly always ending favorably in children, though incurable in the adult. Contraction of the eyebrows, turning of the eyes and face from light, avoidance of noises, as if painful, are signs of head-

ache. Frequent carrying of the hand to the ear, and pressing with the ear against the breast of the mother or nurse, are symptoms of otalgia. Frequent carrying of the fingers to the mouth, in connection with fretfulness or other symptoms of suffering, indicates stomatitis, gingivitis whether from difficult dentition or other causes, painful pharyngitis, or some obstructive disease of the larynx. Frequent rubbing or pressing the nose may be due to intestinal worms or intestinal irritation from other causes. It may be due to coryza or headache. Frequent forcible rubbing or striking the nose should lead to a careful examination and perhaps guarded prognosis. It often indicates grave cerebral disease, and may be a precursor of convulsions.

In severe obstructive disease of the larynx, the child is restless, moving from side to side. In most inflammations of the respiratory organs, a semi-erect position gives most relief. The voice in severe laryngitis is often hoarse or indistinct, and usually so in the pseudo-membranous form; in pleuritis or pneumonitis it is restrained and abrupt, since the movements of the walls of the chest give pain.

The voice in severe diseases of the abdominal organs is feeble and plaintive. It is sometimes short and restrained in acute dyspepsia, in peritonitis, and in cases of great abdominal distension. The horizontal position gives most relief in abdominal diseases. In case of abdominal pain the patient often presses his hand upon the abdomen and flexes his thigh over it. Perfect quietude, with features sunken, and unchanged by smile or crying, is a symptom of severe and exhausting diarrhœal affections.

Respiratory System.

The respiration of the infant under the age of six months is very irregular, and it is more irregular the nearer the time to birth. If the new-born infant is closely observed, it will be seen to sigh often; it breathes pretty uniformly and regularly for a moment, and then, without appreciable cause, the respiration is intermitted; it holds its breath when it smiles or moves its head, or even its limbs; it is very subject to hiccup; this is more common the first week of life than at any other age. So much is the breathing of the young infant disturbed by these causes, that the number of respirations ordinarily varies in consecutive minutes. In order, therefore, to determine with accuracy the frequency of the normal respiration for this time of life, it is necessary to take the average of several observations.

At birth, while the function of the heart has for months been regularly performed, the lungs are still quiescent. The one organ has been active during the greater part of fœtal development, the other is yet untried. Hereafter, in the new order of things, so intimate is the relation between the heart and lungs, that the proper performance of the function of the one

is essential to that of the other. Therefore the commencement of respiration and the return of circulation, which is modified and temporarily arrested at birth, are nearly simultaneous. Respiration commences in the first half-minute of independent existence; often, indeed, attempts to inspire occur before the delivery is completed. The exceptions to this early establishment of respiration are, after tedious or unnatural births. The return of circulation is a moment later.

Respiration in Health.—As the air-cells at birth are closed, the establishment of respiration is difficult. The air at first penetrates a few pulmonary cells, but gradually more and more are inflated through the forcible inspirations which the crying of the infant produces, till after a variable time respiration becomes easy and complete. If the cry is feeble, and especially if with this feebleness there is considerable congestion of the brain, the result of tedious birth, the full establishment of respiration is in a corresponding degree gradual and slow.

The frequency of the respiration in health should be ascertained, in order to determine whether, in a given case, it is abnormally accelerated. The following table embodies the result of observations, which I have made, in order to determine the normal frequency of respiration in the first year of life.

Normal Infantile Respiration (number per minute).

	Age.									
		From first half hour to close of first week.		From close of first week to close of first month.		From close of first month to close of third		Close of third to close of sixth month.		Close of sixth month to close of first year.	
	First half hour.	Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.	Awake.	Asleep.
Number of observations	29	28	14	13	13	16	10	25	7	19	6
Extreme number of respirations per minute..	25–104	32–64	40–64	40–96	28–60	32–68	28–52	36–88	24–40	28–64	24–36
Mean number of respirations per minute....	48.5	52	52	59	45	51	39	54	33	41	29

As the child advances from the age of one year, the number of respirations per minute gradually diminishes; but through the whole period of childhood it remains greater than in the adult. At the age of five years, when the child is quiet, but awake, it is about 27; at the age of ten years, about 22.

Respiration in Disease.—In cerebral diseases the respiration is apt to be slow, and if somnolence occur, intermittent, and accompanied by

sighing. In young infants, in the drowsiness which supervenes when the blood is imperfectly decarbonized, during severe attacks of capillary bronchitis, or broncho-pneumonia, respiration is apt to be intermittent.

In inflammatory diseases of the larynx and trachea, respiration is but slightly accelerated, and, if there is no obstruction, its rhythm is normal; if there is obstructive disease, its rhythm is altered; the inspiratory act is lengthened. In bronchitis, respiration is accelerated in proportion to the degree of extension downward of the inflammation. It is in no disease more accelerated than in severe capillary bronchitis.

In pleuritis and pneumonitis, the respiration is accelerated in proportion to the extent and acuteness of the inflammation. Inspiration ending abruptly, and succeeded by an expiratory moan, is a symptom of both pleuritis and pneumonitis in their acute stages. In certain cases of irritative or inflammatory disease of the abdominal organs, respiration presents a similar character; it is modified in this manner in consequence of the pain experienced in movements of the diaphragm. Ordinarily, however, in abdominal diseases, respiration is nearly natural.

The cough is an important diagnostic symptom. It is loud and sonorous in spasmodic croup, hoarse or harsh in true croup, clear and distinct in bronchitis, suppressed and painful in the early stages of pneumonitis and pleuritis, convulsive and with more inspirations than expirations in pertussis. A cough due to coexisting bronchitis is one of the first and most constant symptoms of measles. Typhoid and remittent fevers, difficult dentition, intestinal worms, irritating ingesta, and severe burns, sometimes give rise to a cough, which is nearly dry and painless. Occurring in such diseases, it is sometimes dependent on more or less bronchitis, to which primary disease has given rise.

Circulatory System.

In all ages and countries the pulse has been considered an important symptom both in diagnosis and prognosis. It aids the practitioner in determining, approximately, not only the character but the gravity of diseases. It is somewhat remarkable, from the importance which is attached to the pulse in medical practice, that its natural frequency and its character in infancy are not more accurately known. It is true that eminent observers, as Trousseau and Valleix, have published statistics relating to the infantile pulse in health, but these statistics disagree, and therefore do not afford a reliable standard with which to compare the pulse in disease. Moreover, some published statistics of the pulse possess but little value, from the small number of observations; some from the fact that records of the infantile pulse are grouped with those of older children; and others because the state of the infant, as regards its activity or emotions, is not mentioned.

Pulse in Health.—It is not easy to collect statistics of the healthy pulse for the period of infancy, which are entirely free from error, since there are often slight derangements of the system in the infant, which are not manifested by any marked symptoms, but which produce acceleration of the pulse. In collecting the following statistics, it was my endeavor to avoid sources of error so far as possible.

In ordinary cases the movements of the heart begin about one-eighth of a minute after birth. They are at first slow, the ventricular contractions not numbering more than eight or ten by the close of the first quarter minute. In the second quarter the cries are vigorous, and the pulse now is rapidly accelerated, rising commonly above 120, and sometimes above 160 beats per minute. In fifty-seven observations of the pulse in healthy infants during the first half hour of life, after the first quarter of a minute, I found that the extremes, with one exception, were 104 and 164—average, 139.

Table of Infantile Pulse in Health.

	Age.									
	First week.		From close of first week to close of first month.		From close of first month to close of third.		From close of third month to close of sixth.		From close of sixth month to close of first year.	
	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.	Awake. Quiet; moving slightly; nursing.	Asleep.
No of observations	22	16	10	10	15	17	25	6	20	3
Extremes..	104–152	108–140	124–160	104–144	112–148	104–132	112–146	104–116	112–144	....
Mean.	126	122	139	118	132	118	129	108	127	109

"M. Ledéberder," says Bouchut, "could only count the pulse in the first minute of life in six children, and he has observed from 72 to 94 pulsations." Valleix estimates the pulse, between the ages of two and twenty-one days, at 87. Trousseau states that the pulse, in the first week of life, varies from 78 to 150; and Dr. Gorham's observations are somewhat similar to Trousseau's. My observations, as seen from the above table, do not correspond with the assertions of Ledéberder and Valleix. Indeed, if there were no conflicting testimony, there would still be a strong presumption that these authors are in error, for we would not suppose that the pulse of the infant, in whom there is greater functional activity, both muscular and visceral, would fall so much below that of the fœtus. It is probable, from the expression "could only count the pulse . . . in six children," that Ledéberder and perhaps Valleix counted the

pulse at the wrist, which, with exceptional cases, is very difficult and often impossible in the first week of life, and that they missed some of the beats, or, not unlikely, sometimes counted their own pulse. Immediately after birth there is so little force of the ventricular systole, and the extreme arteries, therefore, of the system pulsate so freely, that neither in the limbs nor at the anterior fontanelle can the frequency of the pulse be readily ascertained. It can be readily and accurately ascertained only by auscultation, or by placing the hand on the precordial region, or directly after birth by the pulsations in the umbilical cord.

The average pulse of the healthy infant in the first and second months is, according to Trousseau, 137 per minute, 128 from the third to the sixth month, and 120 from the sixth to the twelfth month. It is seen that his observations agree closely with mine, as regards infants who are quiet but awake. One point of interest, established by the above statistics, is the great diminution in the frequency of the pulse in sleep.

Pulse during or after Active Movements or Great Mental Excitement.

	Age.				
	First week.	Close of first week to close of first month.	Close of first to close of third month.	Close of third to close of sixth month.	Close of sixth month to close of first year.
	140	162	176	132	132
	160	156	152	148	144
	140	140	158	148	152
	152	152	144	144	182
	....	....	152	156	198
	....	....	180	156	160
Extremes .	140–160	146–162	144–180	132–156	132–198
Mean . .	148	152	160	147	156

It is seen, by the above table, that by active exercise or great mental excitement the pulse may become as rapid as in grave diseases. There is greater acceleration of pulse from the emotions and from exercise in feeble than in robust children. Obviously, in order to determine to what extent the pulse is accelerated in disease, it is necessary that it should be counted during a state of quietude. As the age increases, it is less and less influenced by the emotions and physical exertion; still, during the whole period of childhood, such influences do have more or less effect on its frequency.

Pulse in Disease.—Febrile and inflammatory diseases produce greater acceleration of pulse in early life than in maturity. Diseases, or derangements of system, particularly those of the digestive organs, which do not materially affect the pulse in the adult, often cause acceleration of it in children. The febrile pulse of early life usually has exacerbations in its

frequency. These commonly occur in the latter part of the day. Distinct and more or less regular febrile exacerbations and remissions are common in several diseases of early life, some of which are serious, while others involve little danger. Among these diseases may be mentioned difficult dentition, intestinal worms, incipient meningitis, and constipation. An intermittent and irregular pulse is common in fully developed meningitis and certain other severe organic diseases of the encephalon. It may be due also to disease of the heart, and it also occurs in some children from temporary disturbance of the digestive function. The pulse is slow in compression of the brain, and also in sclerema of the new-born.

Animal Heat.

The internal temperature of the body in a state of health is uniform. In 33 infants under the age of seven days, M. Roger found the average temperature 98.6° Fahr., while in 25 from four months to fourteen years old it was 99°. The external temperature alone varies in a state of health, according to the temperature of the atmosphere.

Elevation of temperature above the normal standard is a sign of inflammatory and febrile affections. The increase of heat varies according to the character of the disease and its type. In favorable cases of inflammation and in simple fevers it is not ordinarily more than two or three degrees. The greater the severity and malignancy of inflammatory and febrile diseases, the greater the elevation. An elevation of more than six degrees indicates a form of disease which is likely to prove fatal. It is rare that the temperature, even in fatal cases, rises above 107°. In measles the temperature in the eruptive stage is from 101° to 103°; in scarlatina from 102° to 104°, if no complication exist. In diphtheria the temperature is elevated at first, but it is apt to fall to nearly the normal during the stage of profound toxæmia.

Reduction of the internal temperature is an unfavorable prognostic sign; it is observed, a few hours before death, in infants who are greatly reduced by certain chronic diseases, as entero-colitis. In these cases the tongue and even sometimes the breath communicate to the finger or hand a sensation of coldness.

The importance of thermometric observations, as an aid to the diagnosis of children's diseases, is within a few years more fully recognized by the profession. Two diseases which, in their commencement, present very similar symptoms, often vary as regards the temperature. Thus, meningitis presenting in its first stages symptoms very similar to those of typhoid fever, has a lower temperature till an advanced period, when the amount of heat increases.

Digestive System.

Inspection of the buccal and faucial surfaces discloses some of the most frequent local diseases of infancy, as the various forms of stomatitis, and others which, though not frequent, involve great danger, as gangrene of the mouth, diphtheria, and retro-pharyngeal abscess. Inspection of the tongue aids in determining in many cases whether the disease is pursuing a favorable course, or has become asthenic, and is exhausting the vital powers.

Febrile movements, even when slight, give rise to coating of the tongue, and intumescence and distinctness of its follicles. The eruptive fevers are attended by changes upon the buccal and faucial surfaces which possess diagnostic and prognostic value. Hyperæmia of these surfaces appears early in rubeola and scarlatina, prior to those phenomena which are justly regarded as pathognomonic. It is therefore often an important sign in the initial period of these diseases when the diagnosis is obscure. The appearance of the fauces in diphtheria and croup, indicating not only the nature of the disease, but its gravity, need only be referred to in this connection.

Inspection of the buccal and faucial surfaces sometimes enables us to form a probable opinion in reference to the nature of diseases which are seated in other parts. In the infant protracted stomatitis is a common accompaniment of chronic diarrhœa, and it indicates its inflammatory nature.

Vomiting is more frequent in infancy than in childhood, and in either period than in adult life. It is common in cerebral affections, and is one of the first symptoms of scarlet fever, and is not uncommon, though less frequent, in the commencement of the other essential fevers and of acute inflammations. It is a symptom of indigestion, entero-colitis, cholera infantum, and intussusception; it is common, also, after the paroxysmal cough of pertussis, and not infrequent in the bronchial inflammations of young infants; in both which diseases it is excited by the muco-purulent matter upon the faucial surface.

Intestinal gas is in part secreted or exhaled from the mucous membrane, as the experiments of Hunter and others have shown, and is in part the product of chemical changes in the food. A certain amount of gas in the intestines is normal; it subserves a useful purpose. An abnormal amount of it is common in various diseases, as indigestion, chronic entero-colitis, peritonitis, typhoid fever. It is a frequent cause of gastralgia and enteralgia in the infant. In scrofulous or feeble infants, with impaired muscular tonicity and faulty digestion, the abdomen is often habitually more or less distended with gas, which does not, under such circumstances, give rise to pain or other local symptoms; it has significance as showing the general condition of the child.

In the rachitic, whose thorax is compressed and liver often enlarged, while the vertebral column is shortened, the abdomen is commonly protuberant. In feeble children, not decidedly rachitic, whose lungs are seldom fully inflated, and whose chests are consequently depressed, the abdomen is also prominent. The accompanying wood-cut represents one of these cases, presented for treatment at the outdoor department at Bellevue.

Fig. 4.

In feeble children who have suffered from repeated and protracted attacks of bronchitis, and whose chest-walls are consequently depressed, a similar abdominal prominence occurs.

Retraction of the abdominal walls is common in meningitis, and in many exhausting diseases. Tenesmus is a symptom of intussusception in the infant, and of colitis in children.

Much light is thrown on the character of intestinal diseases by the appearance of the stools. Muco-sanguineous stools accompanied by fever, are a sign of colitis. Stools containing unmixed blood, and not accompanied by fever, may result from a rectal polypus and from purpura hæmorrhagica. Scanty evacuations of blood, with obstinate constipation, are a symptom of intussusception in infants.

The alvine discharges of infants often present a green color; sometimes they have the normal yellow hue when passed from the bowels, but become green on exposure to the air, or from reaction of the urine. By the microscope the green coloring matter is seen to occur in small irregular masses. This green substance has been supposed to be bile. I am convinced that as it occurs in the stools of the infant, it is commonly produced by the action of the intestinal secretions on the contents of the intestines; perhaps the action is upon the bile, which is mingled with the contents, for I have often noticed that the contents in and above the jejunum were yellow, while in and below the ileum their color was green.

The green hue may occur from very different causes. It may be due to over-feeding, to the action of cold, to irritating ingesta, to inflammation, etc.; it may be transient, subsiding within a day or two, or it may continue several days. All infants, at times, have green evacuations, even when they appear in good health.

In a large proportion of the cases of diarrhœal maladies occurring during infancy the stools give an acid reaction with litmus-paper. This acid, if in considerable quantity, is irritating, increasing the peristaltic move-

ments of the intestines, and the functional activity of the intestinal follicles, causing erythema of the skin around the anus, and reacting upon and intensifying the intestinal disease. Hence the indication for the use of antacids in the diarrhœal affections of infancy.

The presence of intestinal worms and the species may be ascertained by microscopic examination of the stools of the child who is affected with these entozoa. The stools contain ova, which differ in size and shape according to the species of worm.

Nervous System.

Pain.—This symptom affords important aid to the physician in determining the seat and nature of the diseases of children. Pain in the head may occur in them from coryza involving the frontal sinuses, or from febrile movement in the commencement of an essential fever, or of inflammation of one of the organs of the trunk. Produced by such a cause, it abates in two or three days. If it is protracted, whether constant or intermittent, it is in many cases not neuralgic, as it so often is in the adult, but is due to organic disease of the brain or meninges. Complaint, therefore, of headache in a child, without any apparent general cause, or local cause external to the cranium, should awaken solicitude, and, if it is protracted, the physician should examine carefully in reference to the presence of a cerebral or meningeal disease. Mild frontal headache, continuing for weeks or months, sometimes occurs in children suffering from so-called spinal irritation. In these cases pressure over the first cervical vertebra and the occiput is apt to increase the pain.

Grave thoracic or abdominal inflammations in the adult are almost always attended by a corresponding amount of pain and tenderness; but in children these symptoms are often absent, or, when present, are often not commensurate with the amount of disease. Thus, enterocolitis of nursing infants is, in a large proportion of instances, almost free from these symptoms, and the same may be said of many cases of pneumonitis in young children, namely, those cases produced by extension of inflammation from the bronchial tubes and from hypostasis.

Pain in the chest or abdomen, occasional or constant, continuing for weeks or months, with fever and unattended by thoracic or abdominal disease, indicates caries of the vertebræ. Its most common seat is the epigastric, umbilical, or hypochondriac region. It is a neuralgia due to irritation of the sensitive root of one or more of the spinal nerves. It is a very important symptom to the diagnostician, showing the nature of the disease, which in its incipiency is so obscure. Pain in the leg, especially the inside of the knee, is of a similar character, indicating disease of the hip-joint.

Children with certain acute febrile and inflammatory diseases some-

times have hyperæsthesia of portions of the surface; it is especially marked upon the anterior aspect of the trunk. The physician might be misled into the belief that the tenderness occurred over the seat of the disease and indicated an inflammation; but the pain of hyperæsthesia can be diagnosticated from that of inflammation by the fact that it is so extensive, is less on firm than light pressure, and is especially observed upon the inner surface of the thighs. The symptoms pertaining to the nervous system occurring in the various diseases treated of in this book will be fully described in connection with those diseases, and, therefore, need not detain us in this connection.

CHAPTER XIV.

THERAPEUTICS.

The young practitioner is often perplexed in deciding exactly what dose to prescribe, for a child, of the stronger and more dangerous medicinal agents. A practical rule, which holds good for many medicines, has been proposed by Dr. Cowling as follows: "The proportional dose for any age under adult life is represented by the number of the following birthday divided by twenty-four." This rule is inadmissible for infants under the age of six months, but will apply for those that are older, for the use of a large number of medicines. Another rule proposed by another British physician, Prof. Clarke, is based on differences in weight of children and adults: The adult dose is represented by 150. The dose of a child is determined by dividing its weight in lbs. by 150. But it is an interesting fact, and one of practical importance, that children bear and often require, in order to obtain the desired effect, a much larger proportionate dose of certain agents than adults. This is partly attributable to the active elimination in childhood. Belladonna is notably one of the agents which childhood tolerates; and it may be added that some children can take a much larger dose of it than others, without producing the physiological effects. Thus, recently, I increased gradually a reliable preparation of the tincture to twelve drops for a child of four years, without producing the usual efflorescence; and Farquharson says "the dose . . . . I have pushed in a child of ten, suffering from incontinence of urine, to f℥ij (British Pharmacop.) with good effect, and the development of mild forms of physiological disturbance." Arsenic is also better tolerated by children than adults. An infant of six months can take two-drop doses of Fowler's solution three times daily without ill effect. Prussic acid, strychnia, iron, ipecacuanha, and alcohol are also required in larger proportionate doses

in childhood than is indicated by the rule either of Dr. Cowling or Prof. Clarke.

When practicable, medicines should be given in the liquid form. Those not soluble may often be given in suspension, in some vehicle which in great part disguises the taste. The best vehicle for the bitter vegetables, as the salts of quinia, with which I am acquainted, is the elixir adjuvans of Caswell and Hazard. The following is the formula for its preparation:—

℞. Cort. aurant., ℥ij.
Pulv. semin. coriandr.,
Pulv. semin. carui, āā ℥j.
Pulv. cort. pruni Virginianæ, ℥iv.
Pulv. rad. glycyrrhizæ, ℥vj. Misce.
Menstruum, Alcohol., partis j.
Aquæ, part. ijss. Misce.
Percolat. O. v, et adde—
Syr. simplic.,
Aquæ, āā Oijss.

The elixir adjuvans may also be advantageously employed in the administration of many other medicines apart from those which are repulsive on account of their bitterness. It holds them in suspension so that if they have a greater specific gravity than the elixir it is necessary to shake the bottle thoroughly before using it. The elix. taraxaci comp. is another good vehicle for bitter vegetables, although, like the elixir adjuvans, not officinal. I am sure from many observations, that unpleasant doses are apt to be wasted to a greater or less extent, and the repugnance of children to medicines employed has induced many a parent to seek other and less disagreeable modes of treatment. Chemistry has greatly aided the therapeutics of childhood, in that it has enabled us, in so many instances, to prescribe the active principles in place of the large nauseous doses formerly employed.

PART II.

CONSTITUTIONAL DISEASES.

SECTION I.

DIATHETIC DISEASES.

CHAPTER I.

RACHITIS.

RACHITIS, or rickets, is a disease of the general nutritive process; but the structural changes which attend and characterize it are most conspicuous in the bones.

AGE.—Rachitis commences in most instances between the ages of six months and two years. Now and then we meet cases of its earlier as well as later commencement, and skeletons are preserved in museums, which seem to show that in rare instances rachitis is congenital. Virchow alludes to such a specimen in the Wurzburg Museum, and Ritter von Rittershain describes another in the Museum of the Franz Joseph Hospital in Prague. In the Wood Museum of Bellevue Hospital is a similar skeleton presented by myself, and represented in the accompanying wood-cut. The infant in this case died a few hours after birth, of atelectasis, apparently produced by the contracted state of the thoracic walls. The parents are hard-working English people, whose surroundings are such as are known to predispose to rachitis. Whether this congenital deformity is really rachitic, is, however, doubtful. (See Prof. Depaul, *Archiv. de Tocol.*, Aug. 1878, *Monthly Abstract*, Phila., Oct. 1878.)

FIG. 5.

Enlargement of the costo-chondral articulations, known as the "rachitic rosary," which is one of the earliest and most reliable signs of rachitis, has been observed, though rarely, in infants of two or three months. It should not, however, be regarded as a sign of rachitis unless the enlargement is so great that it can be readily appreciated by examina-

tion through the integument or by sight, for in young children, with the bones in the process of normal development, these joints always have a greater diameter than that of the ribs. After the age of two years the number of those affected with rachitis gradually becomes less as we pass towards manhood.

Published statistics relating to the commencement of rachitis have been derived chiefly from European hospitals. Of 521 cases observed by Ritter von Rittershain, 266 were under the age of twelve months, and 91 under six months. Of Hillier's cases, 7 were six months old or under, 27 from six to twelve months, 40 from twelve to twenty-four months, 40 from two years to four years, and 3 over the age of four years. As rachitis so often commences insidiously, these statistics must be considered only approximately correct, especially as regards those cases which are supposed to have had an unusually late commencement.

Is rachitis ever developed in the adult? Osteo-malacia, or mollities ossium, a rare disease of adults, occurring with few exceptions in women after childbirth, resembles rachitis, since it is attended with softening of the bones from the absorption of their calcareous element. Trousseau, and following him, Bouchut, believe in their essential identity, regarding their differences as due to the difference in age, and especially to the fact that in osteo-malacia the bone has attained its growth, whereas in rachitis it is still growing. Moreover, as arguments in favor of their close relationship, rachitis and osteo-malacia are found to require very similar treatment, and women after childbirth resemble children as regards aptitude for disease.

Causes.—Rachitis, as we have stated elsewhere, is entirely distinct in its nature from scrofula. The scrofulous are not likely to become rachitic, nor the rachitic scrofulous. Proneness to low grades of inflammation or to hyperplasia of the lymphatic glands, which characterizes scrofula, seldom exists in connection with swelling of the bones or other manifestations of rachitis. The differences between the scrofulous and rachitic diatheses, which indeed seem to exclude each other, are marked. The scrofulous are well developed and of good height, as a rule, while the rachitic are stunted. Scrofula manifests itself not less frequently in childhood than in infancy, whereas rachitis we have seen is especially a disease of infancy. Again, as showing the difference between the two, scrofula is not infrequently associated with tuberculosis, whereas rachitis with tuberculosis is rare.

Residence in a cold and moist climate, or in dark, damp, and ill-ventilated apartments, is a cause of rachitis. Therefore it is more common in the north of Europe than in the warm and equable climate of southern Europe; in the damp and dark basements and alleys of the city, than in dry and airy country residences. In deep valleys, shut out from the solar rays, rachitis is more common than among people of the same habits and social position living in elevated and sunlit localities.

A common cause of rachitis is the use of insufficient or improper food. This has been ascertained not only from the history of rachitic children, but from experiments on animals. Diminution in the relative amount of lime and consequent softening of the bones have been produced in various animals by the use of scanty food, or food deficient in nutritive properties. Artificial feeding of young animals at the time when nature designed that they should be nourished by the mother's milk has had the same result. (Experiments by M. Jules Guerin and others.) Rachitis is more apt to occur in those who are prematurely weaned than in those who nurse the full time. Those are most likely to become rachitic in a marked degree, even fatally, who at the same time have scanty and improper food, and reside in damp, dark, and insalubrious localities.

An hereditary predisposition to rachitis must also be admitted, since infants born of rachitic parents are more likely to become rachitic than are those of healthy parentage. The mothers presented traces of rachitis in 27 out of 71 cases observed by Ritter von Rittershain. A mother in habitual ill health and poorly nourished, though without actual disease during the period of gestation, is more apt to have rachitic offspring than is a mother whose health is habitually good.

It is not true, as some have stated, that all that is required to produce rachitis is a certain lowering of the vital powers, since all greatly enfeebled infants would become rachitic, whereas only a portion of such present the anatomical changes which characterize this affection. Cachexia is, however, an important predisposing cause, and therefore the rachitic state not infrequently supervenes on certain exhausting diseases, as the eruptive fevers, pertussis, and enterocolitis. There are supposed to be two direct causes or factors in the production of rachitis: one a deficiency of phosphates in the blood, due to the use of improper food or to faulty digestion; the other an excess of acids, probably mainly the lactic produced by the same causes, which acid or acids dissolve the phosphates in the blood, so that they are eliminated from the kidneys, instead of being deposited as alkaline lime-salts in the bones.

Anatomical Characters. *First Stage.*—M. Lebert says: "In rachitis the bone is diseased in all its histological elements, and the skeleton in its totality." It commences with proliferation of the periosteum and of the cartilages of the epiphyses. In the normal state the new tissue formed by this proliferation changes into bone by the deposits of the lime-salts, that formed from the periosteum increasing the thickness of the bone; that from the cartilages, their length; but in rachitis, as already stated, the osseous change does not occur. Soon the areolæ, which abound in the ends of the long bones, in the short bones, and in the diploë of the flat bones, are observed to enlarge, and the laminæ of which the compact bone is composed, to separate more or less from each other, forming interlamellar spaces.

The areolar and interlamellar spaces are filled with a gelatiniform fluid of a pale reddish color. The same substance fills the medullary canals, and, in certain situations, more or less of it is deposited between the periosteum and the external surface of the bone. The amount of subperiosteal deposit in a given place, depends in a measure on the tensity and degree of adherence of the periosteum. Thus when curvatures occur, the quantity of this substance deposited over the concave surface of the bone, where the periosteum is lax, is considerable, while over the convex surface, where it is tightly drawn, it is absent or scanty. This substance adheres quite firmly to the surface of bone, with which it is in contact, though at autopsies more or less of it can be washed away by a stream of water.

The periosteum and medullary membrane are more vascular than in their normal state, presenting a deep red color, and the vascularity of the bone itself is increased.

Second Stage.—The second stage is that of curvatures and deformity. The laminæ of compact portions, and the walls of the areolæ, in parts that are cancellous, become gradually thinner and more yielding. Here and there loss of the animal matter in connection with the mineral, occurs, producing new apertures and channels, in some of which bloodvessels of a new growth are developed. Occasionally portions of bone become detached, and lie as sequestra in the midst of the gelatiniform substance. The shape of the medullary cavity changes. The extremities of the cavity are considerably larger than its central portion. In this second stage, in typical cases, the relative proportion of calcareous matter being greatly reduced, and the new gelatiniform substance still semi-liquid, if an opportunity occur of examining the skeleton, the long bones can be bent, and their epiphyses, as well as the flat and short bones, compressed, and, in some instances, even crushed between the thumb and fingers. "The bones in this state can be cut with a knife with as much ease," says Trousseau, "as a carrot or other soft root." In cases in which the absorption has been considerable, if the bone removed from the cadaver is dried, it will be found possible to respire through it, so great is its porosity, and its weight is from six to eight times less than that of normal bone.

If rachitis commence at an age, as it commonly does, when the diaphyses and epiphyses of the long bones are united by cartilage, this cartilage, not being transformed into bone, increases in extent and undergoes molecular changes, which have been minutely described by M. Broca. According to him, as we examine the cartilage beginning at the epiphysis, we find first a layer of cartilage which is but little changed, containing cells in their normal state. Nearer the diaphysis we find cartilage perforated with small holes, the cartilage-cells, instead of being distinct, being arranged in longitudinal groups, in other words, lying in longitudinal cavities, and flattened by mutual pressure. Near the diaphysis bands of fibrous tissue surround the clusters of cells.

While the anatomical changes, described above, are occurring, the ligaments which unite the bones become gradually lengthened and relaxed, so that there is increased mobility of the bones upon each other.

The deformities which occur in the second stage vary in degree in different cases, according to the amount of rachitic softening and tumefaction of the bones, and relaxation of the ligaments on the one hand, and the movements of the patient on the other. If the patient is old enough to walk, the curvatures ordinarily occur first in the lower extremities; but if too young to walk, they are sometimes first observed in the upper extremities.

Craniotabes.—Occasionally the cranial bones in rachitis become very much thinned and softened in places, to which the name of craniotabes has been applied. This thinning occurs most frequently in the occipital bone, and sometimes to such an extent that the dura mater and pericranium are nearly in contact. The soft spots are yielding when pressed upon, and in the cadaver they are seen to be translucent when held to the light. Craniotabes has been invested with considerable pathological importance, chiefly through the writings of Dr. Elsässer. If the occipital bone is thin and yielding, the brain is liable to be unduly pressed upon at these yielding points, even by the weight of the head on the pillow. In connection with this, the clinical fact is significant that children with rachitis, and the softening of the calvarium which results from rachitis, are especially liable to internal convulsions.

The changes in the shape of the head in rachitis are characteristic, and are so manifest as at once to attract attention. The growth of the cranium is not retarded like that of other parts of the system, and in some patients its volume is greater than the normal size. If there is considerable cranial development, hypertrophy or hydrocephalus commonly coexists. The rachitic skull does not always present the same shape. It may be elongated, but more frequently it approximates to a square shape. It is more or less flattened superiorly, laterally, anteriorly, and posteriorly. The sutures, which are late in closing, are commonly depressed, while the frontal protuberances are unusually elevated. Elevation of the sutures in ridges has been observed in exceptional cases, as also flattening limited to one plane of the head, or greater in one than in the others, so as to destroy the symmetry of the cranium.

The accompanying wood-cut is of a child with rachitis, now in the New York Infant Asylum. It is 18 months old, has six teeth, a square head, softened and thin cranial bones, and a greatly depressed longitudinal suture. Within the last two months it has had attacks of internal convulsions, in which it holds its breath and fixes its eyes, but which pass off in probably a quarter of a minute, without any noise. This child is very fretful, and dreads to be approached. In the same institution is another child, aged 15 months, without teeth, with a less marked rachitic head,

and without the convulsions, but with the rachitic rosary, and a decided enlargement of certain of the joints of the extremities.

The deformities of the trunk and limbs occurring in the second stage are interesting. There is lateral depression of the thoracic walls between the second or third and ninth ribs, accompanied by projection of the sternum. The shape of the chest resembles that of the prow of a ship, to which Glisson likened it, or the breast of a bird. This deformity is the result of atmospheric pressure, occurring externally upon the thoracic walls during inspiration, at the time when the ribs are most softened, and least elastic. Depression of the first and second ribs is partially prevented

Fig. 6.

by the support which they receive from the clavicles. The length of the clavicles is, however, somewhat diminished, and their curvatures increased, so that the shoulders approach each other. Below the ninth ribs the thoracic walls are expanded; the corresponding ribs on the two sides are more separated from each other than in their normal state. The expansion of the base of the chest diminishes the convexity of the diaphragm, and causes depression of the liver and spleen.

The abdomen in rachitis is protuberant, partly on account of the depression of the liver and spleen, partly on account of the spinal curvatures and shortening of the trunk, but chiefly on account of the fact that in this disease the intestines are distended with gas. The meteorism gives rise to tympanitic resonance on percussion, except occasionally over the lower purt of the abdominal cavity, where there may be dulness from serous effusion.

Spinal curvatures, to which allusion has been made, are common in rachitis. They are due to softening of the intervertebral cartilages, and

the bodies of the vertebræ, and to laxity of the intervertebral ligaments. Their direction is commonly antero-posterior. They are distinguished from the deformity of caries by the absence of an angular projection. Moreover, except in cases of long continuance, the curvature can be removed by placing the patient in a horizontal position, and pressing with the fingers on the projecting parts. The pelvic bones also undergo change of shape. There is expansion of the upper part of the pelvic cavity, from the pressure of the abdominal viscera, corresponding with the expansion of the lower part of the thorax, though not in a great degree, while the lower part of the pelvic cavity is contracted.

The bend of the humerus is such in most patients that its concavity looks inwards and forwards, but occasionally it is directly the opposite.

Fig. 7.

Fig. 8.

The concavity upon the forearm corresponds with the palmar surface of the hand. The concavity of the thigh presents towards the median line and a little posteriorly, the natural bend of the femur being simply increased. The curvatures of the tibia and fibula vary in different cases. If the infant has not walked, their concavity is sometimes directed forwards and inwards; but if it has walked, outward and backwards. Occasionally, the direction of the bend on one side differs from that on the other.

Third Stage.—The third stage is that of reconstruction. After a variable period, depending on the severity of the disease and the state of the constitution, the gelatiniform substance becomes more consistent, and points of calcareous matter appear here and there within it. The deposit of lime-salts continues, and the newly formed bone again becomes firm and unyielding. It is generally cancellous in places where the original bone was of this character, though the extent of the new cancellous struc-

ture is apt to be different from that in the normal bone. Thus not only are the epiphyses cancellous in the new as in the original bone, but I have seen the entire medullary cavity filled with cancellous structure. The subperiostal deposit is sometimes also transformed into cancelli. This was the character of the change occurring under the pericranium in one specimen which I examined. Where the original bone was compact, the reconstructed bone is usually of the same character, as, for example, in the shafts of the long bones. Compact portions of the reconstructed skeleton have been said to lack the elements of true bone; they are osteoid, according to this theory, and not osseous, resulting from petrifaction of the gelatiniform substance. I have, however, found the elements of true bone in the skeletons of two individuals who had well-marked rachitic curvatures. The portions examined were removed from the concavities of the long bones, where there had been decided bending and thickening of the shafts from the large amount of rachitic deposit. In both specimens the osseous corpuscles (*lacunæ*) and Haversian canals were easily demonstrated; but in both there had been considerable growth of the bones since the rachitic period, and perhaps the portions which were examined belonged to this subsequent growth. Whether or not true bone is produced in the third stage of rachitis, that is, from the deposit of calcareous salts, which immediately succeeds the softening, certainly in the subsequent growth there is the formation of true bone.

Such is a brief sketch of the changes which the skeleton undergoes in ordinary cases of rachitis. An extreme degree of softening may be reached in four or five months, or not till the lapse of a year or more. The third stage, or that of consolidation, lasts one or two years. While in the first and second stages there is an arrest of ossification, and a deficiency of calcareous salts in the system, there is often in the third stage, as Lebert has stated, an exuberance of ossification, and a superabundant deposit of the salts of lime, so that the reconstructed bone is firmer and stronger than normal bone.

Occasionally, in reduced states of system, the third stage does not occur. The bones remain very soft and flexible, consisting almost entirely of animal matter. This is what has been designated rachitic consumption of bones. Such cases end fatally after a variable time.

A not unfrequent accident in the second period of rachitis is fracture in the shafts of the long bones. If there is almost complete removal of the mineral substance of a bone, so that the periosteum incloses little except the gelatiniform deposit, and the animal matter of the old bone, the limb bends readily, and no fracture occurs. If there is not so complete absorption, the weight of the body or muscular exertion snaps rather than bends the weakened shaft. From the nature of the fracture, crepitation can rarely be produced. The callus is not generally abundant, and reunion of the bone is slow. Many cases of rachitic fractures are partial, portions of

the shaft deprived of the mineral element bending, while the part which retains this element is fractured.

Rachitis retards the evolution of the teeth. If the disease commences as early as the fifth or sixth month, no teeth commonly appear till after the age of twelve months; if certain teeth have appeared prior to the rachitic disease, an interval of several months elapses before the next are cut. Teeth which are developed during the rachitic state are frail, and deficient in enamel. They become black and carious early, and loosen in their sockets. If there is no tooth at the age of twelve months, the infant is probably rachitic. The fontanelles and cranial sutures remain open longer than in healthy infants. The former may not close till the third or fourth year, and the latter not till the second or third year. Patency of the anterior fontanelle after the age of twenty months indicates rachitis.

Although the prominent and most interesting lesions of rachitis occur in the bones, anatomical changes, resulting from the disease, occasionally occur in the soft parts. The lymphatic glands, liver, spleen, and some other organs not infrequently undergo waxy degeneration, diminishing greatly the chances of recovery. Whether this degeneration results from the diathesis directly, or is due to the bone disease, the substance which is produced is now admitted to be the true waxy material, though for a time denied, as it does not always give a clear reaction with iodine.

Rachitis influences the future growth of the skeleton. The long bones, though unusually thick and firm, do not attain the normal longitudinal development; therefore the child of ten years, who has had rachitis, is scarcely taller than one of six who has not been thus affected. In many patients the curvatures in the course of time gradually diminish, so that in youth and maturity the body is less misshapen than at the age of two or three years. It is rare, however, that the deformities entirely disappear.

It is seen that the anatomical characters of rachitis resemble, in certain respects, those pathological processes which are admitted to be of an inflammatory nature. The tenderness, hyperæmia, proliferation, and consequent thickening of the periosteum, and the proliferation of the epiphyseal cartilages, are perhaps inflammatory, since they resemble more closely the lesions of inflammation than any other recognized pathological state. The soft substance, which is produced so abundantly in places underneath the periosteum and in the spaces of the bone, is perhaps in part an exudation, and in part the animal matter which is formed in the normal development of the bone.[1]

[1] The immediate cause of the elimination of the lime salts from the kidneys, and the consequent arrest of ossification of the skeleton, demands further investigation. The theory stated above, that it is due to an acid, probably the lactic, which is generated in the intestines, during the process of digestion, receives support from the fact, that so many who have become rachitic have previously suf-

Symptoms.—The patient in incipient rachitis is quiet and melancholy, shunning caresses or attempts to amuse him, since movement of his body increases his suffering. He has general tenderness, due in part to the morbid state of the periosteum, and in part to hyperæsthesia. The rachitic infant, therefore, unless very mildly affected, will evince anxiety and dread even at the approach of any one, through fear of being touched or moved. Trousseau says: "This change in the character of the infant, the fear which it experiences of seeing its sufferings return, which the pressure of another's hand causes, this habitual sadness impressed upon its features, differs from that which we observe at the commencement of other maladies, especially from that in the prodromic period of cerebral fevers. In truth, in an infant over whom this last and cruel affection is impending, we are able to excite again a momentary cheerfulness; we are able, by exciting actively its spirits, to make it turn temporarily from this melancholy languor, which constitutes its habitual state. It is not thus in the rachitic; the more you desire to arouse it, the more you solicit its movements, the greater will be its impatience. It is indifferent to the plays which it previously loved. This . . . . habitual sadness in an infant, who, with an appetite rather augmented than diminished, sensibly emaciates, who has constantly acceleration of pulse coincident with profuse perspiration, these symptoms, I repeat, have positive significance when the infant does not cough or present any of the signs which induce us to believe in the occurrence of tubercular phthisis."

Febrile movement, manifested by acceleration of pulse and increased heat of blood, is common, although, in most cases, there is no decided exaltation of the external temperature, perhaps in consequence, in part at least, of the free perspiration to which these patients are subject.

A bruit de soufflet of greater or less intensity, synchronous with the pulse, has frequently been heard in rachitic cases, when the ear was applied over the anterior fontanelle. Drs. Fisher and Whitney, New England physicians, first called attention to this murmur, believing it to be a sign of chronic hydrocephalus. MM. Rilliet and Barthez heard it in cases

fered from indigestion and gastro-intestinal derangements. Moreover, Dr. Heitzmann, now of New York, has produced rachitic bone in the rabbit by introducing a considerable quantity of lactic acid in its food. Nevertheless, in the New York Infant Asylum, which during the last few years has afforded a good opportunity for observation, while certain of the cases evidently suffered from intestinal derangements, certain rachitic infants, who had been constantly under observation before and during the rachitic period, were wet-nursed (some by their mothers), and gave no evidence of faulty digestion. They seemed to us to have as good and abundant nutriment as others who were not rachitic, and with fully digested and not too frequent alvine evacuations. It appeared, therefore, to us, that in them there was some unknown constitutional condition which favored the development of rachitis.

of rachitis, and therefore concluded that the American observers had mistaken the rachitic for the hydrocephalic head. Later observations have established the fact that this murmur possesses little diagnostic value. It is heard in healthy as well as diseased infants. Dr. Wirthgen detected it 22 times in 52 children, all of whom, except four, were in good health. I have auscultated the anterior fontanelle in 29 infants, who were, with two exceptions, between the ages of three and thirty months. Most of them were well, or with trivial ailments which would not affect the cerebral circulation. In most infants with a patent fontanelle a murmur can be distinctly heard synchronous with the respiratory act, and in 15 of the 29 cases no other bruit could be detected, while in the remainder, namely, 14, a bruit synchronous with the pulse was heard at the fontanelle.

The rachitic, as stated above, are liable to perspirations, which are profuse about the head and neck, so as to moisten the pillow on which they lie. The respiration is more or less accelerated except in the mildest cases, in consequence of the flexibility and diminished elasticity of the ribs, and the lateral depression of the thoracic walls, which prevent full inflation of the lungs.

The urinary secretion is abundant, like the perspiration. During the first and second periods it contains a large amount of the calcareous salts, since the lime which enters the system with the ingesta, and which in the normal state is expended in the growth of bone, is eliminated from the system by the kidneys.

The appetite in the beginning of rachitis is good, sometimes even better than in health; but it gradually diminishes, as the disease increases in severity, till it is entirely lost. Diarrhœa alternating with constipation is common. With the continuance of febrile movement and loss of appetite, the patient soon begins to lose flesh, emaciation in the second stage being a prominent symptom.

Since the rachitic patient sits or lies quietly, unable or disinclined to make exertion, the muscles become small and flabby from disuse. Deposition of fatty matter may occur between the primitive muscular fasciculi.

Rachitis in the female infant is attended by one serious consequence, namely, narrowing of the pelvic cavity, from the thickening, change of shape, and imperfect development of the pelvic bones. Rachitis, therefore, in the female greatly increases the danger of childbearing, and may render it impossible.

Complications.—Rachitis is often attended by certain serious complications, the most common of which are inflammatory affections of the respiratory apparatus. Bronchitis is one of the most common diseases during the age at which rachitis occurs, and even a mild form of it involves great danger if the ribs are soft and flexible or the thorax have the rachitic deformity. In these cases, since full inflation of the lungs is prevented,

collapse more or less complete of certain of the lobules is apt to occur, increasing the amount of dyspnœa, and therefore diminishing the chances of recovery; hence bronchitis is very fatal in infants who are decidedly rachitic.

Imperfect digestion of food, and unhealthy alvine evacuations, common in rachitic children, frequently cause diarrhœa, and, after a time, intestinal inflammation. The diarrhœa, especially if it has become inflammatory, is apt to be obstinate and dangerous, the patient becoming emaciated and feeble.

Internal convulsions, the so-called laryngismus stridulus or spasm of the glottis, has been observed in so large a proportion of cases, that its occurrence in rachitis must be considered something more than mere coincidence. Elsässer believed that he had discovered the cause of the laryngismus in craniotabes, but later observations have failed to establish the correctness of his views. Hypertrophy of brain, and chronic hydrocephalus, are also occasional complications. In cases of great deformity of the chest from rachitis, in which the lungs are more or less compressed, the pulmonary circulation is retarded and imperfect. This gives rise to congestion of the right cavities of the heart, with hypertrophy of this organ, and congestion of the hepatic veins, liver, and portal system. Congestion of the portal system may be regarded as a cause of the diarrhœal attacks.

Diagnosis.—Diagnosis is easy, except in incipient or slight cases. The lesions which pertain so largely to the skeleton are readily detected. Beading of the costo-chondral articulations occurs early, and is apparent to the sight. Enlargement of the joints of the limbs, arrested dental evolution, the state of the anterior fontanelle, the peculiar shape of the head, the sternal projection, and rachitic curvatures, indicate positively the rachitic state. Profuse perspiration upon the head and neck, and the general tenderness of the patient, as evinced by his cries when moved or disturbed, are also important diagnostic signs.[1]

Prognosis.—The prognosis is favorable, as regards life, if rachitis is recognized at an early period, and properly treated. The vicious nutritive process may be arrested, and the patient recover with but slight deformity. If curvature of the long bones has occurred, and the head and thorax are misshapen, the patient under favorable hygienic conditions commonly recovers from rachitis, but with permanent deformities.

If there is that degree of spinal curvature in the dorsal region, and depression of the ribs, that respiration is, habitually, more or less accelerated

[1] And yet rachitis, though not uncommon in the tenement-house families of New York, is frequently overlooked by physicians, who attribute the fretfulness, perspiration, etc., to other causes. The backwardness of dentition is a notable sign of rachitis. Sir William Jenner says, if an infant reaches its ninth month without a tooth, it is rachitic.

and embarrassed, on account of compression of the lungs, the prognosis is unfavorable, since bronchial or pulmonary inflammation, occurring in this condition, is apt to be fatal. If there is much emaciation, and especially if diarrhœa is present, or of frequent occurrence, the prognosis should be guarded. In these cases there is probably waxy degeneration of important organs, which cannot be remedied.

TREATMENT.—The correct treatment of rachitis is obvious when we consider its character and the nature of its causes. The indication is to restore healthy nutrition. This requires both hygienic and therapeutic measures. The apartment in which the child resides should be dry, airy, and plentifully supplied with light. He should be taken daily into the open air, in order to invigorate his system, but in such a way as not to increase his suffering, in consequence of his general tenderness. The diet should be appropriate for the age. It should be bland and easy of digestion, and, at the same time, sufficiently nutritious. Cleanliness of person and apartment, and clothing sufficient to protect from vicissitudes of temperature, are requisite. The rachitic patient of the city should, if practicable, be removed to a well-selected locality in the country.

The medicines which are of undoubted efficacy in rachitis are cod-liver oil and lime. I prefer the following formula, which agrees with most children.

℞.—Ol. morrhuæ, ℥vj;
Syr. calcis lactophosphatis,
Aq. calcis, āā ℥iij.—Misce.

Give one to two teaspoonfuls three or four times daily. To it may be added the syrup of the iodide of iron; the vegetable and ferruginous tonics, as the citrate of iron and quinia.

The compound syrup of the phosphates, the citrate of iron and quinia, wine of iron, iodide of iron, the various preparations of cinchona, columbo, etc., are the medicines which, with or without cod-liver oil, are best calculated to restore healthy nutrition. When complications arise, the treatment should be modified to meet the exigencies of the case. Most of the diseases which occur as complications, require treatment similar to that which is appropriate in their idiopathic form, but all measures of a depressing nature should be avoided.

CHAPTER II.

SCROFULA.

The term scrofula (*scrofa*, a pig, from the resemblance of the enlarged cervical glands of a scrofulous individual to a swine's neck) is applied to a diathesis, which is characterized by increased vulnerability of the tissues. The nutritive process of the tissues is readily disturbed even by trifling irritants or agencies in those who possess this diathesis, and, therefore, the scrofulous are very prone to inflammations of various parts and to hyperplasia, more particularly of the lymphatic glands. Inflammations, which can properly be considered as dependent upon this diathesis, or as occurring under its influence, are for the most part subacute or chronic, and they differ from ordinary inflammations in the fact of a greater cell formation, great liability to cheesy degeneration of inflammatory products, so that return to the healthy state by absorption is slow or impossible. Moreover, this diathesis, while it gives rise to certain inflammations, which do not occur or are rare in other states of the system, and which all physicians at once recognize as scrofulous, often modifies those common inflammations to which all persons, whether scrofulous or non-scrofulous, are liable, as coryza and bronchitis, rendering them more protracted and less amenable to the ordinary treatment.

Scrofula is a disease chiefly of infancy and childhood. Manhood, especially the first years of it, is not entirely exempt, but scrofulous manifestations after the age of twenty years are feeble and infrequent, disappearing entirely as the individual advances towards middle life. The diathesis is most active prior to the age of ten years.

Causes.—Scrofula is congenital or acquired. Parents who had scrofulous symptoms in early life, or who are in a state of decided cachexia, as from cancer, syphilis, intermittent fever, or tuberculosis, are apt to beget scrofulous children. Insufficient nourishment of the mother during a considerable part of her gestation, and advanced age, and therefore feebleness, of the father, are occasional causes. Near blood relationship of the parents is also a recognized cause, and to this has been attributed the scrofula of royal families. Children whose father and mother are first cousins are, according to my observations, apt to be scrofulous.

Again, those born with sound constitutions may acquire scrofula through anti-hygienic influences in the first years of life. Among the poor of New York we often observe one child in the family who presents scrofulous

symptoms, while the rest of the children are well, and in many cases we are able to trace back the diathesis to some depressing cause or causes, which were sufficient to effect the peculiar change in the molecular condition of the tissues which constitutes this disease. Obviously the causes of acquired scrofula are quite numerous. In the infant it is sometimes produced by insufficiency or poor quality of the breast-milk, or the use of artificial food during the period when breast-milk is required. Too protracted lactation also, especially if artificial food is almost wholly withheld, may cause it; as may also, in those who have passed beyond the age of lactation, the continued use of a diet which is deficient in nutritive properties.

Residence in damp, dark, and filthy apartments or streets may also produce it. Hence one reason of its frequent occurrence among the city poor. Residence in a small, crowded, and imperfectly ventilated apartment has been known to produce it, even with personal cleanliness, and a diet sufficiently nutritive.

Scrofula may also be caused, in those previously robust and of sound constitution, by disease of an exhausting nature. The eruptive fevers, as smallpox, measles, and scarlet fever, if severe, occasionally have this result, or they render active the diathesis, which had hitherto been latent. In this city, where chronic entero-colitis of infancy is common, I have sometimes been able to trace the diathesis to it.

Can a child affected with scrofula communicate it to others? Does scrofula possess a peculiar principle, a *materies morbi*, which is communicable to others? There is a strong popular belief that it is communicable by contact, and some good pathologists and high authorities in children's diseases are inclined to believe that the popular opinion has some foundation in fact. M. Bouchut, who holds that the scrofulous and tubercular diatheses are identical, says of scrofula that it has not been shown to be inoculable. "Nevertheless, if its contagiousness has not been demonstrated, we are not able to say that it will not be some day. The facts of vaccinia followed by impetigo, by scrofulous ophthalmia, and enlargement of the cervical glands attributed to the inoculation of scrofulous vaccine virus, and those of the contagion of phthisis by constant cohabitation, demand, at least for the present, a certain reserve."

But scrofula differs widely in its nature from those diseases which are known to be communicable. It presents no analogy with them. We would not suppose, apart from observations, that a diathesis which consists in such a state or constitution of the tissues that they are easily wounded, possessed any inoculable principle, and, in my opinion, observations go to show that no such principle exists. How often do we observe children with scrofula, coryza, otorrhœa, or scrofulous cutaneous eruption, associating with others without communicating the diathesis?

Vaccination, however, affords the best opportunity for determining

whether scrofula is inoculable, and the very prevalent opinion of non-professional people, that it may be communicated and established through this operation, should have due weight. For it may be stated, as a rule, that a widespread popular belief in reference to a disease, which has external manifestations, does have some basis of truth.

The following are the facts in reference to this matter :—

1st. It is the almost unanimous opinion of the most experienced vaccinators that pure vaccine lymph taken from a vesicle prior to the eighth day, never communicates anything but vaccinia. When another disease, as syphilis, is communicated by the use of the lymph, it is through the blood, which has been mixed with the lymph by careless puncture of the vesicle. This opinion, so strongly established by observations, also commands assent from its reasonableness.

2d. Vaccination of those who are decidedly scrofulous with virus from a healthy child, especially if the scab is employed, not infrequently produces a sore which becomes covered with a thick and irregular crust, consisting in part of inspissated pus, and the sore is long in healing. In the scrofulous, also, impetiginous eruptions are apt to arise around the vaccine sore, and the axillary glands to become tumefied on the side corresponding with the vaccination. This gives rise to the belief on the part of friends that impure virus has been used, and scrofula communicated, while the fault is in the constitution of the child itself. The tumefaction of the glands, and the primary and secondary sores, gradually disappear, in most cases, leaving no ill effects, and with no subsequent manifestations of disease.

3d. The vaccine crust from a decidedly scrofulous child, as it contains more or less animal matter, and is often pale, irregular, or broken, inserted in the arm of a healthy child, not infrequently produces an immediate inflammation with suppuration, so that the vaccine vesicle, if it forms, is soon broken, and an irregular sore and crust result, which present none of the appearances observed in the uncomplicated vaccine eruption. A simple inflammation, produced by the pus or other products contained in the scrofulous scab, has coexisted with and modified the specific eruption. The sore heals gradually, and impetiginous eruptions may occur around it, but no struma remains or is communicated.

4th. Scrofulous manifestations sometimes appear for the first time after vaccinia, but they appear also after those analogous but severer eruptive fevers, namely, measles, scarlet fever, and smallpox. Those infectious exanthematic diseases which profoundly affect the constitution, it is admitted, may be a co-operating, if not a main, cause of scrofula, and is there anything unreasonable in the supposition that vaccinia may have occasionally a similar effect, though less frequently or in a less degree, in proportion as it is milder? From my own observations, I am of opinion that vaccinia, not vaccination, may occasionally awaken to activity the scrofu-

lous diathesis, or, in combination with other causes, may even produce it in those who previously possessed good constitutions. It is a well-established fact, in the etiology of diseases, that causes which, in themselves, are entirely inadequate, or even insignificant, frequently produce disease in a system which other agencies have already prepared for it. Thus an excoriation gives rise to erysipelas, or a slight exposure to cold produces rheumatism. And so in those cases in which the friends have charged the production of scrofula upon vaccination, it has seemed to me that the most that could, with truthfulness, be alleged, was that the constitutional disease which had been produced by the operation, namely, vaccinia, was a subordinate, but, under the circumstances, a sufficient cause.

The following is the most striking case of the apparent communication of scrofula through vaccination which I have met: D——, West Fortieth Street, residing in a tenement-house, had no scrofulous affection, and was considered healthy till the age of eleven years. The remaining children of the family have never exhibited scrofulous symptoms. At the age of eleven years this boy was vaccinated from a scab, the source of which was not known, but by a physician whose practice was chiefly among the city poor. The sore produced was long in healing, and, before it had healed, the axillary glands, and those of the face and neck, began to be prominent and hard. From this time to the present, a period of six years, these glands have remained so large as to constitute a deformity, and certain other groups of glands, as those in the left infra-clavicular region and right groin, have undergone a similar hyperplasia. Examination of the blood by the microscope shows the absence of leucocythæmia. This case, at first view, certainly appears to be an example of the communication of scrofula through vaccination, and, for a time, I could interpret it in no other way. But, when we recollect the facts already stated, namely, the improbability of the communicability of a diathesis of such a nature, how frequently scrofula is acquired by children of the tenement-house population, solely through the anti-hygienic conditions in which they live, the large number of scrofulous children in the crowded quarters of the poor, many of which have external ailments so that the conditions for communication are present in a high degree if scrofula were contagious, while the instances of its apparent communication are very infrequent, is it not probable that cases like this are to be explained in the manner indicated above, and that scrofula is not transmissible by vaccination?

The close resemblance clinically of scrofulous affections with the ulterior lesions of syphilis, has been adduced in support of the belief that scrofula, like syphilis, is due to some undiscovered specific principle. But the parallelism, it seems to me, is more apparent than real, and the difference between the two diseases is so great as to destroy the validity of the argument. For while syphilitic manifestations result from the reception of a certain poison in the system, scrofula as certainly results from a

variety of ordinary depressing agencies, affecting the system in so many distinct ways that it seems to me unreasonable to suppose that they produce a fixed specific principle, which, remaining in the system, causes the phenomena of scrofula. The facts then appear to justify the belief that scrofula does not possess any specific contagious principle, but that this constitutional anomaly is the direct result of the action of depressing agencies on the constitution of the tissues.

The primary scrofulous ailments, by which the diathesis is manifested, occur for the most part upon one of the free surfaces, namely, upon some part of the skin or mucous membrane. Certain standard authors attribute this to the fact that these parts are most exposed to the action of noxious agencies. The lymphatics lying in the inflamed area take up the altered lymph and carry it to the adjacent lymphatic glands, which become irritated, and undergo hyperplasia, and perhaps ultimately suppuration. This is, in a large proportion of cases, the beginning and the cause of scrofulous ailments. Nevertheless, in not a few instances, the first manifestations are in deep-seated and covered parts, as when scrofulous periostitis or osteitis occurs, without any peripheral lesion.

Anatomical Characters.—There are no ascertained anatomical changes in the blood which are peculiar to scrofula. As long as the appetite and general health remain good, and the local affections have not occurred, the composition of this fluid is, so far as known, unaltered. In the cachexia, which is present when the general health is impaired, the blood becomes impoverished, the red corpuscles lose a portion of their coloring matter, and the watery element predominates.

Does the glandular hyperplasia of scrofula produce an excess of the white corpuscles? Virchow says (*Cellular Pathology*, Lect. IX.): "During the progress of an attack of scrofula, in which, if the disease run a somewhat unfavorable course, the glands are destroyed by ulceration, or cheesy thickening, calcification, etc., an increased introduction of corpuscles into the blood can only take place as long as the irritated gland is still, in some degree, capable of performing its functions, or still continues to exist; as soon, however, as the glands are withered or destroyed, the formation of lymph-cells likewise ceases, and with it the leucocytosis. In all cases, on the other hand, in which a more acute form of disturbance prevails, connected with inflammatory tumefaction of the gland, an increase of the colorless corpuscles always takes place in the blood." Although the glandular hyperplasia occurring in scrofula increases the number of white corpuscles in the blood, scrofula cannot be regarded as sustaining any causative relation to that great and constant increase of white corpuscles which characterizes the disease leucæmia; for this disease, as remarked by Niemeyer, does not occur in childhood, when the scrofulous diathesis is active, but in manhood, when it has ceased to exist, or has become latent.

Strumous inflammations of the cutaneous and mucous surfaces, which

we have seen are the initial lesions in a large proportion of scrofulous cases, do not present any peculiar anatomical characters. Some of them are attended by an abundant formation of cells, and by dense infiltration of the inflamed tissues; but inflammations which do not depend on the strumous diathesis may present these same characters. The most marked differences between the strumous and non-strumous peripheral inflammations are found in their origin, amount of cell-formation, and duration.

The swelling of the lymphatic glands, which is so common in the neighborhood of scrofulous ailments, and which we have seen is in most instances the result of "conducted irritation," is due to hyperplasia of the lymphatic glands, with comparatively little or no increase of the stroma. Thus hyperplasia of the cervical glands is common, resulting from eczema of the scalp or face, or from otitis, or any of the forms of stomatitis; and so pharyngitis often gives rise to hyperplasia of the tonsils which are lymphatic glands. The scrofulous nature of the glandular enlargement is apparent from the fact that it continues long after the primary inflammation which gave rise to it has abated. Lymphatic glands sometimes enlarge in those who are not scrofulous, either from direct injury or propagated inflammation, but the tumefaction is commonly less in degree, and in most instances it soon abates when the exciting cause is removed.

The glands which most commonly undergo scrofulous enlargement are the cervical, inguinal, bronchial, and mesenteric; but in those who are decidedly scrofulous, the glands in the vicinity of any protracted inflammation are very prone to hyperplasia. Thus I have seen enlarged and cheesy glands in the vicinity of scrofulous ostitis, or periostitis.

Under favorable circumstances the glandular enlargement abates after a short time by absorption of the redundant cells. But the products of hyperplastic or inflammatory action in the scrofulous individual are very apt to undergo cheesy degeneration, and the close causative relation of this cheesy substance with tubercles is now admitted. If resolution do not soon occur in the gland, it begins to undergo cheesy degeneration. It becomes firm and inelastic, its nutrient vessels narrowed and compressed, so that circulation through it ceases, and its cells, losing their liquid and vitality, shrivel away. This necrobiotic process appears in points in the gland, which enlarge and unite, till finally the whole gland becomes a dead mass, with shrivelled elements, of a whitish appearance, like cheese, the resemblance to which has suggested the name by which the degeneration is known.

A cheesy gland not infrequently acts as an irritant, like inorganic matter, producing suppurative inflammation, and its history thenceforth is that of an abscess. Purulent matter mixed with the cheesy debris escapes by ulceration upon the nearest surface, and a scrofulous ulcer is the result, which slowly heals, leaving a permanent cicatrix; calcification of a cheesy gland occurs in exceptional instances.

The cervical lymphatic glands, having undergone hyperplasia in the scrofulous child, not infrequently continue painless and indolent for a considerable time, producing according to their size an unsightly appearance, and without undergoing cheesy degeneration. Finally one or more becomes inflamed, and the broken down gland substance softens and is expelled, mixed with pus through an ulcerated opening in the skin.

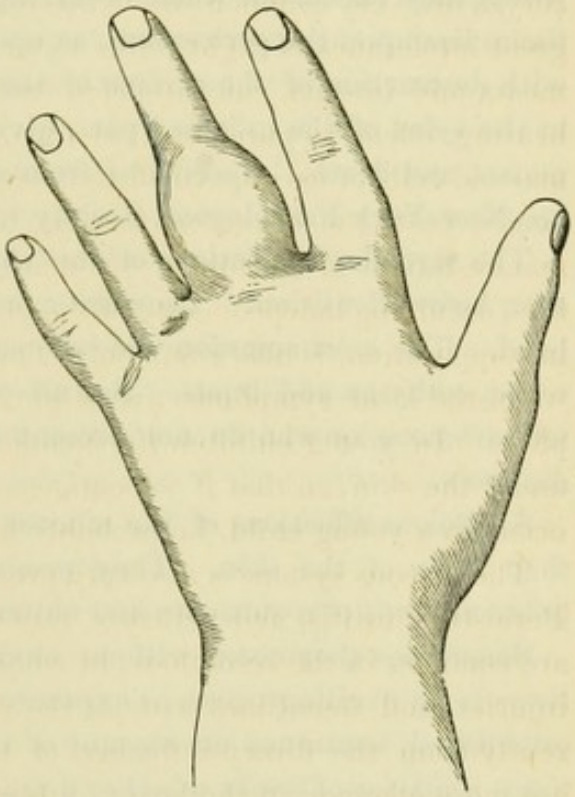
In order to complete the description of the anatomical character of scrofula, it would be necessary to describe the various inflammations to which the diathesis gives rise. Those which are most common and important occur in the skin, mucous membrane, connective tissue, the joints, the bones with their periosteal covering, and the eye and ear; eczema and coryza are very common scrofulous ailments. Phlyctenular keratitis with great intolerance of light, otitis externa, causing protracted otorrhœa, or media and interna, causing deep-seated pain, with impairment or loss of hearing, offensive purulent discharge, and in the gravest cases caries of the mastoid cells or caries extending along the petrous portion of the temporal bone even to the brain, causing meningitis and death, are not uncommon manifestations of scrofula, in the families of the city poor. Strumous cellulitis, occurring independently of the glandular affection, and quickly ending in suppuration, is also common. The term *cold* is applied to the abscess when the local symptoms are slight, and there is but little heat of the parts. In young children the common seat of these abscesses is directly under the skin, so that if subcutaneous cellulitis running into an abscess occur in a young child, he probably has the strumous diathesis.

The osseous system is also very prone to inflammation in the scrofulous. Periostitis, ostitis, aud arthritis, rare in those with healthy constitutions, are common in the scrofulous, in whom they result, even from very slight injuries, and sometimes without the recollection of any injury, and apparently from the direct influence of the diathesis. These inflammations are more common in the lower extremities than in the upper. Periostitis may occur independently of inflammation of the bone, where its usual seat is upon the shafts of the long bones, and it also accompanies inflammation of the bone, as pleurisy accompanies pneumonia. The osseous inflammations of strumous patients are of two kinds: first, the destructive, producing caries with suppuration, or necrosis; and, secondly, the so-called *fungous*, in which there is proliferation of tissue as in white swelling. Often both these processes coexist, granulations and new tissue springing up, while the carious or necrotic process is extending.

Dactylitis is in most instances when occurring in young infants a syphilitic affection, but in children of one year or more, in whom no marked syphilitic symptoms have previously occurred, it originates from the strumous cachexia, as in the following case: Charles R., aged twenty months, was admitted into the New York Infant Asylum in 1876. He had always been pallid, and had a strumous aspect. A physician acquainted with his

parentage states positively that he is free from syphilitic taint, but when a few months old he had a mild form of coryza, which gradually abated under anti-strumous treatment. At the age of five months he had purpura hæmorrhagica of a severe form, but apparently not accompanied by hemorrhage from any of the mucous surfaces. The patches of extravasated blood were quite numerous, and large over the trunk and limbs, and it was nearly three months before they entirely disappeared. A few months subsequently he began to have offensive otorrhœa on one side, which did not entirely cease. In December, 1876, at the age of eighteen months, well marked dactylitis was first observed, involving the first phalanx of the left middle finger. The swelling was somewhat tender, and the skin which covered it had a slightly reddish or pinkish tinge, indicating the inflammatory nature of the malady. Neither joint at the extremity of the phalanx was involved, so that the movements were unimpaired. The dactylitis increased somewhat after it was first discovered, and then began to decline, under treatment with the cod-liver oil and syrup of iodide of iron. The accompanying wood-cut represents the outlines, obtained by tracing the hand of the infant, when pressed on paper.

Fig. 9.



Symptoms. — The scrofulous diathesis is exhibited by certain physical signs, which are present in infancy, but are more manifest in childhood. In one class of strumous children, they are as follows: Form, tall and slender; quickness of movement and perception; intelligence, good; skin, thin and semi-transparent, through which the superficial veins are distinctly seen; features, delicate; cheeks, habitually pale or florid, and flushed by slight excitement; eyes, bright, with bluish conjunctiva; muscles and bones, slender in proportion to their length. Those children who present these peculiarities are said to have the erethitic form of the diathesis.

Others have what has been designated the torpid scrofulous habit, which is characterized by softness and flabbiness of the flesh, distended abdomen, large head, broad face, slow, languid movements, and an over-production of fat in the subcutaneous connective tissue in certain situations, especially the nose and upper lip. Though typical cases can be readily re-

ferred to one or the other of these forms, there are many cases which are intermediate.

One of the earliest of the scrofulous manifestations is subcutaneous cellulitis, alluded to above, giving rises to abscesses, commonly not large, with little surrounding induration, little pain, tenderness, and heat, and slow in discharging; in a word, indolent. The most frequent seat of these abscesses is upon the extremities, but they may occur upon the scalp or elsewhere. They gradually heal when the pus escapes, their site being indicated for a considerable time by the depression and reddish discoloration of the skin, which gradually returns to its normal state. Ordinarily, these abscesses do no harm apart from the reduction of the general health which they effect, but when occurring in localities where the connective tissue lies upon the periosteum, as upon the fingers, periostitis may result, with destruction of the surface of the bone. Again, thrombi may occur in the veins of the inflamed part, giving rise to emboli, embolismal pneumonia, and death. Specimens from such a case were presented by me to the New York Pathological Society in 1868.

The scrofulous affections of the skin often also occur at an early age, even before dentition. They are more frequent in infancy than in childhood. The most common are eczema and impetigo, and of rare occurrence, ecthyma and lupus. But all of these may occur in those who are not strumous or who do not present the characteristics of the strumous diathesis.

Scrofulous affections of the mucous surfaces are scarcely less frequent than those of the skin. They present the ordinary features of mucous inflammations of a subacute and chronic character.

Sometimes they occur without obvious exciting cause; in other cases there is an exciting cause, as exposure to cold; but the inflammation, once established, continues on account of the diathetic condition. It is sometimes a matter of doubt whether a mucous inflammation is of such a character that it is proper to designate it scrofulous, especially if it occur upon such surfaces as are often the seat of ordinary inflammation. If the child has heretofore presented symptoms of scrofula, if the inflammation is subacute, and there is no apparent cause to originate or sustain it apart from the diathesis, it is probably of a strumous character. The diagnosis is rendered more certain by observing the effect of anti-strumous remedies. The most frequent of these scrofulous inflammations of mucous surfaces are coryza, tracheo-bronchitis, and conjunctivitis. More rarely, stomatitis, pharyngitis, vaginitis, and, according to some, entero-colitis, are of a strumous character. Coryza gives rise to snuffling respiration, the formation of crusts around and within the nares, and excoriation of the upper lip. The tracheo-bronchitis is attended by thickening of the mucous membrane, increased production of mucus and epithelial cells, and a loud tracheal râle, accompanying each inspiration.

Strumous inflammation of the mucous membrane of the trachea and bronchial tubes is not a very infrequent disease in this city. It sometimes originates in a simple inflammation from cold, or the tracheo-bronchitis of measles, or pertussis, and it is apt to continue, with its râles, cough, and scanty expectoration, for months, unless relieved by a proper course of treatment.

Among the most common of the strumous affections, are inflammation of the eyelid, designated psorophthalmia, and that of the eye itself. The former is characterized by redness and thickening of the lids, detachment of the eyelashes, and inflammation and altered secretion of the "Meibomian glands;" the latter, namely, strumous ophthalmia, by pain, lachrymation, photophobia, and a moderate degree of hyperæmia of the affected organ. One of the most common serious results of strumous inflammation affecting the eye, arises from the conjunctivitis and keratitis, namely, the formation of phlyctenulæ and ulcers on the margin of the conjunctiva and upon the cornea, fed by newly formed vessels. If not controlled by proper treatment, they may result in opacities more or less permanent, or possibly, worse still, in perforation, with its consequent ill effects.

Inflammations of the external and middle ear have their origin very generally in the strumous diathesis. Occasionally there is an exciting cause of the otitis, as an injury, or severe constitutional disease like scarlet fever. Protracted otitis, whether external or internal, and especially that form of it which leads to ulceration, destruction of the ossicles, and caries of the petrous portion of the temporal bone, it is proper, in a large proportion of cases, to regard and treat as strumous.

I have stated that inflammations of the osseous system are common in strumous children. Some of the best observers and highest authorities, as regards the surgical diseases of children, both in this country and Europe, state that they do not consider these affections to be of a strumous nature; while others regard them as manifestations of struma. After carefully examining the reasons for this variance in opinion, I am convinced that the difference of views in reference to this matter occurs from a different understanding of the nature of scrofula. Those who state that the affections alluded to are not scrofulous, believe, so far as I have been able to ascertain, that scrofula and the tubercular diathesis are identical. As tubercles are not, as a rule, present in children who suffer from these affections, it is therefore held that these affections are not scrofulous. If those holding this belief were told, or could be made to believe, that scrofula is entirely distinct from the tubercular diathesis, that it is merely a name applied to a diathetic condition in which the tissues are easily wounded, there would probably be but one opinion as regards the scrofulous nature of these inflammations. For, as I have often had an opportunity to observe, they occur in a large proportion of cases from very trivial injuries, showing a highly vulnerable state of the tissues.

Holmes, in his useful and eminently practical *Treatise on the Surgical Diseases of Children*, says of one of the most common of the affections alluded to, namely, morbus coxarius: "The affection in question occurs very frequently in strumous children, a circumstance which has led to its being denominated strumous. . . . . If by strumous be meant a state of the system which renders the subject of it prone to the deposit of tubercle in the viscera, I think that there is good reason for asserting that morbus coxarius often attacks children who are not strumous, *i. e.*, who display no such tendency to the deposit of tubercle." Still, Mr. Holmes states "that there is that condition of the system which disposes its subjects to the development of low inflammations of various kinds," which is almost the full definition of scrofula, as understood by us.

The stubbornness and frequent disastrous consequences of scrofulous inflammation of the skeleton are well known. Nearly every bone, as well as its periosteum, is liable to this form of inflammation, but some are more frequently affected than others. Inflammation of the bone may terminate by resolution, by the formation of an abscess, or, and frequently, by carious or necrotic destruction of the bone itself. Necrosis is most apt to occur in the shafts of the long bones, caries in the spongy extremities of these bones, and in the spongy portions of the short bones. If abscesses form, the pus may finally escape from the system by a tedious ulcerative process, or, retained, may undergo cheesy degeneration. Scrofulous arthritis, if early detected and properly treated, may resolve, leaving no ill effect; if otherwise, suppuration, ulceration, cartilaginous and osseous, and anchylosis, are apt to result.

Scrofulous children are perhaps no more liable to inflammation of the internal organs than other children, but the inflammatory products are more liable to cheesy degeneration, and the prognosis is therefore less favorable. The most frequent of these inflammations, and the one of chief interest, is pneumonia. Catarrhal pneumonia, so frequent in early life, whether primary or secondary, in connection with measles, pertussis, etc., is a disease often involving grave consequences in those who are decidedly scrofulous; since, instead of resolving, the affected lung-tissue presents a strong tendency to caseous degeneration, ending in consumption of the lungs and death. I have most frequently noticed cheesy pneumonia during extensive epidemics of measles, as a complication or sequel of this disease. It may occur in those who are not scrofulous, if the vital powers are greatly reduced, but it is so much more common in the scrofulous, that some recent writers have designated this form of inflammation by the term scrofulous, instead of cheesy, pneumonia. From the fact, however, of its sometimes occurring in the non-scrofulous, the term cheesy or caseous, especially, too, as it expresses the anatomical state, seems more appropriate.

Relation of Scrofulosis to Tuberculosis.—Tuberculosis, in a large proportion of cases, results from an infecting substance, which is produced by caseous degeneration. In the caseous substance when it softens are found fat globules, albuminous granules, and a large amount of substance in solution. These are reabsorbed to a greater or less extent, and in them is the virus, which, lodged in healthy tissue, causes the peculiar cell proliferation, by which the tubercle is produced. The theory that the virus acts as an embolus intercepted in the capillaries, has its advocates. In certain instances the intimate causative relation of the cheesy substance to the tubercular neoplasm appears from the fact that tubercles are developed in abundance in the cheesy focus, while there are no tubercles in other parts of the system. Fungous and ulcerative inflammations occurring in the osseous system afford common examples. Now since cheesy substance occurring in the system of a young person results, in most instances, from the products of those inflammations which we recognize as scrofulous—for the products of inflammation occurring in those who are not scrofulous seldom undergo this change—we see the intimate relation between scrofulosis and tuberculosis, and why for a long time the strumous and tubercular diatheses were considered identical.

Prognosis.—As scrofula may be acquired through anti-hygienic influences, so it may disappear, or become latent through influences of an opposite character. Therefore the manifestations of scrofula may be limited to a brief period, or they may occur at intervals through the whole of childhood, and the first years of youth. When the diathesis is inherited, and fostered by unfavorable circumstances, the scrofulous affections appear earliest, are most varied and severe, and continue longest.

In most cases, with proper treatment, the prognosis is good, but the danger to life depends on the nature and extent of the scrofulous inflammation. The most common unfavorable result is the occurrence of pulmonary or general tuberculosis from the infection supplied by the cheesy substance, in the manner stated above. This is the usual result from cheesy pneumonia. The next most common cause of death, either directly or indirectly, is inflammation of the osseous system. Many deaths occur from inflammation of the vertebræ, or of the hip or knee joints, when it has been allowed to continue a considerable time without proper treatment. Protracted suppurative inflammation of the bones is apt to produce amyloid degeneration of organs, which is permanent, and likely to prove fatal, or death may occur from exhaustion, with or without tuberculosis. Among the city poor meningitis is not very uncommon, consequent on a long continued otitis media and caries of the petrous portion of the temporal bone. Permanent impairment of the sight and hearing often results from neglected strumous ophthalmia and otitis.

After the age of puberty the strumous affections cease, and among the

most robust adults are those who in early life presented indubitable symptoms of the strumous diathesis.

Treatment. *Prophylactic.*—Measures designed to prevent scrofula are impossible without the co-operation of willing and intelligent parents. It is obvious that the prevention of congenital scrofula requires the treatment of disease or impaired health in the parent. If parents should be taught, or should remember that good health in themselves is the necessary condition of the inheritance of a sound constitution in the child, and should adopt such therapeutic and regimenal measures as would procure this, the number of cases of inherited scrofula would be materially reduced.

As the first years of life are very important, both for correcting the diathesis when inherited, and for preventing its development in those of sound constitution, care should be taken that the regimen of the child be such as would in no way produce deterioration of the general health. The nursing infant, if the mother is in poor health, should be provided with a healthy wet nurse, for in young children the diathesis may be acquired solely by the use of food that is scanty or of poor quality. Those old enough to be weaned should have plain and nutritious diet, with a proper admixture of animal food. More or less outdoor exercise, and residence in a salubrious locality with sufficient air and sunlight, are requisite.

Curative.—As scrofula originates in a state of weakness existing in the parent in the congenital, and in the child in the acquired form of the disease, and is characterized by feeble resistance of the tissues to irritating agents, the inference is reasonable that all tonics have, to a certain extent, an anti-scrofulous effect upon the system. The ordinary vegetable tonics, and sometimes the ferruginous, are indeed useful in the treatment of scrofula. Employed in connection with proper regimenal measures they are sufficient, in many cases, to remove the diathesis after a time, or render it latent. Besides these medicinal agents, which tend to correct the scrofulous diathesis by their general tonic effect, there are certain others which experience has shown to be beneficial in the treatment of scrofulous affections, and which are, therefore, largely used. One of these is cod-liver oil, which contains iodine with numerous other ingredients.

Cod-liver oil is useless or nearly so in the torpid form of the diathesis, which is characterized by an increased deposit of fat in the subcutaneous connective tissue, slow circulation, and sluggish muscular movements. On the other hand, in the treatment of the erethitic form it possesses real value. Its protracted use in such cases does so modify the molecular condition of the tissues that they are less liable to inflammation, and the diathesis is, therefore, rendered milder or removed. From one to three teaspoonfuls, according to the age, should be given three times daily. While we frequently experience so much difficulty in administering it to adults affected with tuberculosis, and sometimes find it necessary to discontinue

its use on account of its nauseating effect, scrofulous children rarely refuse to take it, and it does not seem to diminish their appetite.

Iodine is justly celebrated as a remedy in the treatment of scrofulous affections, but it is a question whether it has not been overrated as a remedy for the diathesis itself. Iodine employed internally is especially serviceable in glandular hyperplasia, and in scrofulous thickening and induration of the connective tissue and periosteum. In general, it should not be administered to children in its isolated state, on account of its irritating properties, but one of its compounds should be employed. The compounds which are chiefly prescribed in the treatment of scrofula are the iodides of starch, iron, potassium, and sodium. If, as is frequently the case, the patient is pallid, and his appetite poor, the iodide of iron should be preferred; if not in this cachectic state, the iodide of starch. Pharmaceutists prepare syrups of both these iodides, so that they can be readily administered to the youngest child. The iodide of starch may be administered by dropping from one to five drops of the officinal tincture of iodine on a little powdered starch, and giving it in syrup. These iodides are preferable to the iodides of potassium and sodium for internal administration to children, as they are not irritating to the mucous membrane, and the iodine is readily set free. Prof. Dalton has, indeed, demonstrated that the iodide of starch is decomposed in most of the liquids of the body, and the iodine liberated.

In New York city a large proportion of the scrofulous children are cachectic, and need iron, and the iodide of iron is more frequently employed, and with good results, than any other iodine compound. The syrup of the iodide of iron, which is readily absorbed, should be given in one to two-drop doses three times daily to a child of six months, and one additional drop added for each additional year. Among the vaunted remedies of scrofula are phosphoric acid and the phosphate of lime. I have not employed these agents without at the same time using other remedies, and cannot say, therefore, to what extent they have been curative in my practice. Probably there is no better combination of remedies for the strumous diathesis than the following, which is now used in some of the institutions of New York:—

℞. Ol. morrhuæ, 2 parts;
Syr. calcis lactophosphat., 1 part. Misce.

Dose, one teaspoonful to a dessertspoonful three or four times daily, to each dose of which the syrup of the iodide of iron may be added at the time of its employment.

The internal use of mercury as an antidote for scrofula is now generally discarded; unless, perhaps, in those cases in which the diathesis is immediately dependent on syphilis, its use for this purpose, from what we know of its therapeutic effects, would probably be more injurious than beneficial.

Among the medicines which have from time to time been employed for the cure of scrofula, some of which have had considerable reputation but have nearly fallen into disuse, are walnut leaves, sarsaparilla, elecampane, conium, digitalis, horseradish, compounds of silver, gold, arsenic, baryta, and bromine. It is probable that none of these has any effect on scrofula or scrofulous ailments, except such as improve the appetite and general health, as horseradish.

The same hygienic measures are required in the treatment of scrofula as are demanded in the prophylaxis of it. The nursing infant should have healthy breast milk, and if its mother belong to a tubercular or scrofulous family, or is feeble, a healthy wet nurse should be employed, or it should be sent to the country where suitable cow's milk can be obtained. In the city, the infant may be fed during the cool months with porridge made of the best cow's milk and barley flour, rice flour, Ridge's or Nestle's food, or one of the preparations of Liebig's soup; but, as stated elsewhere, such food will prove disastrous to infants under the age of twelve months who are kept in the city during the hot term. Their removal to the country is indispensable, both as regards the treatment of struma, and to prevent intestinal catarrh. The expressed juice of beef slightly boiled, given several times daily in small quantity to infants, aids materially in restoring a better nutrition of the tissues. Obviously similar care is necessary in the selection and preparation of the food of children, who have passed beyond the period of infancy. While the diet should be highly nutritious, it should be plain, and easily digested, and given at sufficient intervals so as not to overtax digestion.

Fresh air, out-door exercise, daily bathing, personal and domiciliary cleanliness, are very necessary for the most successful treatment of the diathesis. Since scrofula is comparatively infrequent in farming sections, scrofulous families are greatly benefited by farm life, with all the accessories to health which pertain to it.

The local scrofulous ailments require additional and special treatment. Those located on the cutaneous and mucous surfaces are less dangerous, as a rule, than the deeper seated inflammations; still they should be promptly treated not only for the inconvenience and annoyance which they cause, but because they are apt to lead to hyperplasia of the neighboring glands, which sometimes proves serious. Thus a pharyngitis may cause a peripharyngeal adenitis and abscess, and a bronchitis may cause an adenitis of the bronchial glands, with the probability of their cheesy degeneration. The so-called bronchial phthisis is believed to result in a large proportion of cases from a strumous bronchitis, which has been allowed to run on uncontrolled by medicine, and a similar state of the mesenteric glands may result from intestinal catarrh in the strumous. Inflammations of the skin and mucous surface occurring in the strumous require the continued use

of anti-strumous remedies, conjoined with such treatment, designed to act locally, as is appropriate in individuals who are not strumous.

It is the common practice to treat the enlarged glands of struma by daily applications over them of the stronger iodine preparations. This treatment does not cause absorption of the redundant gland substance. It causes proliferation of the epidermic cells, and quickens the cell change in the gland underneath so that leucocytes are apt to form in it. Cutaneous inflammation as eczema or impetigo causes hyperplasia of the lymphatic glands underneath. In like manner strong applications, which irritate the skin, are apt to quicken the cell formation, so that suppuration is a common result. I once produced accidentally such an amount of vesication over an enlarged, hard, and apparently indolent gland in an infant of fourteen months, that I was very anxious lest a sore would result, which would heal with difficulty, and yet instead of dispersion of the glandular swelling the pathological processes were so promoted that suppuration and discharge of pus occurred by the time that the cuticle had reformed.

We know no better substance for the local treatment of strumous adenitis than iodine, and it should be applied, in my opinion, in such a manner that it is absorbed with the least possible irritation of the gland. The following will be found useful ointments and solutions for the treatment of these cases :—

℞. Potas. iodidi, ʒj,
Ung. stramonii, ℥j.

To be rubbed over the gland several times daily. It should not be ap plied as a plaster, as it is too irritating and will vesicate. I have known a glandular swelling, which had continued about three months, to disappear in three weeks under its use in connection with internal remedies. Vaseline, in place of the stramonium ointment, makes a nicer preparation.

℞. Liq. iodinii composita,
Glycerinæ, equal parts.

To be applied as an inunction. The glycerine renders the skin soft and in a favorable state for absorption.

In *The Medical Press and Circular* for August 3, 1870, J. Waring Curran states that he has used with great success what he designates a new iodine paint, consisting of half an ounce of iodine, the same quantity of iodide of ammonium, twenty ounces of rectified spirits, and four ounces of glycerine.

Mercurial ointments have been recommended by writers of reputation for the treatment of these glands. I have employed them, and known them to be employed, but cannot say that I have ever observed any benefit from their use whatever. In the children's class at the Out-door Department at Bellevue we have discarded them entirely for this purpose, although

both the citrine and white precipitate ointments, diluted with an equal quantity of lard, have been used with much apparent benefit for chronic coryza of a strumous nature, and also occasionally for external otitis of the same nature.

In a paper read at the meeting of the British Medical Association in 1870, by Mr. Jordan, the writer recommends, as attended with success, vesication, not over the gland, but at a little distance from it, as, for example, behind the neck, for treatment of the cervical glands. But a mode of treatment which seems so unlikely to be beneficial requires stronger proof of its utility than has yet been presented.

When the gland becomes actively inflamed, as indicated by increased heat and tenderness, and redness of the skin, applications of iodine are no longer proper. They increase the local disease. There is no longer any probability of resolution of the glands, and poultices should be applied.

In strumous conjunctivitis and keratitis the solution of sulphate of atropia, two grains to the ounce of water, should be dropped three times daily into the eye. It relieves the photophobia, while it exerts a curative effect on the inflammation. To remove the phlyctenula and opacities, finely powdered calomel should be dusted into the eye every second day. For the otitis, injections of tepid water to which a little carbolic acid is added (gr. ij to iij to the ounce) should be employed, and afterwards a mild astringent.

It is very important that the diseases of the osseous system should receive early and correct treatment, and it is in reference to these inflammations that error of diagnosis is made. Thus, I have known periostitis, with the diffused redness of the skin and heat which it produces, to be mistaken for erysipelas, until the diagnosis was corrected from its persistence and non-extension. It is remarkable that strumous arthritis sometimes appears in two or more joints at once, as in the case related below. I have known it to occur nearly simultaneously in three joints, though only for a brief time in two of the joints, while it was chronic in the other. Hence, the fact that this inflammation is often mistaken for inflammatory rheumatism, and treated as such for a few days, till its nature becomes apparent; and so the febrile movement, lassitude, abdominal pain, etc., of vertebral caries are, in a large proportion of cases, attributed to something else, and the true disease not suspected till irreparable damage has occurred, or much longer confinement and treatment required than would have been, with an earlier diagnosis.

The common strumous inflammations of the osseous system which involve the joints, as Pott's disease, hip-disease, and white swelling, are usually quite amenable to treatment, early applied, which insures complete rest; but, as a rule, cases neglected, or wrongly treated, go from bad to worse. There are exceptions, for a case may do well or terminate with moderate

deformity without treatment, as in the following interesting instance, which also shows the difficulty which often attends diagnosis :—

Anna D., aged six years, came to the children's class in the Out-door Department at Bellevue in February, 1877, with the following history: Her health was good till two years ago, when she complained of pain of a mild form in both knees. Her parents attributed it to her rapid growth, and she was always able to walk with little suffering. Slowly but steadily these joints began to swell. She has had no pain in other joints, and no member of the family has had rheumatism except a grandparent. She walks without complaint to the rooms of the Bureau. The affected joints are about equally swollen, and it is evident on examination that they contain some serous effusion. Direct pressure is not painful, but pressing the bones together with a twisting or rotating movement gives some pain. She is pale, and has a strumous aspect. A sister of fifteen years has a similar swelling of one knee, which began at the age of seven or eight years, but which has received no regular treatment, has not prevented the free use of the limb, and has given her little inconvenience.

Fig. 10.

The physicians who have examined this child, one of whom is an expert in orthopædic surgery, agree that the disease is strumous and not rheumatic ; that it did not, during two years of neglect and unrestrained motion, go on to suppuration, and destruction of the joints, was probably due to the good general health.

Though the result in the above case was good, since there was little impairment in the use of the joints, and no suffering, yet delay and neglect in the treatment of all those strumous inflammations which involve the joints is exceedingly dangerous, for if left to themselves they more frequently end in suppurative inflammation and ulceration, with all the sad consequences which these entail. Strumous inflammations of the osseous system now receive more early and correct treatment than formerly, and orthopædia, almost unknown till within the last twenty years, has become an important branch of surgery. Formerly in New York, especially in the tenement houses, we often met emaciated bed-ridden children with strumous osteitis and arthritis, their limbs swollen, and painful on motion, and offensive from the discharge, for the most part shunned by physicians, and with no prospect of relief except by amputation. Now this spectacle is comparatively infrequent. The early symptoms of these diseases being

better understood and sooner recognized, the plaster of Paris or starch dressing to insure immobility, or ingeniously devised steel splints, which produce extension, and allow motion of the limb without friction of the inflamed surfaces, coming into general use, a large proportion of cases do not go beyond the first stage and are cured.

CHAPTER III.

TUBERCULOSIS.

The term tuberculosis is applied to a disease which is characterized by the formation of small nodules, developed in one or more organs.

Etiology.—The tubercular diathesis may be inherited. Hence the well-known fact of tubercular families. Cases are not infrequent in which hereditary tuberculosis proves fatal before the death of the affected parent. The offspring of a tubercular parent does not, as a rule, have tubercles at birth; but the tubercular diathesis, at first latent, as in syphilis, manifests itself in a few weeks or months in the formation of tubercles, and in the consequent cough and emaciation. In two cases which I recall to mind, a cough from tubercles was observed, according to the statement of friends, as early as the second or third week after birth. Under good hygienic conditions, the inherited diathesis may remain latent or be removed. If both parents are tubercular, the offspring almost necessarily become so.

Tuberculosis frequently results from prolonged anti-hygienic conditions in those previously healthy and of healthy parentage. It may result from residence in damp, dark, and dirty apartments, from scanty or unwholesome food, protracted and exhausting diseases, in fine, from any agency which gives rise to great and continued impoverishment of the blood. Age is a predisposing cause. Tuberculosis is comparatively rare under the age of one year, while it is not uncommon in wasted infants between the ages of two and five years. This remark is fully substantiated by the statistics of the Nursery and Child's Hospital and Infant's Hospital of this city.

Is tuberculosis propagated by infection? Most physicians would answer in the negative, though in some countries, as in Italy, it is stated that the profession have long regarded it as mildly infectious. Every physician of experience must have remarked the frequency with which tuberculosis occurs in those not predisposed to the disease, but who have been in intimate relation with consumptive patients. This has been commonly regarded as due in no way to infection, but has been thought to be a coin-

cidence, or has been attributed to an influence not fully understood, which the emotions or imagination exert in the causation of diseases. But recent discoveries concerning the etiology of tuberculosis, which will presently be related, afford ground for the opinion which some of our best authorities in the pathology of tuberculosis, as Waldenburg, now hold, that minute particles exhaled or expectorated from the lungs may be the medium of infection.

In December, 1865, M. Villemin read before the Academy of Medicine of Paris and published his celebrated memoir, which contained the results of his experiments in inoculating certain lower animals with tubercular matter. Since then the fact has been established by many experiments, that tubercle may be produced in the rabbit and other animals by inserting under their skin various pathological products, whether tubercular or non-tubercular, as gray tubercles, cheesy products, thickened pus, etc., and by inserting finely divided foreign substances, not animal, as anilin blue, and also by traumatic irritations which give rise to the formation of inflammatory products under the skin, as the use of a seton. The coloring matter, whether introduced alone or in combination with a pathological substance, is found in the tubercle which results in the lungs or elsewhere. Therefore, it is inferred that tubercle in these experimental cases is produced by minute particles of the inserted substance, which enter the circulation and are deposited in the lungs or other organs. Where they are deposited, inflammation (formative irritation) occurs, with proliferation of the cellular elements of the part. This corpusculation produces the tubercle.

The importance of these discoveries is apparent. Cheesy substances produced in the system, whether in the lungs, lymphatic glands, bones—as in vertebral caries—or elsewhere, and also long retained purulent collections, as in empyema, may give rise to tuberculosis, provided particles of the morbid substance gain admittance into the circulation.

Blood extravasated in the alveoli of the lungs, and undergoing degenerative changes, is considered a cause of tuberculosis; but such extravasations are rare prior to the age of puberty. Protracted inflammation of the air-passages, as bronchitis or laryngitis, is stated to give rise to tubercles in certain cases, but it is not easy to see how this could occur except when the inflammation has extended to the lungs or given rise to cheesy degeneration of the contiguous glands. In infancy and childhood the common cause is a diathesis inherited, or acquired through impoverishment of the blood by previous disease or anti-hygienic conditions, or it is infection of the system from cheesy glands or purulent collections.

Post-mortem examinations in connection with these recent discoveries demonstrate that the immediate cause of the formatian of tubercles in the lungs, spleen, and other viscera, in certain cases, is hyperplasia and cheesy degeneration of the bronchial and mesenteric glands, whether or not this glandular affection is to be considered tubercular. Thus in the last two

cases which I have examined there were minute transparent tubercles in the lungs, some becoming yellow, evidently of very recent formation, and also in one of the cases in the spleen, while in both cases the bronchial glands were enlarged and cheesy, and in one also the mesenteric. In another case, occurring in the Child's Hospital, the bronchial and mesenteric glands were cheesy, with all the thoracic and abdominal viscera healthy, while there were granulations nearly the size of a pin's head, due to cell proliferation, as ascertained by the microscope (tubercular), in the pia mater at the base of the brain, along its sides, and between the hemispheres.

Cases are less frequent, but are occasionally observed, in which retained purulent collections appear to be the cause of the formation of tubercles. Thus, in 1870, I presented to the New York Pathological Society the lungs, containing minute, recent tubercles, removed from an infant, who had died when a few months old. The lungs were otherwise healthy, and there were no cheesy glands, for which a careful examination was instituted; but in the left thigh was a large deep-seated abscess, which had been detected a month before death.

Another, and probably the most frequent local cause of tuberculosis, is cheesy pneumonia. Caseous degeneration of the inflammatory products is common in young and feeble infants affected with pulmonary inflammation, and the supposition is reasonable that particles are more readily detached from a caseous mass in the lungs than in most other situations. Certainly, in this city, cases are not infrequent of young children presenting the history of pneumonia, cheesy degeneration, and finally tubercles, especially during epidemics of measles.

General Anatomical Characters of Tuberculosis.—Analysis of the blood of tubercular patients shows an increase in the water, albumen, fats, and white corpuscles, and a decrease in the number of red corpuscles. The fibrin is slightly diminished, except in cases complicated by inflammation, in which it may be in excess. The chief interest, however, as regards the anatomical characters of tuberculosis, pertains to the tubercle. The tubercle is as characteristic of tuberculosis as the eruption is of an exanthematic fever. It is produced, as already stated, by a local proliferation or corpusculation produced by the irritation of the tubercular virus in the endothelial lining of the lymphatics and bloodvessels, which is now regarded as the mother soil of tubercle, instead of the cells of the connective tissue as first taught. It is, therefore, a cell-growth, and not a deposit.

If we examine with a microscope a thin section of a recent tubercle, we will observe in its peripheral portion, in which proliferation was active at the time of death, large mother cells, spindle-shaped fibro-plastic cells, and small round cells, which have been released from the mother cells. This zone of proliferation often has considerable extent. Passing towards the

central portion of the tubercle, we find these small round cells in great abundance. They represent a more advanced stage of the tubercle, since the central part is oldest. They are the most numerous cells in the tubercle, and they have been designated the tubercle-cells. They resemble closely in appearance the smaller of the white corpuscles of the blood, and cannot be distinguished from the normal cells of the lymphatic glands, each consisting of a single large nucleus surrounded by protoplasm. They are among the most fragile of pathological cells. The cells are held together by a transparent adhesive substance, which is firm and resisting.

Every tubercle tends to undergo a molecular change by which its transparence is lost. This consists in a decay of the cells and the intercellular substance. Granules of fat are deposited within them, and the cells shrivel and disintegrate. Fragments of cells, and shrunken cells, and cell-nuclei are thus produced, which Lebert described as the tubercle-cells, and which were accepted as such by all observers till Virchow ascertained their true character. The molecular change which I have described commences in the interior of the tubercle, and extends outward till the whole tubercle becomes opaque and yellow, and at the same time so friable as to be readily crushed between the fingers. The yellow tubercle is therefore only an advanced stage of the gray semi-transparent.

It is evident that tubercle in its first period possesses vitality, and, like all neoplasms, has its bloodvessels. These are soon closed by coagula or granular fibrin, mixed with white blood-corpusclus. When the tubercle has reached the yellow transformation, its vessels are no longer pervious, but it is surrounded by a vascular zone, in which circulation continues. The subsequent history of tubercle is well known. It is seldom, perhaps never, absorbed. It softens, and henceforth, as has been said by a German pathologist, its history is that of an abscess. It is an irritant, producing inflammation in the surrounding tissues, with thickening and induration, and abundant production of pus-cells, which mingle with the tubercle elements. Ulceration and discharge of the liquefied substance upon one of the free surfaces is the common result. In exceptional cases, instead of softening, the tubercle may undergo fibroid degeneration or cretification.

Anatomical Characters in Infancy and Childhood.—The anatomical characters of tuberculosis in the first years of life vary in certain particulars from the form which they present in the adult, but after the age of three years the differences are fewer and less pronounced than previously.

Tubercular laryngitis, so common in the adult, is absent in a large proportion of cases under the age of three years, and when present has little intensity; and ulceration of the larynx very seldom occurs. This has been attributed to the fact that there is so little expectoration in young children, the sputum being an irritant. Niemeyer, however, does not consider the sputum of tuberculosis sufficiently irritating to cause laryngitis

and laryngeal ulceration; but the arguments in favor of this mode of causation, in my opinion, more than counterbalance those which have been presented against it.

I have never met a case of tubercular ulceration of the larynx or trachea in the post-mortem examination of young children, nor do I recollect ever treating a case in which there was that degree of dysphonia which indicated ulceration. Rilliet and Barthez, in more than 300 necropsies of tubercular cases, found no ulcers in the larynx or trachea under the age of three years; 8 cases between the ages of three and ten years, and 8 between ten and fourteen years. The ulcers, whether seated in the larynx or in the trachea—and they are in most cases in the former, since the inequalities upon the surface of the larynx favor the retention of the sputum—are commonly small, superficial, round or elongated, and with little thickening or inflammation of their borders. Occurring in the folds of the mucous membrane, as, for example, around the vocal cords, their form is usually elongated.

Bronchitis is not infrequent. This inflammation is due to, and dependent on, the pulmonary tubercles, and is therefore most intense in the part of the lung where the tubercles are most abundant and furthest advanced. Consequently it is more intense on one side than on the other, and it may be unilateral. It differs in this respect from idiopathic bronchitis, which is commonly pretty uniform on the two sides. It differs also in the fact that it is sometimes accompanied by ulcerations. The ulcers are round or elongated in the direction of the axis of the tubes, and, like those of the larynx or trachea, are superficial. Idiopathic bronchitis of infancy and childhood does not cause ulceration. Circumscribed inflammation may attack a bronchial tube, as indeed, the trachea, and give rise to ulceration and perforation, from the presence and pressure of a diseased lymphatic gland external to the tube. This subject will be treated of hereafter.

Lungs.—It is well known that in the adult tubercles are always present in the lungs, if they occur in any part of the system. I have met two cases in which the lungs were free from tubercles in 36 post-mortem examinations of children who died of tuberculosis. One of the two was an infant, but its exact age is not stated in the records. It had cheesy degeneration of thymus and bronchial glands, enlargement of mesenteric glands, but without cheesy degeneration, and disseminated tubercles in liver and spleen. The other, fifteen months old at death, had tubercular meningitis, with numerous granulations upon the convexity of the brain, and the other usual lesions of meningeal inflammation, with bronchial and mesenteric glands slightly enlarged and cheesy, and one of the former softened. In one case, then, in 18, the lungs had escaped the disease. Rilliet and Barthez state that they found the lungs non-tubercular in 47 cases in 312, and Hillier did in 25 cases in 160. In their cases, therefore, the lungs were exempt from tubercles in about 1 case in 7. But it is to

be recollected that the statistics of these observers were prepared at the time when all cheesy degenerations were thought to be tubercular, and the bronchial and mesenteric glands are sometimes cheesy when there are no tubercles or lesions referable to tuberculosis in any other part of the system. I have records of two such cases, which I reject from my statistics of tuberculosis, as there is no evidence that the disease was anything else than cheesy inflammation. Did I include these cases, my statistics would more closely correspond with theirs.

Pulmonary tubercles in children under the age of three years are, as a rule, discreet, and disseminated through the lungs. In cases at this age, which have advanced to a fatal termination, we commonly find yellow tubercles from the size of a pin's head to a shot in the different lobes, many still semi-transparent if the disease has been of short duration, but if protracted most of them yellow, and here and there one softened and surrounded by condensed fibrous tissue. Around the semi-transparent or gray tubercles, many of which were growing, and therefore were in the state of active cell proliferation at the time of death, narrow vascular zones can often be detected by the naked eye.

Under the age of three years, tuberculosis exhibits but little tendency, perhaps none, to affect the upper lobes sooner or in greater degree than the lower.

The following are the statistics relating to the site of the tubercles in the lungs in the cases which I have examined. All, it is to be remembered, were under the age of three years:—

	Cases.
Tubercles disseminated throughout the lungs	26
Tubercles disseminated throughout the two upper lobes	3
Tubercles disseminated through right middle lobe and left lower lobe only	1
Tubercles disseminated through left upper lobe only	2
Tubercles disseminated (few and semi-transparent) in left lung only	1
Tubercles disseminated in three points in right, and two in left lung	1
No tubercles in lungs	2
	36

Between the ages of three and fifteen years, statistics show that the upper lobes are more liable to tubercles than the lower; but the difference in liability is not great. In many cases occurring in this period, the different lobes are affected nearly simultaneously, and not very infrequently the upper lobe is the last which is involved. In October, 1866, I made the post-mortem examination of a boy who died in the Children's Service of Charity Hospital, at the age of fifteen years, and small scattered tubercles were found in the lower lobe of the left lung, while all other portions of these organs were healthy. Rilliet and Barthez, who include in the

same statistics all cases from birth to the age of fifteen years, found gray semi-transparent tubercles.

	Cases.
In the right superior lobe in	63
In the right middle lobe in	43
In the right lower lobe in	55
In the left superior lobe in	65
In the left inferior lobe in	54

The same observers found yellow tubercles in the

Right superior lobe in	40
Right middle lobe in	28
Right inferior lobe in	39
Left superior lobe in	35
Left inferior lobe in	31

Tubercle, especially when softening commences, is itself an irritant, exciting inflammation around it. Inflammation occurring from this cause is obviously likely to be protracted, continuing for weeks or months, unless the tubercular matter is eliminated by ulceration. The highly vascular and delicate lungs of the young child are very liable to inflammation when they are the seat of tubercles, and as the tubercles are disseminated, the pneumonia is commonly more extensive than when it occurs from ordinary causes. In fifteen, or nearly one-half of my cases, there was pneumonia affecting portions of one or more lobes, or an entire lobe. From the extent and position of the solidified portions, it was obvious that in most instances the inflammation originated from the irritating effect of the tubercular matter, while in others it was due to hypostatic congestion, occurring in consequence of the long-continued recumbent position and the feebleness of circulation. In these fifteen cases the seat and extent of the inflammation were as follows:—

	Cases.
Nearly entire right lung	2
Nearly entire middle and lower lobe	1
Entire left upper lobe	2
A considerable part of both lungs	1
Posterior parts of both lower lobes	4
Posterior part of left lung	1
Left lower lobe, and right middle and lower lobes	1
Left upper lobe (contained a large cavity) and posterior part of left lower lobe	1
Nodules of inflamed lung around tubercles	2

The inflammation in about one-third of the cases was due to hypostasis, as it occurred in depending portions, extended but little into the lungs, and sustained no relation to the amount of tubercle. It was in the stage of red, or more rarely of gray hepatization.

In seven of the cases there were pulmonary cavities as large in propor-

tion as we ordinarily find in tuberculosis of the adult. The seat of one was in the right lower lobe; of two, the left upper lobe; of one, the right upper lobe; of another, the right lung, its exact seat not stated; and in the remaining case the cavity, which was the largest of all, occupied the interior of all three lobes on the right side. Some idea of the size of these cavities may be learned by the following extracts from the records: 1st Case. "A small superficial cavity communicating on one side with a bronchial tube, and on the other side with a small circumscribed collection of pus in the pleural cavity." 2d Case. "Cavity of the size of a hickory-nut." 3d Case. "Cavity of the size of a large hickory-nut." 4th Case. "Cavity three-fourths of an inch in diameter." 5th case. "A large abscess." 6th Case. "The cavity occupied nearly the whole of the interior of the left upper lobe." 7th Case. "About half the right lung excavated into a cavity which extended through the three lobes."

Circumscribed pleuritis, produced by tubercles underneath the pleura, was observed in seven cases. It was ordinarily attended by little exudation except the fibrin, but in one case a sufficient amount of serum had been exuded to compress considerably the lung. Pus was not observed in any notable quantity.

Emphysema was present in several cases, chiefly in the upper lobes, sometimes vesicular, with fulness or bulging of the lung, an anæmic appearance of it, and doughy, inelastic feel. In other cases emphysema was interstitial, producing little bladders of air under the pleura, especially towards the root of the lung, or separating the lobules by wedge-shaped or irregular interspaces filled with air. In one case air had escaped from an emphysematous bladder into the right pleural cavity, causing pneumothorax and collapse of the lung.

Next to the lungs, the bronchial glands are more frequently diseased than any other organs, in the tuberculosis of infancy and childhood.[1] They undergo the successive structural changes which characterize glandular inflammations, namely, hyperplasia, and more or fewer of them cheesy degeneration and softening. In the state of hyperplasia their firmness is diminished, and they have a pale flesh-color. Cheesy degeneration commences in one or more points in the gland, sometimes in the peripheral,

[1] The term bronchial phthisis has long been applied to that state in which the bronchial glands are enlarged and cheesy. Now this glandular disease, we have seen, is often the result of inflammation in the strumous; and while it may be the cause of tubercular infection, is probably not, in most instances, tubercular itself. But microscopy has not yet drawn the distinction between the cells of lymphatic glands, which cause the enlargement by proliferation when the glands are inflamed, and the cells of the tubercular neoplasm. They seem alike in the field of the microscope. Therefore it seems proper not to attempt to distinguish scrofulous glands from tubercular, when they occur in a patient affected by tuberculosis.

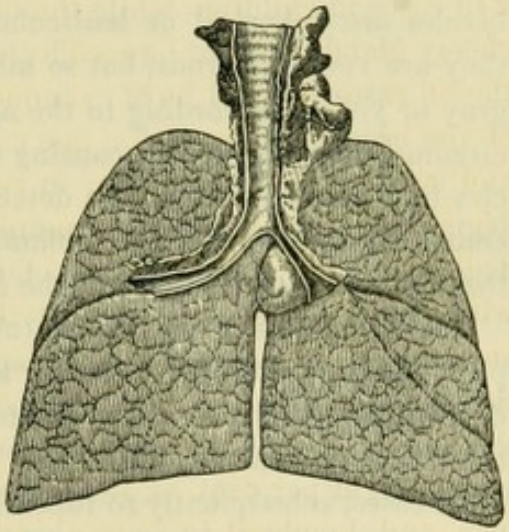
sometimes in the central portion, and it extends till the whole gland presents the well-known cheesy appearance. When the gland softens, the thick liquid presents a puriform appearance, consisting of amorphous matter, fatty particles, and the shrivelled and disintegrated cells of the gland. Soon pus-cells occur, and their number increases.

Rilliet and Barthez state that the bronchial glands were tubercular in 249 cases in children, while the lungs were tubercular in 265 cases. All cheesy glands, it is to be recollected, they considered tubercular. In 4 of the 36 cases which I have examined, no record was preserved of the state of the bronchial glands; in one case there was no perceptible hyperplasia and no cheesy degeneration; in two there was hyperplasia, but no cheesy degeneration, while in the remaining twenty-nine cases there was cheesy degeneration of more or fewer of the enlarged glands, or parts of them, with occasional softening. In the fact that the bronchial glands are enlarged and caseous, we have an explanation in part of the fact, that the symptoms in the tuberculosis of young children differ from those in the adult, since Louis found the bronchial glands involved in only twenty-eight per cent. of the adult cases of tuberculosis which he examined, and Lombard in only nine per cent. A gland pressing upon the recurrent laryngeal or pneumogastric nerve, or the trachea, may give rise to dyspnœa and a cough; or on the descending vena cava or one of the venæ innominatæ, to congestion of the brain and meninges, intracranial serous effusion, and even thrombosis in the cranial sinuses. The fact that a softened bronchial gland not infrequently is eliminated from the system, by ulceration, into a bronchial tube or the trachea, is well known. In one case which I observed the ulceration had destroyed portions of three of the cartilaginous rings of a bronchus, and the aperture was plugged by a cheesy fragment of a softened gland which protruded. Occasionally, it is stated by authors, the ulceration is into one of the large vessels of the mediastinum, or even into the œsophagus.

The following is an example of bronchial phthisis, as it commonly occurs. This case, which is not included in the foregoing statistics, was seen almost daily by me during its entire progress. On September 3d, 1874, I examined an infant in the New York Infant Asylum, who had wheezing respiration during the last eight days. The wheezing occurred both on inspiration and expiration, and also, though less pronounced, during sleep; pulse 96, respiration 40, temperature normal. Its mother, who had charge of it, and had till recently wet-nursed it, had had unequivocal symptoms of tuberculosis for several months. The child was pallid, and its flesh was soft and flabby. The fauces were perhaps a little redder than usual, but were otherwise normal, and a careful exploration of the chest revealed no cause of the embarrassed respiration. Auscultation and percussion gave a negative result. In the latter part of September a troublesome diarrhœa occurred, which continued more or less till near death. The

temperature on September 28th, October 8th, 10th, and 11th, was 100½°, 100°, 99½°, and 100°. The pulse on October 10th and 11th was 120 and 126. On October 8th the percussion-sound over the upper part of the right lung seemed somewhat duller than on the other side, though the respiration was not observed to be notably changed in the area of the dulness. There was but little cough during the entire sickness. Death occurred on October 20th. At the autopsy the bronchial glands were found enlarged and cheesy, and underneath the right bronchus, near the bifurcation, was a softened, almost diffluent gland, as large as a small hickory-nut, and compressing the bronchus. This, no doubt, had produced the wheezing respiration, which had been the chief local symptom. The lungs, spleen, and in less degree the liver, contained numerous small miliary tubercles. Certain of the mesenteric glands were also cheesy, but to less extent than the bronchial. The disease of the bronchial glands was evidently primary, the tubercles of the lungs and abdominal organs being apparently quite recent. The accompanying woodcut, from a photograph by Mr. Mason, the photographer at Bellevue Hospital, represents a posterior view of the lungs and air-passages.

Fig. 11.



In no case have I found tubercles in the heart or pericardium, though they have been observed in rare instances in the latter. The mesenteric glands were enlarged by hyperplasia, and more or less cheesy, in 30 cases; in their normal state, to appearance, in two cases, and in the remaining four cases their condition was not stated. In most of the cases the mesenteric glands were smaller and less cheesy than the bronchial, but in a few instances they were larger than the bronchial and more cheesy.

It is a noteworthy fact, as bearing on the causative relation of these glands to tubercles, that not infrequently the amount of hyperplasia and cheesy degeneration of the former was very considerable, while the tubercles in the lungs or elsewhere were small, even minute, semi-transparent, and evidently of recent formation.

Abdominal Viscera.—In children, tubercles in the solid organs of the abdomen rarely give rise to appreciable symptoms, as they are small and disseminated, not impairing materially the function of the part in which they are located. On the other hand, peritoneal and intestinal tubercles, and the enlarged and cheesy mesenteric glands, give rise to symptoms which require description. The most frequent seat of perito-

neal tubercles is upon the attached surface of the peritoneum, where they are formed from the connective tissue. They are distinctly seen through the peritoneum, and cause some prominence of it. Exceptionally their seat is upon its free surface. Every portion of the peritoneum, whether visceral, parietal, or omental, is liable to tubercles, but general tuberculization of so extensive a surface does not occur in any one case. The tubercles are spherical or lenticular, and most of them small. Sometimes they are very numerous, but so minute as to be scarcely visible. They are gray or yellow, according to the age. Peritoneal tubercles often produce circumscribed peritonitis, causing adhesion of opposite surfaces. The tubercles in themselves cannot be detected by palpation; but masses or *plaques* composed of tubercles and inflammatory products are sometimes so large that they can be felt through the abdominal walls.

The symptoms of peritoneal tuberculosis are attributable, for the most part, to the peritonitis. Among them may be enumerated abdominal tenderness or pain, meteorism, ascites—usually slight—and derangement of the bowels, commonly diarrhœa. As tubercles in this situation occur, in most cases, subsequently to tubercles elsewhere, the symptoms which have been described are associated with and are subordinate to others.

Stomach and Intestines.—The most common seat of gastro-intestinal tubercles is the small intestine, and more frequently its lower portion, near the ileo-cæcal valve, than its upper or central. They are rare in the duodenum or contiguous part of the jejunum. They are developed ordinarily in the connective tissue, either that lying under the mucous or the serous surface.

Gastro-intestinal tubercles are often accompanied by ulceration of the adjacent mucous membrane. But in a certain proportion of cases there is probably no causative relation of the tubercles to the ulcers, for ulceration of this membrane is not infrequent in the tuberculosis of children, when there are no tubercles in the walls of the stomach or intestines. The following statistics of Rilliet and Barthez, relating to this point, will aid in an understanding of the symptoms:—

Tubercles in walls of stomach, 7 cases, { with ulcers, 6 cases. / without " 1 case.

Ulcers of gastric mucous membrane, without gastric tubercles, 14 cases.

Tubercles in small intestines, 82 cases, { with ulcers, 70 cases. / without " 12 "

Ulcers without tubercles in small intestines, 51 cases.

Tubercles in large intestines, 15 cases, { with ulcers, 10 cases. / without " 5 "

Ulcers in large intestine, without tubercles, 47 cases.

The ulcers have vascular, thickened, and infiltrated borders. Their diameters vary from a line to half an inch or more, and their general form

is circular, or, if two or more unite, irregular. Tubercular ulcers of the stomach are mostly in the great curvature, those of the small intestines in the ileum and lower part of the jejunum, and those of the large intestine in the cæcum.

The following table exhibits the state of the principal abdominal viscera in the 36 cases :—

	Liver.	Spleen.	Kidneys.
Tubercular	12	22	1
Non-tubercular	16	6	21
Not stated	8	8	14
Fatty	5	0	0

In no instance did I observe tubercular softening in the abdominal organs, and a large proportion of the tubercles in the liver, spleen, and kidneys were still in the first stage. In the five cases in which the liver was recorded fatty, this state of the organ was obvious to the sight, as it is in tuberculosis of the adult. A moderate excess of fat in the hepatic cells may have been present in some of the other cases, but it was not sufficient to be appreciable without the microscope. It is to be remarked that in the five cases in which the liver was recorded fatty, this organ contained no tubercles. The spleen is seen to have been the most frequent seat of tubercles of all the viscera, except the lungs. In fourteen cases the intestines were examined; and, in five, tubercles discovered developed in their connective tissue. The intestinal tubercles were small, and ulceration had occurred of the mucous membrane which covered them.

The brain was examined in fifteen cases. In twelve cases the amount of cerebro-spinal fluid varied from ℥ss to ℥v, by estimation. In two others the records state that there was a considerable amount of this fluid, the exact quantity not being given, while in the remaining case congestion of the brain and meninges was noticed, but nothing was recorded in regard to the amount of cerebro-spinal liquid. The increase of the cerebro-spinal fluid in tuberculosis is attributable to wasting of the brain, a *hydrocephalus ex vacuo*, and in some cases to passive congestion and serous transudation, due to feeble circulation, or obstructed flow from the pressure of bronchial glands on the vessels within the thorax, as already stated.

Tubercles were present in the pia mater in three cases: in two with fibrinous exudation; in the other without fibrin or other evidence of inflammation.

Symptoms.—The symptoms in tuberculosis of children arise in part from the diathesis, and in part from the tubercles. Before the period of tubercles, there are signs of failing health, such as loss of appetite, flabbiness of the soft parts, or emaciation, lassitude, and loss of strength. These symptoms continue after the formation of tubercles, and increase.

The features are ordinarily pallid, but during the paroxysms of fever, to which tubercular patients are subject, they may be flushed. Lividity

of the features, due to imperfect decarbonization of the blood, occurs, if there are enlarged bronchial glands which compress the vessels within the thorax, or if there is extensive pulmonary tuberculization, or pulmonary tuberculization, whether extensive or not, which is complicated by capillary bronchitis or pneumonia.

The skin is nearly natural, or it loses its flexibility and softness, and becomes dry and rough. In some patients there is, at times, general or partial furfuraceous desquamation of the skin, due to exaggerated development of the epidermis. Children, like adults, notwithstanding the general dryness of the surface, are liable to perspirations at night and in sleep. This symptom is less frequent at the commencement than at an advanced period, and in acute than in chronic cases, in the very young, namely, those under three or four months, than in older children. It is more abundant about the head and limbs than elsewhere, and is sometimes confined to these parts.

Anasarca is not infrequent. It sometimes arises from obstructed circulation, in consequence of compression of the thoracic vessels by enlarged lymphatic glands; in other cases it is due to diminished plasticity of the blood, a result of the tubercular cachexia. The latter is the more common cause. It is not an important symptom, on account of the small amount of serous transudation, and the character of the parts in which it occurs.

Emaciation, already alluded to, is early, constant, and progressive. Under the age of six or eight months it is less marked than in older children, many preserving considerable rotundity of features and form even in advanced tuberculosis. The failure of the strength corresponds in amount and progress with the emaciation. Slight at first, and exhibited only by a degree of lassitude, it gradually increases, till for weeks before death the little patient is fatigued by the ordinary muscular movements, and is disposed to keet quiet.

The nervous system is not ordinarily affected except in cases of intracranial tubercles. In acute tuberculosis, or tuberculosis complicated by severe inflammation, there may be agitation and delirium, especially at night.

In most patients the mucous membrane of the buccal cavity presents its normal appearance, with the exception of a moist fur upon the tongue, and a paler hue than normal of its surface generally. In acute tuberculosis, and in cases complicated by inflammation, the tongue is sometimes dry and brown. The appetite may be normal till the close of life, or it is poor or changeable. Occasionally it is increased, although the disease is progressing. The bowels are regular or relaxed. Diarrhœa may be a prominent symptom, even when there are no intestinal tubercles or ulceration. Meteorism and fulness of the abdomen are common.

Fever, constant, but usually with evening exacerbation, is rarely absent.

It continues for weeks or months. During the exacerbation the pulse rises to 120, 140, or even to 180 beats per minute, and there is a corresponding exaltation of the temperature, which in the latter part of the day, without inflammatory complication, ranges from 100° to 102° or 103°. The fever is a symptom of diagnostic value as regards the nature of the disease, though it does not indicate the seat of the tubercles.

In addition to the symptoms now described, there are *special* symptoms, due to tuberculization of the different organs. In young children, on account of the fact already referred to, namely, the tendency to a generalization of tubercles, there is apt to be a blending of the symptoms which arise from different organs, but with care it is not difficult in most instances to isolate and refer them to their proper source. The following are the symptoms which arise from tuberculization of the more important organs.

Encephalon.—The symptoms produced by tubercles of the encephalon vary according to their seat and size, and the structural changes in surrounding parts to which they give rise. Meningeal tubercles, which are located for the most part in the meshes of the pia mater, and by preference along the course of the small arteries, are ordinarily small, not more than a line in diameter, and they may remain latent for a considerable time. In the majority of cases, however, they sooner or later cause meningitis, the symptoms of which are well known and need not be described. But tubercles in this situation do sometimes give rise to symptoms when there is no meningeal inflammation. They occasion congestion of the surrounding vessels, and serous transudation, and, if developed on the under surface of the pia mater, they may produce symptoms by encroaching upon and irritating the brain; for they are sometimes so much imbedded in the convolutions that careful examination is required in order to determine that they are meningeal, and not cerebral. Among these symptoms may be mentioned headache, frontal or occipital, sometimes intermittent, nausea, melancholy, and in certain cases the symptoms produced by the serous transudation.

The symptoms of *cerebral* are in part similar to those of meningeal tubercles, but in most cases others of a neuropathic character are present, which serve for differential diagnosis. The differences as regards the symptoms of different patients affected with cerebral tubercles are attributable in part to the fact that their size and rapidity of growth vary, but more to the difference in their seat; for any part of the brain may be the seat of tubercles, though certain portions, as the cerebellum, are more frequently affected than others.

The child with cerebral tubercles is quiet, but irritable and easily excited. Delirium is not common, but many before the close of life exhibit a degree of mental dulness. The headache, common in cases of cerebral as well as meningeal tubercles, may be nearly general, or it is frontal,

parietal, or occipital, according to the seat of the tubercles. It is often lancinating, often intermittent.

Clonic convulsions occur towards the close of life. Exceptionally they are among the earliest symptoms. Observations have failed to establish any relation between the seat of the tubercles and the localization of the convulsions. The convulsions may be unilateral, while the tubercles are in both hemispheres; or general, while the tubercles are on one side only.

The severity and duration of the convulsive attacks, and the frequency of their occurrence in tuberculosis of the brain, vary greatly in different patients. They have been attributed to softening of the cerebral substance, which sometimes occurs immediately around the tubercles, to local congestions excited by them, and also to serous effusions in the ventricles. The convulsions, sooner or later, end in paralysis or coma.

Contraction, or tonic convulsion of certain muscles, is sometimes observed. Its most frequent seat is the muscles of the back, and of one or both of the lower extremities. It is a late symptom. It occurs in those cases in which there is softening around the tubercles, and usually in the muscles of the opposite side.

Paralysis is also a late, but not an infrequent symptom. It is preceded by headache, and sometimes, as already stated, by convulsions. Occurring as a symptom of tuberculosis of the brain, it is due either to pressure on a cranial nerve, or to compression and perhaps softening of the cerebral substance. The paralysis may be paraplegic, commencing as feebleness of the lower extremities, and increasing until it becomes complete, or a more or less complete hemiplegia. In paraplegia due to tubercles of the brain, the cerebellum is, as a rule, their seat, while paralysis of one side, or of certain muscles of one side, indicates tubercles of the opposite cerebral hemisphere; but there are exceptions. Paralysis of the third cranial nerve gives rise to ptosis, of the sixth to paralysis of the external motor nerves of the eye, and therefore to internal strabismus.

Feebleness or loss of vision, inequality, oscillation, and finally dilatation of the pupils, are not infrequent symptoms of tuberculosis of the brain, and they possess great diagnostic value. Atrophy of the optic nerve, causing amaurosis, sometimes results from tubercles as well as other tumors of the brain. Atrophy of this nerve occurs not only when the tubercles are so located as to press on the optic tract, in which case the explanation is apparent, but also, in certain patients, when the tubercles are in other parts of the brain. In these last cases it is thought by Brown-Séquard and others that the imperfect nutrition of the nerve is due to contraction of its nutrient vessels, produced by the tubercles through reflex action.

In tuberculosis of the brain, symptoms pertaining to the respiratory, circulatory, and digestive systems are either absent or are quite subordinate to those of a neuropathic character. Slowness of the pulse, with or

without intermittence, has sometimes been observed, and it is therefore a symptom of some diagnostic value. Towards the close of life both pulse and respiration are apt to be accelerated. Vomiting, constipation, and retraction of the abdomen, which are so common in meningitis, are only occasional symptoms.

Bronchial Glands.—During the progress of tuberculosis, hyperplasia, cheesy degeneration, and softening may occur of various lymphatic glands throughout the body, but the bronchial and mesenteric are not only those which are most frequently affected, but they are the only glands, unless in exceptional instances, which materially increase the danger or give rise to special symptoms. These symptoms either have a mechanical cause, namely, the pressure exerted by the enlarged glands on contiguous parts, or they are due to softening of the glands and consecutive inflammation and ulceration.

The following are the principal symptoms due to compression. Some of them are not infrequent; others are rare. Compression of the pulmonary veins retards the flow of blood from the lungs to the left auricle, giving rise to congestion, and, in extreme cases, œdema of the lungs, with sanguineous extravasations into the lung-substance, congestion of the right cavities of the heart, hepatic veins, and of the systemic capillaries generally. Compression of the pneumogastric nerve, or of the recurrent laryngeal, which is the motor nerve of the laryngeal muscles, modifies the voice, and produces a cough which is apt to be spasmodic. The cough resembles that of pertussis, and has been mistaken for it, but it is not so violent or protracted. The voice, clear and natural at first, becomes by degrees hoarse or feeble from deficient innervation of the laryngeal muscles.

An enlarged gland, or mass of glands, lying against the trachea or one of the bronchial tubes (this may occur with tubes up to the third or fourth division), and pressing its walls inward, obviously obstructs more or less the current of air. If there is considerable obstruction, a loud sonorous râle is produced, which is heard distinctly at a distance from the chest, obscuring other râles. It is loudest when the patient is agitated, and it sometimes intermits. Feeble respiratory murmur, dyspnœa, and a cough are not infrequent in bronchial phthisis. Diminished intensity of the respiratory murmur is general or partial, according to the seat of the compression. It has been most frequently observed at the summit of the lungs. In certain patients this symptom is not constant, the respiration being for a time feeble and then normal. The dyspnœa may be a prominent and distressing symptom, the alæ nasi dilating, and the infra-mammary region sinking with each inspiration. The cough which occurs when a gland presses on the trachea or bronchial tube, is due to the tracheitis or bronchitis to which the pressure gives rise. If ulceration occur at the point of pressure, the cough continues as long as the ulcer remains. Compression of the large veins within the thorax, which return blood from the head

and upper extremities, causes more or less congestion of these parts, with, perhaps, transudation of serum in the subcutaneous connective tissue, and within the cranium. Rarely a softened gland by ulceration gives rise to other symptoms than those mentioned, namely, hemorrhage by ulceration into a vessel, or pleuritis or pneumonitis if the ulceration is towards the lungs.

Improvement in the condition of the patient affected with bronchial phthisis is not unusual. It may be permanent, but in most patients it is temporary, so that in a few weeks or months the symptoms are as severe as before. The improvement is due to softening and elimination of a gland which had given rise to symptoms by its mechanical effect, or by the inflammation which it had excited.

Physical Signs.—These are absent or obscure in the incipient disease, when the glands are small, and they are most marked in those cases in which the glands are so large as to press on the thoracic walls, since the glands then become the medium for the transmission of sounds to the ear. The part of the thorax against which they most frequently press is the dorsal vertebræ, from the first to the sixth, and each side of the vertebræ, and less frequently the upper third of the sternum. The physical signs are dulness on percussion over the interscapular space, and perhaps, though to a less extent, over the upper part of the sternum, and bronchial respiration in the same situations. Occasionally a bruit can be detected, due to the pressure of a gland on one of the large vessels of the chest.

Lungs.—A cough is one of the earliest and most persistent of the symptoms of pulmonary tuberculosis. It is so rarely absent, that those of largest experience do not meet with more than one or two such cases. It varies in severity and frequency. If the tuberculosis is acute and its course rapid, the cough, even from its commencement, is frequent, so as to weary the patient and deprive him of needed rest. But in ordinary cases, namely, when the disease is chronic, the cough commences gradually, attracting little attention by its infrequency, but becoming more frequent and painful as the malady advances.

Ordinarily the cough is dry in the first weeks or months, but it becomes looser in the course of the disease, from the greater amount of bronchial inflammation. In exceptional instances the cough has a spasmodic character, like that produced by pressure of an enlarged bronchial gland on the pneumogastric or recurrent laryngeal nerve. This occurs from the accumulation of viscid mucus in one or more of the bronchial tubes, usually in dilated portions of them, from which it is with difficulty expectorated.

The respiration in pulmonary tuberculosis is accelerated in proportion to the degree of tuberculization. Tuberculization of a considerable part of both lungs gives rise to dyspnœa, especially when, as is ordinarily the case, bronchial, pulmonary, or pleuritic inflammation has supervened. Pneumonitis or pleuritis gives rise to the expiratory moan, and as these

inflammations, when induced by tubercles, are protracted, this symptom may continue for weeks or months.

Patients under the age of six years do not expectorate, or but rarely. After this age expectoration is not common in the commencement of pulmonary tuberculosis, but in the confirmed disease it is a pretty constant attendant of the cough. Hæmoptysis is also rare under the age of six years, and less frequent subsequently than in the adult. It is most apt to occur in those cases in which there is already passive congestion of the lungs, produced by the pressure of enlarged bronchial glands in the manner already described. Patients old enough to make known the subjective symptoms, sometimes complain of fugitive pains under the sternum or between the shoulders.

In young children the physical signs of incipient pulmonary tuberculosis are wanting, or are so obscure as not to be readily recognized. This is due to the small size and dissemination of the tubercles. In older children the physical signs appear early, and are readily recognized, because, as a rule, the tubercles are aggregated, and are more frequently at the apices of the lungs than elsewhere, as in the adult. In the advanced disease, whether in infancy or childhood, when inflammation and more or less destruction of the lung-substance have occurred, the physical signs, so far from being obscure, enable us in most cases, in connection with the history, to make an immediate and positive diagnosis.

In young children affected with pulmonary tuberculosis the irregular and imperfect expansion of the lungs produces by degrees changes in the shape of the thorax, which are apparent on inspection. In some, the lungs being habitually imperfectly inflated, the obliquity of the ribs is increased, and the thorax consequently elongated, while its antero-posterior and transverse diameters are diminished. This obviously increases the convexity or arch of the diaphragm, so that this muscle sometimes lies against the thoracic walls as high as the ninth or even eighth rib. If the costal cartilages are yielding, there is anterior flattening of the chest and depression of the sternum; if they are firm, on account of the more advanced age the chest remains circular.

Another shape of the thorax is not infrequent in feeble tubercular children, especially infants, who have suffered from repeated attacks of bronchitis. It occurs also in the non-tubercular, if the conditions which favor it are present. The conditions are, on the one hand, feebleness of the patient, with diminished force of respiration and impaired resiliency of the ribs; and, on the other, obstruction by mucus of one or more of the bronchial tubes. Occlusion more or less complete, of a bronchial tube, and consequent obstruction to the current of air, produce a corresponding degree of collapse in the proportion of lung to which the tube leads. The portions which collapse are, in most cases, the lower lobes, and the thin anterior margins of the upper lobes. This causes lateral depression of the

lower ribs, except such as are pressed outward by the abdominal viscera, and an anterior projection of the lower part of the sternum. The shape of the thorax in these cases differs from that in rachitis, in the fact that the lateral depression does not extend to the upper ribs, nor does the upper part of the sternum project.

Certain precautions should be observed in examining the chest by percussion and auscultation. The child should sit or recline, with the arms and shoulders in the same position, and the axis of the trunk straight. Inclination of the trunk to either side, raising or depressing a shoulder may produce an appreciable difference in the two sides as regards the physical signs. Percussion of the two sides should be practised at the same stage of respiration. A slight difference in the degree of resonance does not afford proof of disease, unless it is observed at different examinations; for, in feeble children, it often happens that all portions of the lungs do not expand alike, so that where we have noticed slight dulness at one visit, it may by the next have disappeared, or even at the same visit if forcible inspirations are excited.

The physical signs ascertained by palpation, auscultation, and percussion are, as in the adult, vocal fremitus, bronchial respiration, bronchophony, and dulness on percussion. In those cases in which the tubercles are mainly at the apices of the lungs, diminished expansion of the infra-clavicular region is observed during inspiration, and this part of the thoracic wall is permanently depressed, so that the clavicles are unusually prominent. If there is emphysema, this flattening does not occur, or is slight. Dulness on percussion, though more frequently observed in the infra-clavicular region than elsewhere, may be present in different isolated places. If pneumonia supervene, the dulness not infrequently extends over a considerable part of one lung. The cracked-pot sound is often observed on percussion, but it possesses no diagnostic value. It can be produced, when there is no pulmonary disease, by percussing over a bronchus.

Bronchial respiration and bronchophony are important signs, as indicating solidification of the lung, but they do not show whether the solidification is tubercular or pneumonic, or the two conjoined. This must be determined by the history of the case, the extent of surface over which these signs are heard, and their persistence. When the tubercles begin to soften, and the lung-tissue breaks up, moist râles appear, often hoarse and gurgling, obscuring the bronchial respiration. A cavity in the lung, or pneumothorax, is attended by the same physical signs as in the adult.

Pleura.—Little need be said in reference to the symptoms and physical signs of tuberculosis of the pleura, since this affection is in most instances associated with tuberculosis of the lungs, and is not distinguishable from it. But now and then the pleural tubercles are numerous and large, giving rise to symptoms, while those of the lungs are small, few, and without symptoms, or attended by symptoms which are quite subordinate. Either

the costal or visceral portion of the pleura may be the seat of tubercles. They are developed directly under the pleura, or upon its free surface. They are very apt to occur in the newly formed connective tissue which results from pleuritis. Those located upon the free surface, or under the costal pleura, rarely soften, while those under the visceral pleura sometimes soften and cause ulceration. Occasionally numerous aggregated tubercles form a firm continuous layer upon the surface of the pleura, preventing, if upon the visceral pleura, full expansion of the lung. This may give rise to a degree of dulness on percussion, and feebleness of the respiratory murmur. Ordinarily, however, in this form of tuberculosis, the symptoms and physical signs, so far as any are observed, are due to the pleuritic inflammation which the tubercles excite.

Stomach and Intestines.—The symptoms in tuberculosis of the stomach and intestines vary according to the seat and stage of the tubercles.

Tubercles, whether gastric or intestinal, are not at first accompanied by symptoms, or the symptoms are obscure and ill-defined. Symptoms arise when inflammation occurs in the adjacent tissues. Diarrhœa is one of the most common and persistent of the symptoms. The alvine discharges are brown and thin, and sometimes, in advanced cases, very offensive. They may be streaked with blood which has escaped from the ulcers. Intestinal tubercles, developed immediately underneath the peritoneal coat, sometimes cause local peritonitis, usually of little extent. This gives rise to circumscribed pain, tenderness, and more or less meteorism.

Diagnosis.—It is evident from the foregoing description of symptoms that the diagnosis of incipient tuberculosis is much more difficult in children than adults. Before commencing the examination, it is advisable to learn the hereditary tendencies of the family and the history of the patient, especially as regards antecedent diseases or debilitating agencies, and the duration of the symptom.

Tuberculosis of the encephalon is diagnosticated with more difficulty than that of the thoracic or abdominal organs; but certain of these organs are ordinarily tubercular at the same time, and the knowledge of the fact that they are affected aids in the diagnosis of the disease of the brain or its meninges. Among the symptoms which possess diagnostic value may be mentioned cephalalgia and more or less fever, with exacerbations in the commencement of the disease, and, at a more advanced period, strabismus, inequality or irregular action of the pupils, impairment of vision, retraction of the head, and convulsive movements or paralysis.

In certain cases careful observation and discrimination of symptoms are requisite, in order to determine whether they arise from intra-cranial tubercles, or from congestion of the brain caused by obstruction in the venous circulation by the pressure of enlarged bronchial glands.

The diagnosis of bronchial phthisis, when the glands are still small, is

necessarily uncertain, on account of the absence of symptoms. When they have increased in size and are so located as to press on the pneumogastric or recurrent laryngeal nerve, producing the spasmodic cough already described, the differential diagnosis between that disease and pertussis may be made by attention to the following facts: Bronchial phthisis occurs singly, and is non-contagious, while pertussis occurs as an epidemic, and with evidences of contagion. There are no successive stages, namely, those of catarrh, paroxysmal cough, and decline, as in that disease, and the cough, though paroxysmal, is short, and without hoop or vomiting.

In feeble children, with inherited tubercular diathesis, emaciation, sweats, and a chronic cough, with the absence of pulmonary symptoms, should excite suspicions that the bronchial glands are involved. The evidence is almost conclusive if the cough becomes paroxysmal, and there is a loud, persistent, tracheal, or bronchial râle.

In certain of the patients affected with this form of tuberculosis, we have seen that the prominent symptoms are due to compression of one or more of the large vessels in the chest. Compression of these vessels, and consequent retarded circulation, may be confidently referred to enlarged bronchial glands, since aneurism, carcinomatous or other tumors, which would produce a similar result, are very rare before puberty. Sometimes the diagnosis is rendered certain by the physical signs observed by auscultation, and percussion over the sternum and the interscapular space. The condition of the external glands should also be observed, as those of the axilla, neck, and groin.

The diagnosis of pulmonary, though more readily made than that of intra-cranial and bronchial tuberculosis, is often difficult and uncertain. This is, in part, explained by the fact that the tubercles are so frequently disseminated, while emaciation and a chronic cough are not infrequent from other causes than tubercles. Rachitis, intestinal worms, dentition, simple tracheal or bronchial inflammation, may be attended both by a chronic cough and emaciation. Caution is therefore requisite in order to avoid a grave error in diagnosis. Precipitancy in the diagnosis of doubtful cases is worse than indecision, and it is often best to postpone an expression of opinion as to the nature of the disease till the case has been observed for a few days.

The significance and importance of the symptoms, physical signs, and other facts on which a diagnosis must be based, have already been sufficiently pointed out. It is difficult, in fact in certain cases impossible, to discriminate between simple cheesy pneumonia and cheesy pneumonia which has ended in the formation of tubercles. The patient has an attack of catarrhal pneumonia; but, instead of absorption of the inflammatory product, cheesy infiltration occurs, and the lung in places becomes infiltrated with pus, softens, and breaks down. The patient presents the symptoms and physical signs of phthisis. He may recover after a protracted

sickness, or may die. The disease may, and often does, remain a pneumonia; but this is a condition of the lungs which favors the development of tubercles, and in a certain proportion of cases tubercles do form in the last weeks of life. Though the differential diagnosis in such cases between simple pneumonia and tuberculosis supervening on pneumonia is impossible, practically the discrimination is unimportant, as the same treatment is required.

Advanced pulmonary tuberculosis, except when it supervenes upon pneumonia, can in most instances be readily diagnosticated by a careful examination. Still, it is to be recollected, as already pointed out, that certain of the symptoms and physical signs, which occurring in the adult would afford almost positive proof of pulmonary tuberculosis, not infrequently have a different origin in children.

The diagnosis of tubercles in the abdominal organs is facilitated by the presence of symptoms which indicate at the same time tuberculosis of the lungs. Among the chief diagnostic signs of tuberculosis of the peritoneum may be mentioned meteorism and a degree of tenderness on pressure, but there is danger of mistaking the tympanitic state of the intestines common in ill-nourished infants and the rachitic, or the fulness due to enlarged spleen or liver, for that occasioned by peritoneal tuberculization, and *vice versâ*. The history of the case, and a careful examination of accompanying symptoms, and the shape and feel of the abdomen, usually suffice to establish the diagnosis. In simple gaseous distension of the abdomen there is an absence of the symptoms, general and local, which attend tuberculosis; rachitis occurs at an earlier age than peritoneal tuberculosis, and digital examination, aided by percussion, enables us to diagnosticate enlargement of the liver or spleen.

Tubercular enlargement of the mesenteric glands cannot be positively diagnosticated when they are small. When they have attained such a size that they can be felt through the abdominal walls, palpation in connection with the history and symptoms of tuberculosis suffices to establish the diagnosis. The glandular tumors can be diagnosticated from other tumors by the fact that they are tender on pressure, and occupy the umbilical region, while fecal tumors are not tender, and are located in the iliac or lumbar region. Gastro-intestinal tuberculosis cannot be positively diagnosticated. Protracted diarrhœa, or frequent attacks of diarrhœa, not readily controlled by medicine, and occurring in tubercular cases, are probably associated with intestinal ulceration; but in only a certain proportion of cases of ulceration are there also tubercles in the walls of the intestines, as we have seen above.

Prognosis.—Death is the ordinary result of tuberculosis in the child, as it is in the adult; but now and then one recovers. Hospital statistics show that the average duration of the disease is from three to seven months. Under favorable circumstances it is more protracted, even to

two or three years. Those succumb soonest who inherit a strongly marked tubercular diathesis, live in damp, dark, and ill-ventilated apartments, and whose diet is scanty or of poor quality. Therefore in the poor quarters of the city tuberculosis presents a worse form and pursues a more rapid course than among families in better circumstances.

Favorable prognostic signs are absence of tubercular diathesis, good appetite and general health, with little emaciation, infrequency of cough, with respiration, pulse, and temperature nearly normal. Such symptoms may afford hope of recovery with judicious regimenal and therapeutic measures. On the other hand, if the symptoms are grave, death is inevitable, unless in bronchial phthisis, in which, even when there is considerable urgency of symptoms, the offending gland is sometimes eliminated by softening and ulceration, and the patient improves temporarily, if he does not ultimately recover. Complete and permanent recovery is, however, quite exceptional.

Death in tuberculosis of children may occur from exhaustion induced by the general disease, or from the local effect of the tubercles. Thus, in intra-cranial tuberculosis it may result from coma; in pulmonary tuberculosis, from dyspnœa, though more frequently from exhaustion; in that of the bronchial glands, from coma, dyspnœa, exhaustion, or even from hemorrhage; in that of the abdominal organs, from peritonitis or protracted diarrhœa.

Treatment. *Prophylactic.*—Since an infectious principle generated in cheesy substance is the common cause of the development of tubercles, it is evident that measures which tend to prevent the occurrence of this substance are prophylactic of tuberculosis. And since, in children, cheesy matter, in most instances, is a product of strumous inflammations, the anti-strumous remedies are demanded in the prophylactic as well as curative treatment of tuberculosis. Therefore, the strumous child should be watched with great care, and such measures be employed as are calculated to invigorate its system. If the mother belongs to a decidedly tubercular family, or gives the history of scrofula in her childhood, it is better that she do not suckle her infant, but employ a healthy wet-nurse. Children who are weaned should have plain, but nutritious and easily digested diet, a part of which should be milk. Residence in an airy and salubrious locality, out-door life, a scrupulous avoidance of exposure, by which a cold might be contracted, are important, in order to the continued latency of the diathesis.

Loss of flesh or appetite, or other evidences of failing health, indicate the need of other measures of a therapeutic character. Alcoholic stimulants should now be allowed three or four times daily in milk; cod-liver oil, with half its quantity of syrup of the lactophosphate of lime, to which the syrup of the iodide of iron is added, will be found useful for these cases, as it is in the ordinary forms of scrofula. The various bitter pre-

parations containing iron, as the citrate of iron and quinine, elix. calisaya bark with iron, etc., should by employed, when, for any reason, cod-liver oil is not tolerated. By the employment of such precautionary measures as soon as indicated, multitudes of children might be saved from tuberculosis who now perish.

Curative.—The medicinal agents which are required in ordinary cases have been already mentioned, namely cod-liver oil, iron, sometimes the vegetable tonics, and alcoholic stimulants. The oil may be given in emulsion to disguise the unpleasant flavor, or, which I prefer, mixed with half its quantity of syrup of the lactophosphate of lime, as recommended for the treatment of scrofula.

If the cod-liver oil is not tolerated, or if it impairs the appetite, it should be discontinued. In cases of diarrhœa it is of little or no benefit, and may do harm. Under such circumstances patients sometimes do better with simple regimenal measures, aided by alcoholic stimulants, and one of the least unpleasant of the tonics, as wine of iron or the calisaya bark. The regimen already recommended for prevention is also required as a part of the curative treatment.

Certain modifications of treatment are demanded on account of the localization of the tubercles. Intra-cranial tuberculosis, as soon as diagnosticated, should be treated by pretty decided doses of iodide of potassium, though, unfortunately, there is little prospect of improvement. The glandular disease, whether bronchial or mesenteric, requires the iodide of iron, with or without that of potassium. Pneumonitis or pleuritis, so frequent a complication of pulmonary tuberculosis, requires emollient poultices, with moderate counter-irritation, and the judicious use of opiates with stimulants. The peritonitis occurring in abdominal tuberculosis, which is usually circumscribed, is best treated by fomentations and poultices, with opiates, and the diarrhœa by subnitrate of bismuth and chalk, five to ten grains of each, or the bismuth with Dover's powder, or a more active astringent.

CHAPTER IV.

SYPHILIS.

Syphilis in infancy and childhood presents itself under two forms, namely, the congenital and acquired; the former is the more frequent.

Etiology.—Congenital syphilis may be derived from either father or mother. Either parent, having previously had syphilis, may transmit it to the offspring, although at the time free from syphilitic symptoms. The mother healthy at the time of conception, but infected with syphilis prior

to the eighth month of gestation, may communicate the disease to the fœtus; syphilis contracted in the eighth or ninth month does not affect the fœtus. If both parents have syphilis, the infant is almost necessarily syphilitic; on the other hand, if only one parent is affected, the infant may or may not be contaminated. Sometimes, with such parentage, a part of the children are syphilitic, and a part healthy.

Acquired syphilis in infancy and childhood may be received through primary lesions—that is, by reception of the virus from a chancre or bubo; or it may be derived from certain of the secondary lesions. Inoculation by primary lesions may occur at the birth of the infant, from a syphilitic sore in the vagina or upon the vulva of the mother; inoculation in this manner is, however, rare. Children may also receive the virus from primary lesions on the persons of nurses or companions. Infection in this manner is sometimes accidental, and sometimes the result of criminal conduct. A chancre on the breast of the wet-nurse not very infrequently communicates syphilis to the nursling.

The contagiousness of "secondary manifestations," for a long time doubted, is now fully established. Syphilis may be communicated by the secretion or exudation of a mucous patch, or a secondary sore. Hence the danger of lactation by unhealthy wet-nurses, though they present no symptoms of recent syphilis. Excoriations or sores upon the nipple or breast of an infected wet-nurse may communicate the disease to the nursling; and, on the other hand, mucous tubercles or fissures upon the lips or tongue of the infected infant may be the means of contaminating a healthy wet-nurse. Many such cases are now contained in the records of medicine. Vaccination by means of the scab is also a mode by which constitutional syphilis may be communicated. For further particulars in reference to this subject the reader is referred to our remarks on vaccination.

Clinical History.—The effects of the syphilitic poison upon the development of the fœtus, and the development and health of the infant, are different in different cases. The fœtus, under the influence of the poison, often ceases to grow, shrivels, dies, and is expelled, long before term, or it may be born alive, but prematurely, and showing clear evidences of the disease, as soon as it comes into the world; or, again, it may be born at term, but dead. So frequently is syphilis a cause of non-viability, that, as Trousseau has remarked, this disease should be suspected as the cause, whenever a woman repeatedly aborts. Abortion from syphilis commonly occurs at or about the sixth month of gestation. In these cases in which the fœtus dies from syphilis there is often placental syphilitic disease, namely, an undue growth of cells in the villi, which, compressing the vessels, gives rise to fatty degeneration, and prevents the requisite interchange between the maternal and fœtal blood. (Herring, Frankell.) Frankell designated the change "granulation-cell hypertrophy of the placental

villi." Virchow, in one case, found a gummy tumor in the maternal portion of the placenta.

When a fœtus destroyed by syphilis is expelled, it is apt to present a macerated appearance, the cuticle being detached over large patches of surface, and in other parts raised in blebs, with a thin, puriform, and offensive fluid underneath; the liver is occasionally indurated, and abscesses with spots of inflammation are sometimes observed in the thymus gland; the amniotic fluid is offensive, turbid, and of a greenish or greenish-brown appearance.

If the fœtus, in which syphilitic manifestations have begun to occur, has reached a viable age, and is born alive, it is small and imperfectly developed, often shrivelled and senile in appearance. The skin looks unhealthy, and it may exhibit a distinct rash. Bouchut saw a seven and a half months' infant born alive, with an eruption of a copper color upon the legs and arms, and onyxis upon the fingers and toes. The bullæ of pemphigus are also not infrequent upon the skin at birth, or they appear within a few days, two or three, after birth. The smallest are about the size of a split pea; but many are considerably larger; the largest consist of two or more which have coalesced. They contain a thin, greenish, purulent matter, and appear most frequently upon the palms of the hands and soles of the feet, but also in severe cases upon the face and over the surface of the body. Recently I was able to diagnosticate syphilis in an infant within a day after birth, by its small size and feebleness, and the appearance of large blebs of pemphigus upon its hands, feet, fingers and toes, over which the skin soon broke, leaving troublesome and bleeding sores; coryza commenced about the twelfth day. The parents seemed healthy, but I was enabled to trace the syphilitic taint to the mother. Non-syphilitic pemphigus, the result of cachexia, sometimes appears soon after birth, but its primary and usual seat is around the neck, and upon the body. I have known it to appear within the first week of life, and end fatally by the close of the second week. I have not found it difficult to distinguish it from syphilitic pemphigus by the history of the family, and its absence from the palmar and plantar surfaces of the hands and feet. Condylomata, mucous patches, and stains of a copper color are the principal syphilitic affections, besides pemphigus, which have been observed at birth on the bodies of contaminated infants. It is stated that M. Cullerier, in ten years' attendance at the Hôpital de Lorraine, met only two cases of syphilitic manifestations at birth, and Victor de Meric only two cases in forty-six infants, who were affected with congenital syphilis (Bumstead); but in the practice of others a larger proportion have exhibited symptoms at birth. Ordinarily the period in which congenital syphilis is first revealed by symptoms is between the fifteenth and fortieth days. Rarely the manifestation of the disease is delayed several

months. M. Diday ascertained the time of the commencement of symptoms in 158 cases as follows :—

Before the completion of one month after birth, in	86
" " two months "	45
" " three " "	15
At four months	7
" five "	1
" six "	1
" eight "	1
" one year	1
" two years	1

In cases of tardy commencement of syphilitic symptoms it is probable that the poison has been partially eradicated from the affected parent by appropriate treatment.

The nutrition of the infant who has inherited the syphilitic taint, but does not exhibit it at birth, is for a time good, but it begins to be impaired when the local manifestations of syphilis appear, or soon after. The system gradually wastes ; the skin loses its fresh and healthy appearance, and becomes sallow, and, after a time, more or less wrinkled ; the features become pinched and contracted, and wear a sad expression. M. Diday says : " Next to this look of little old men, so common in new-born children doomed to syphilis, the most characteristic sign is the color of the skin." Trousseau thus describes this discoloration of the surface : " Before the health becomes affected, the child has already a peculiar appearance ; the skin, especially that of the face, loses its transparency ; it becomes dull, even when there is neither puffiness nor emaciation ; its rosy color disappears, and is replaced by a sooty tint, which resembles that of Asiatics. It is yellow, or like coffee mixed with milk, or looks as if it had been exposed to smoke ; it has an empyreumatic color, similar to that which exists on the fingers of persons who are in the habit of smoking cigarettes. It appears as if a layer of coloring had been laid on unequally ; it sometimes occupies the whole of the skin, but is more marked in certain favorite spots, as the forehead, eyebrows, chin, nose, eyelids—in short, the most prominent parts of the face ; the deeper parts, such as the internal angle of the orbit, the hollow of the cheek, and that which separates the lower lip from the chin, almost always remain free from it. Although the face is commonly the part most affected, the rest of the body always participates more or less in this tint. The child becomes pale and wan."

The infant whose system is profoundly affected by syphilis rarely smiles, and its voice is feeble and plaintive ; its frequent whimpering cry is quite characteristic.

Coryza is one of the earliest and most constant of the local affections which occur in infantile syphilis. It is slight at first, attracting little attention from the parents, who are not aware of its significance, and

usually attribute it to a slight cold; but it gradually increases. It gives rise to a secretion from the Schneiderian membrane, at first thin, but which becomes more consistent, and is attended by the formation of scabs. The thickening of the mucous membrane, in consequence of the inflammation and the presence of crusts, narrows the passage through the nostrils so as to produce snuffling respiration, and sometimes render nursing difficult. In severe cases respiration through the nostrils is almost wholly prevented, so that death may occur from inanition, unless the breast is milked into the infant's mouth, or it is fed with a spoon; but, ordinarily, even in grave coryza, it continues to nurse, though obliged often to release its hold of the nipple to obtain breath. It is when coryza begins to interfere with lactation that it first alarms the parents. The inflammation at the same time may affect the throat and larynx, causing hoarseness of the voice. Ulceration of the Schneiderian membrane and the adjacent cartilage or bone is rare in infancy or childhood, although cases occur which are even attended with more or less flattening of the nose. Diday believes that the discharge which accompanies coryza is in great part due to mucous patches developed on the Schneiderian membrane. The upper lip, over which the discharge flows, becomes red, excoriated, and more or less incrusted. The coryza, in most cases, coexists with other local syphilitic affections. Occasionally it occurs alone, and is the only evidence of the presence of the specific taint, except such as is afforded by the mal-nutrition and general appearance of the patient.

Mucous patches occur in most patients. They are developed either upon the mucous surfaces, or upon parts of the skin which are thin and exposed to friction, and such as are moistened by secretion or transudation from the vessels underneath. The most common seat of mucous patches is at the termination of mucous canals; but in infancy, on account of the peculiar delicacy of the skin, they may occur upon almost any part of the cutaneous surface. They are most common, however, around the anus, upon the vulva, scrotum, umbilicus, labial commissures, in the axillæ, and behind the ears.

Mucous patches upon the skin present a rounded border, and are slightly elevated. Their color has been compared to that of the skin which has been softened by the prolonged application of a poultice. Erosions and cracks sometimes occur in the patches, from which a thin liquid exudes.

Upon mucous surfaces they are less elevated than upon the skin, and are prone to ulcerate. These ulcerations, commencing at the centre, extend, and soon the mucous patch disappears, and its site is occupied by an ulcer. The ulcer may be circular, oval, elliptical, crescentic, or irregular. The arches of the fauces are a common seat of mucous patches.

Roseola is an occasional symptom of infantile syphilis. "It is distinguished," says Diday, "by patches of a bright rose-color, circumscribed, irregularly rounded, of various sizes (most frequently about as large as

one of the nails); appearing, by preference, on the belly, lower part of the chest, neck, and inner surface of the extremities." The spots do not readily and fully disappear by pressure.

Pemphigus appearing soon after birth has already been alluded to. Its most frequent seat, whether occurring after birth or as a subsequent manifestation, is, as we have stated, the palms of the hands, soles of the feet, the fingers, and toes. This eruption commences by a violet tint of the skin, and in the course of twenty-four to forty-eight hours a watery fluid collects underneath, which soon becomes turbid. The skin peels off, and sometimes an angry sore results, which bleeds readily when rubbed or pressed. In other and more favorable cases new skin takes the place of that which is lost. Pemphigus at birth is a precursor of death, but when it appears for the first time some weeks after birth, it is a less unfavorable prognostic sign. In cases of recovery it disappears, with proper treatment, in two or three weeks.

Acne, impetigo, and ecthyma are occasionally observed in children afflicted with syphilis. The indurated pustules of acne occur most frequently upon the shoulders, back, chest, and buttocks. The pus is sometimes absorbed, and in other cases discharged, leaving a small cicatrix, which, after a time, disappears. Impetigo appears most frequently upon the face, and occasionally upon the chest, neck, axilla, and groins. Unlike simple impetigo, the syphilitic impetiginous eruption is surrounded by a copper-colored areola. Ecthyma occurs upon the legs and buttocks chiefly. It commences as violet-colored spots, which are soon transformed into pustules. Ulcers succeed, which, in reduced states of the system, are apt to enlarge and endanger the safety of the child. Of the three pustular eruptions, acne, according to Diday, is the least serious—indicating a "less confirmed diathesis." Ecthyma is the most serious, on account of the reduced state of system with which it is apt to be associated. Syphilitic papulæ and squamæ are rare in infants, but cases have been observed. Onychia occasionally occurs, though less frequently than in syphilis of the adult.

Visceral Lesions.—The visceral lesions which occur in the syphilis of infancy and childhood are, suppuration in the thymus gland; gummy tumors in certain organs, most frequently the lungs and liver; increase of the connective tissue of the liver, known as syphilitic cirrhosis; partial perihepatitis, with depressions resembling cicatrices on the surface of the liver; peritonitis; periostitis, with thickening of the bone and exostosis.

Suppurative inflammation in the thymus gland is not common, or has not been frequently observed. When it is present the gland sometimes presents its normal appearance externally, and the abscess is only discovered by incisions. Gummy tumors are white and spheroidal; some are as small or smaller than a pin's head, while others are as large as a pea, or even a hazel-nut. I have seen a considerable number of them not as large

as a pin's head, in the liver of an infant. Gummy tumors, according to Lebert, consist "of loose fibrous tissue, made up of pale elastic fibres, inclosing in their large interspaces a homogeneous granular substance, the elements of which are less adherent to each other than in deposits of true tubercle." Lebert also, with other microscopists, discovered round granular cells in these tumors. According to Robin, gummy tumors "are made up of rounded nuclei belonging to fibro-plastic cells, or *cytoblastions;* of a finely granular, semi-transparent, and amorphous substance; and, finally, of isolated fibres of cellular tissue, a small number of elastic fibres, and a few capillary bloodvessels."

Constitutional syphilis is one of the principal causes of waxy degeneration, and the spleen and liver of infants may be enlarged from this cause. Dr. Samuel Gee has expressed the opinion that in half the cases of hereditary syphilis the spleen is enlarged. (London *Lancet*, April 13th, 1867.)

Infiltration of the liver by fibrous substance was first noticed by Gübler. It is not common in the infant. A specimen, showing this lesion, was presented to the London Pathological Society in 1866, by Dr. Samuel Wilks. The following remarks by Dr. Wilks convey a good idea of the appearance and state of the liver in syphilitic cirrhosis: "Having dissected the bodies of several infants, who have died of congenital syphilis, I have found fatty livers, and an inflammation of the capsule; but in only two have I discovered adventitious products of a fibrous character. The present example, however, corresponds in every particular with the disease described by Gübler. It must be distinguished (at least as far as the naked-eye appearance reaches) from the syphilitic disease of adults, of which many specimens have been before the Society. In these the organ is cicatrized on the surface, and contains distinct nodules of fibrous tissue; whilst in the disease of children, as in the present specimen, the whole organ is infiltrated by a new material, and it consequently becomes, as described by Gübler, hypertrophied, globular, and hard, resistant to pressure, and even when torn by the fingers, its surface receives no indentation from them; it is also elastic, and when cut, creaks slightly under the scalpel. This was the form of disease in the present specimen. It came from a syphilitic child, a month old, in whom the liver could be felt enlarged during life, and when removed weighed a pound and a half. It was smooth on the surface, and so hard that it resembled rather a fibrous tumor than a liver. It is seen that the liver in the syphilitic child is liable to three distinct pathological processes, namely, gummy tumors, cirrhosis or fibroid degeneration, and waxy degeneration.

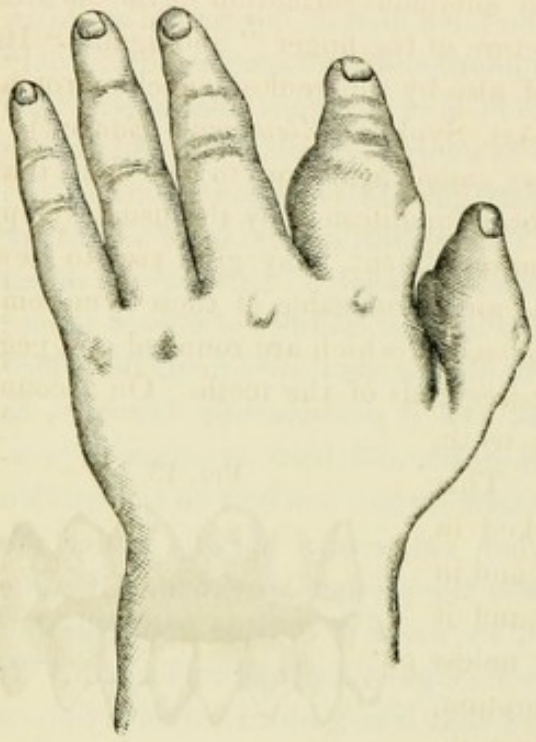
Syphilitic perihepatitis and periostitis are more rare in infancy and childhood than in adult life, but they occasionally occur. The late Sir James Y. Simpson considered peritonitis in the fœtus one of the results of syphilis, and a cause of its death.

Osseous Lesions.—Within the last few years, important discoveries have been made in regard to the effect of syphilis upon the nutrition of

the bones in children. In 1870, Dr. Wegner, of Berlin, published his observations of the state of the skeleton in twelve syphilitic children, who were either stillborn, or who died within a few days or weeks after birth. He found clear proof that the syphilitic dyscrasia very frequently disturbs the nutrition and produces anatomical changes in the skeleton of the fœtus. The following are the lesions, clearly referable to syphilis, which he observed: Periostitis of long bones, including the ribs; softening, separation, and sometimes crepitation, at the point of union of diaphysis and epiphysis; chalky concretions and infiltrations along the line of ossification; fatty degeneration of marrow; irregular formation and distribution of spongy substance in the epiphysis. These lesions were not all observed in each case, but they occurred with such frequency, that there could be no doubt that they were due to the syphilitic taint of system. Confirmatory observations also, in twelve cases, have since been made by Waldeyer and Köbner.[1]

Again, there is a syphilitic lesion of the bone in children, which is not usually present or has not usually been observed at birth, but is developed in the first weeks or months of infancy. The lesion alluded to is a circumscribed enlargement of one or more bones. This has been most frequently observed upon the long bones, including the clavicle and ribs; but in certain children it occurs upon other bones in addition. In some cases it is one of the first manifestations of hereditary syphilis, occurring even sooner than the coryza, while in others several months elapse before it appears. In one case, reported by Dr. Bulkley,[2] of this city, it was first seen only a few days after birth, being perhaps congenital; while in another case, in which the enlargement was upon certain phalanges, and which is represented in the accompanying figure, it appeared at the age of twelve months. When it occurs upon a phalangeal bone, it is designated *dactylitis syphilitica*.

Fig. 12.



[1] See elaborate paper by R. W. Taylor, M.D., New York Journal of Obstetrics, etc., July, 1874.

[2] Rare Cases of Congenital Syphilis, New York Med. Journal, May, 1874.

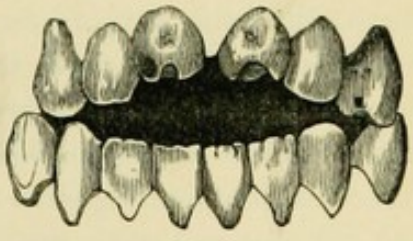
The enlargement, if upon a long bone, ordinarily begins at or near the point of union of the diaphysis with the epiphysis. It is located upon the extremity of the shaft which it encircles, and it extends over a part or nearly the whole of the epiphysis. It has an elevation of perhaps one-half or three-quarters of an inch in typical cases; its surface is smooth, or slightly undulating, and the skin over it, though distended, has its normal appearance, and is easily movable, unless ulcerations have occurred.

These enlargements, which result from the specific inflammation occurring in the periosteum and the bone, may resolve under proper treatment; but if neglected, and the anti-hygienic conditions are bad, degenerative changes may occur, ending in ulceration and destruction of the diseased part to a greater or less extent.

Though these bone enlargements, whenever observed, should excite suspicions of syphilis as the cause, enlargements which present the same general appearance do occur from other causes. Such a case was observed by me in the children's class in the Outdoor Department of Bellevue, and Dr. Bulkley details another case in his paper. In the case observed by me, the inflammation and enlargement seemed to be strumous. Bäumler says: "Dactylitis syphilitica does not always originate in the bone; similar appearances may be produced through gummous formation in the sheaths of the tendons, and in the fibrous structure of the finger;" and again, "Its outward appearance may be produced also by tuberculosis, enchondroma, or sarcoma of the bone-marrow." (Art. Syphilis, *Ziemssen's Encycl.*)

Mr. J. Hutchinson, of London, has called attention to the fact, that hereditary syphilis, having perhaps been manifested by the usual symptoms during infancy, and then becoming latent, may give rise to new symptoms after the fourth year. The most noticeable of these symptoms is a dwarfing of the permanent incisor teeth, which are rounded and peg-like, and their enamel notched at the free ends of the teeth. On account of the small size and shape of the teeth, there are interspaces between them. This abnormal development is most marked in the central incisors of the upper jaw, and in certain cases it is limited to them, and it never appears in the other incisors unless it does also in them. Another symptom, which only appears in hereditary syphilis, is an interstitial keratitis occurring on both sides, and attended by the deposition of fibrin in the substance of the cornea. In a few weeks the inflammation declines, but a slight opacity of the cornea remains. The cerebral nerves may become affected, usually a single pair—if the auditory, deafness resulting; if the optic, dimness of sight. Occasionally there are other manifestations of syphilis in this period, as enlargement of spleen and liver, and nodes upon the long bones.

Fig. 13.



Prognosis.—This depends in great part on the general condition of the patient. If there is much emaciation, and the symptoms indicate a deeply-seated cachexia, a considerable proportion perish. On the other hand, if the general health is not greatly impaired, although the local affections are pretty severe, the prognosis with correct treatment is good. The younger the infant, when the symptoms of syphilis appear, the more unfavorable, as a rule, is the prognosis.

Treatment.—Parents who beget syphilitic children ought, from a due regard for their offspring, to make use of antisyphilitic remedies, although they present in their persons no evidences of syphilitic taint. A good prescription for the parents is one-sixteenth of a grain of corrosive sublimate in the compound tincture of bark, given twice or three times daily for several weeks. If the father has had syphilis, both parents should be subjected to this treatment, and it may be continued, at least on the part of the mother, during the first months of her gestation. So small a dose of the mercurial does not, in my opinion, materially increase the liability to miscarry. There is much more danger of miscarrying from allowing the syphilitic taint to remain uncontrolled. Some prefer the use of mercurial ointment in the treatment of pregnant women for syphilis, in the belief that it is less likely to produce abortion. It is used for this purpose in the proportion of one drachm to the ounce. It is equally effectual in the eradication of the syphilitic taint with the small dose of corrosive sublimate recommended above for internal administration; but it is impossible to determine the quantity of mercury which enters the circulation when inunction is employed, and salivation is more likely to occur.

Syphilis in the infant requires mercurial treatment as in the adult. Mercury may be employed internally or by inunction. Some prefer inunction in the treatment of ordinary cases, in the manner recommended by Sir Benjamin Brodie. "I have spread," says he, "mercurial ointment, made in the proportion of a drachm to an ounce, over a flannel roller, and bound it round the child once a day. The child kicks about, and, the cuticle being thin, the mercury is absorbed. It does not either gripe or purge, nor does it make the gums sore, but it cures the disease. I have adopted this practice in a great many cases, with the most signal success." Trousseau, on the other hand, discountenances the use of inunction, as mercurial ointment applied to the skin produces irritation, and increases the suffering and restlessness of the child. He prefers the following solution, which is known as Van Swieten's, for internal treatment:—

℞. Hydrarg. bichlorid., 1 part;
Aquæ, 900 parts;
Spts. rectific., 100 parts. Misce.

Dose, one or at most two grammes (15.434 to 30.868 grains), in milk, daily.

In order to avoid the risk of establishing a diarrhœa, and to leave the stomach free for the employment of other medicines, as cod-liver oil and the iodide of iron, I prefer and commonly prescribe for infants inunction

with the mercurial ointment diluted with eight times its quantity of lard, cold cream, or vaseline. It should not, in my opinion, be applied as a plaster, but a quantity of the size of a large chestnut should be rubbed three times daily upon the neck or breast of an infant of three or four months. For children over the age of eight or ten months Van Swieten's or one of the following formulæ may be employed :—

℞. Hydrarg. cum cretâ, gr. iij–vj.
Sacch. alb., ℈j. Misce.
Divid. in chart. No. xii. One powder 3 times daily.

℞. Hydrarg. chlor. corros., gr. j–ij.
Syr. sarsæ comp., ℥ij.
Aquæ, ℥viij. Misce.
One teaspoonful 3 times daily.

℞. Hyd. chlor. corros., gr. ss.
Potas. iodid., ʒj.
Ferri et ammon citrat., ʒj.
Syr. simplic., ℥vj. Misce.
Dose, one teaspoonful 3 times daily for a child of 3 to 5 years.

℞. Hyd. chlor. corros., gr. j.
Potas. iodid., ʒij.
Syrup. simplic.,
Aquæ, āā ℥ij. Misce.
Dose, six drops 3 times daily for a child of 3 months.

Mercury, in whatever way employed, should not be discontinued entirely till several weeks after the syphilitic symptoms have disappeared; it is proper to continue it for a time, in diminished quantity and fewer doses, after the health seems fully restored.

When the mercurial is omitted, tonics are often required. The preparations of cinchona are useful in certain cases, as are also those of iron. If the patient remain feeble and pallid, presenting evidences of struma, cod-liver oil and syrup of the iodide of iron will be found beneficial continued for some weeks or months after the mercurial is discontinued. Attention should always be given to cleanliness and the hygienic management of the child. In some instances direct treatment of the local affections is serviceable. To aid in the cure of syphilitic coryza, the following ointment should be applied within the nostrils by a nasal sponge three times daily :—

℞. Ung. hydrarg. nitratis, ʒij.
Ung. zinci oxidi, ℥ij. Misce.

Condylomata or mucous patches seated upon the cutaneous surface may be dusted with calomel. At my clinique, in April, 1871, a child two years and ten months old was presented, with a large condylomatous outgrowth near the anus. The history of the child showed that in all probability the disease had been contracted within a year from syphilitic children in one of the public institutions. Within three weeks this affection disappeared by dusting upon it calomel once daily, with appropriate internal treatment.

SECTION II.

ERUPTIVE FEVERS.

CHAPTER I.

MEASLES.

The disease known in the vernacular as measles has also the names rubeola and morbilli. It is a common exanthematic affection, occurring at any age, but most frequently in childhood. It affects once the majority of mankind. Writers recognize three stages of measles: first, that of invasion, which ends with the appearance of the eruption; secondly, the eruptive stage; and thirdly, the stage of decline or desquamation.

Symptoms.—This disease commences with such symptoms as usually occur in mild but pretty general inflammation of the air-passages, namely, cough, fever, anorexia, and thirst. The eyes present a suffused, moderately injected, and brilliant appearance, and the buccal and faucial surface is injected. The Schneiderian membrane, and that lining the larynx, trachea, and bronchial tubes, participate in the increased vascularity. The cough at first is dry, and sometimes distinctly croupy. Catarrhal or false croup, indeed, is not infrequent in the initial period of measles. The cough is attended by little acceleration of respiration, and by little or no pain in the respiratory movements. If auscultation is practised at this early stage, we observe the vesicular murmur, somewhat harsh in character, and sometimes sonorous and sibilant râles. A little later, râles of a moist character appear.

The patient, if old enough, commonly complains of headache, and of dull pain in the epigastric region or the centre of the sternum, due to the bronchitis. With these local symptoms febrile reaction occurs. The temperature rises to about 102° or 103°, as indicated by the thermometer in the axilla. The pulse numbers from 110 to 130 per minute. The fever is somewhat greater than in primary tracheo-bronchitis, except when the bronchitis extends to the bronchioles, but it is less than in most cases of scarlet fever.

The fever in the premonitory stage of measles after the first day is not uniform. It is attended by remissions and exacerbations, the former occurring in the first part of the day, the latter in the evening. Some-

times two exacerbations occur in the day. The face is flushed and somewhat swollen, especially during the times of increase in the fever, and the child is drowsy or restless. Vomiting, so common a symptom in the commencement of scarlet fever, occasionally occurs in measles. While in scarlet fever this takes place in the first twenty-four hours, in measles it occurs with about equal frequency at any period previously to the eruption. It was present during the first stage, sometimes almost as late as the eruptive period, in thirteen, and was absent in twenty-three cases, in which I preserved records in reference to this symptom.

The duration of the first stage varies in different cases. It is usually from two to five days, with an average of about four. Occasionally it is more protracted on account of some disturbance in the economy, either from exposure to cold or other cause, which prevents the necessary afflux of blood towards the surface, and retards the eruption. In eighteen cases in my practice in which the duration of the cough previously to the appearance of the rash was accurately ascertained, the time varied from one to five days, with an average of three and one-third; in ten other cases it had continued, the parents stated, about a week, and in five, from one to two weeks, previously to the eruption.

The eruption commences, when the disease pursues its normal course, upon the forehead and neck, then the face, and gradually extends downwards, occupying from twenty-four to thirty-six hours in passing over the trunk and limbs. It appears first as indistinct red points, not more than a line in diameter, which increase in size and become more distinct. Their borders are uneven or irregular, or they are finely notched; their general shape is, however, circular, except as two or more unite, when they may assume any form. The crescentic form which writers describe is due to the union of two points of eruption. The largest of these spots, when there is no coalescence, do not exceed a quarter of an inch in diameter, and many are much smaller. Frequently in plethoric children, if there is much fever, there is continuous redness over several inches of surface. The eruption is then confluent. This form is often observed upon parts of the surface where the capillary circulation is most active, when it is discrete elsewhere. In some of these cases, diagnosis of measles from scarlet fever is attended with difficulty.

The rubeolous eruption is slightly elevated. This is not appreciable to the sight, but can be ascertained by passing the finger slowly over the skin, when a little roughness is felt at the point of eruption. Sometimes the elevation, especially in the commencement of the efflorescence, is not appreciable, even to the touch. The eruption is broad and flat, never acuminate, never changing its form to the vesicular or pustular. It disappears by pressure, and immediately reappears when the pressure is removed. It has been compared in appearance to flea-bites. Small, pointed, papular, vesicular, or pustular eruptions are sometimes seen in connection with those

of measles, but they are accidental, occurring in other states of system, as well as in measles, if there is the same augmented temperature.

In the commencement of the eruptive period the severity of the constitutional and local symptoms increases. The pulse and temperature correspond with the character which they presented during the exacerbations of the first stage. The features are slightly swollen; the eyes still watery and sensitive to light; the conjunctiva, ocular and palpebral, and the mucous membrane of the cavity of the mouth and of the air-passages, continue injected. The tongue is covered with a moist thin fur, and its papillæ are prominent, though less so than in scarlet fever. The cough continues frequent, and is seldom attended with much expectoration, in uncomplicated cases; often there is no expectoration whatever. The appetite is lost, but drinks are readily taken on account of the thirst. Diarrhœa sometimes occurs on the first day of the eruption, but it lasts only a few hours, and, if the disease pursue its usual course, abates of itself. With the exception of this the bowels are regular, or a little constipated during the eruptive period.

On the second day of the eruption, or sixth of the fever, the symptoms begin to abate. The pulse is less accelerated, and the temperature diminishes; the cough is less frequent and is easier, and the flushed and swollen appearance of the face declines. By the close of the third or on the fourth day the rash has disappeared in the order in which it extended over the body. There only remain faint maculæ, which in the course of a day or two fade completely.

With the disappearance of the rash the fever nearly or quite ceases, but a slight and painless cough continues for several days.

Occasionally the eruption presents a livid appearance; this is the rubeola nigra of writers. From cases which I have observed, it is my opinion that this should not be considered a distinct species in the vast majority of cases, but that the dark color is due to internal inflammation, usually capillary bronchitis or pneumonia, which prevents full oxygenation of the blood. Rarely rubeola nigra is due to the vitiated state of the blood, or the malignant nature of the disease. The course of the eruption in this form of measles is somewhat different; it continues longer, fades more slowly, and does not disappear so readily on pressure. Traces of it are observed a week or more after its first appearance; it is apt to be fatal. Measles may present this form from the beginning, or, commencing as vulgaris, it may pass into rubeola nigra.

Measles may be irregular in form, but aberrations are less frequent than in scarlet fever. Writers describe measles without catarrh, and, on the other hand, with catarrh but without the rash. But positive diagnosis in such cases must be difficult. It is probable that simple catarrh and roseola have sometimes been mistaken for the two forms of irregularity mentioned, but when a child, in a family of children affected with measles, presents

all the symptoms of that disease, except the catarrh or except the eruption, the diagnosis of irregular measles would, as a rule, be correct.

Occasionally the stage of invasion is very short, or even absent. In one case the parents informed me that the catarrhal symptoms began on the day when the eruption appeared. Convulsions sometimes occur at the commencement of measles, as well as during its progress. A single convulsive attack at the commencement of measles is usually not dangerous; when repeated, it is more serious; it is also more serious when it occurs in the course of measles. In certain cases the eruption appears in an irregular and partial manner, occurring, perhaps, at a late period, and indistinctly, upon the trunk alone, or upon the trunk and partially upon the legs. In many cases of deferred or partial eruption there is internal congestion or inflammation of some part, which causes withdrawal of blood from the surface, and thus prevents the normal development of the rash.

When the eruption disappears the third stage commences, that of desquamation. It is characterized by a scanty furfuraceous exfoliation of the epidermis. The desquamation is seldom as great as in scarlet fever, and it occurs most where the eruption has been thickest and the epidermis most inflamed. Exfoliation occurs between the fourth and seventh days after the commencement of the eruption, the eighth and the eleventh of the disease. In some children it does not take place, or is so slight as not to be observed.

With the disappearance of the rash, the symptoms rapidly abate. The pulse becomes more natural, the temperature is reduced, the digestive organs return to their normal state, and convalescence is established. The cough continues several days after the other symptoms abate, but it is less and less frequent, and is not painful.

Complications.—The complications of this disease are important. Much of the success of the physician in the management of measles depends on a correct diagnosis and understanding of them. The most frequent of these complications are bronchitis and broncho-pneumonia. Slight bronchitis is common in measles, but if it increase so as to cause embarrassment of respiration, and become a source of danger, it is properly a complication. This complication, as well as pneumonia, may occur at any period of measles; but it commences most frequently in the first stage. Occurring in the first stage, it may prevent the regular appearance of the rash; if in the second, it often causes retrocession of it.

When bronchitis becomes really serious, it usually has invaded the minute bronchial tubes. This disease, designated capillary bronchitis or suffocative catarrh, I have elsewhere described. The clinical history of fatal bronchitis, as a complication of measles, is as follows: The respiration, at first not notably altered, becomes, by degrees, accelerated, and the patient more and more fretful. The pulse, instead of becoming less

accelerated, as after the first days of simple measles, is daily more rapid, and the respiration more frequent and labored. The dyspnœa gradually increases, the infra-mammary region is depressed during each inspiration, and the subcrepitant râle is heard on both sides of the chest. There is, probably, collapse or inflammation of some of the lobules. Finally the prolabia and fingers become livid, and death occurs from apnœa. Capillary bronchitis is diagnosticated from pneumonitis by the physical signs. It is in the young child more dangerous than that disease, unless perchance the latter be double. A large majority of those affected under the age of three years, die. The anatomical characters of fatal bronchitis occurring in connection with measles, I have had an opportunity to inspect. In an infant who died with this complication in the Infants' Hospital in the spring of 1867, there were evidences of continuous inflammation from the epiglottis to the minutest bronchial tubes.

Pneumonia as a complication does not differ materially from the idiopathic form, except that it is more protracted and fatal. Its form is in most cases catarrhal, resulting from an extension of the bronchial inflammation.

The next most frequent serious complication of measles is entero-colitis. This may commence at any period during the course of the disease. If the colon is more especially the seat of inflammation, the evacuations contain mucus and blood, unless in young children, in whom the stools, even in severe colitis, commonly have a green color. The anatomical character of this complication varies in different cases, like the idiopathic form of inflammation. Sometimes there is simple arborescence of the intestinal mucous membrane, with tumefaction of its follicles; in other cases, in addition to increased vascularity, the mucous coat is softened and thickened; and in others still, especially if the inflammatory action has been somewhat protracted, ulceration occurs, for the most part in the site of the solitary glands. Exceptionally, in fatal cases of measles attended with diarrhœa, no vascularity is observed after death, although the intestine may be somewhat thickened and softened. In these cases the diarrhœa may have been non-inflammatory or inflammatory, the injection of the vessels having disappeared after death.

Severe and obstinate diarrhœal affections occurring with measles, usually commence as the primary disease is about declining. They then become sequelæ, ending fatally in many instances several days or perhaps weeks after the disappearance of the eruption. Diarrhœal attacks, occurring in, or previously to, the eruptive stage, are, as a rule, mild and easily relieved.

In some grave cases, measles have a tendency from the first to affect the internal organs more than the surface. There then coexist bronchitis, pneumonia, and entero-colitis, with indistinctness of the eruption on the skin. Such complications render a fatal result highly probable.

Another very fatal complication and sequel is true croup, commencing when rubeola is beginning to decline; but it is less frequent than pneumonia or entero-colitis. In catarrhal or false croup, which, as has been previously stated, is not infrequent at the commencement of measles, the cough has a loud, ringing character. In true croup, on the other hand, it is hoarse or harsh, and less distinct, on account of the presence of the pseudo-membrane in the larynx. True croup, always a grave disease, is more serious when it occurs as a complication of measles than in the idiopathic form, not only because the blood is vitiated and the system reduced by the primary affection, but because the inflammation of the mucous surface is in general more extensive, as is also, I believe, the pseudo-membrane. This membrane in the croup of measles I have seen extend so far down the air-passages, that tracheotomy could not have been attended by any decided amelioration of symptoms. This complication, though always grave, is not, however, necessarily fatal. I have known cases recover by inhalation of spray, when for days there had been dyspnœa and other evidences of a pretty firm pseudo-membrane. True croup causes continuation of the fever, which had perhaps begun to abate.

Diphtheria, when epidemic, also frequently complicates measles. Much of the mortality from measles in this city, since the year 1858, was due to this cause. In cases observed by myself, diphtheria usually began while the fauces were still inflamed, and sometimes before the eruption had begun to fade.

These are the most common complications of measles. There are others of less frequent occurrence, among which may be mentioned congestion of the brain, with or without serous effusion. Stomatitis, pharyngitis, and otitis are occasional complications. Rarely, also, purpura, attended by hemorrhages from the different mucous surfaces, occurs in connection with measles. This complication is, however, more frequent in certain other constitutional diseases, as scarlet fever, and especially variola.

It is seen that the inflammations which are apt to occur in the course of measles are chiefly of the mucous surfaces. In scarlet fever, on the other hand, the inflammations are more frequently serous.

There are other affections, originating in measles, which are rather sequelæ than complications. Gangrene of the mouth is one which, as stated in another part of this book, is more apt to occur after measles than any other disease. After a severe epidemic of measles in the Catholic Foundling Asylum, in 1874, three cases of gangrenous vulvitis occurred in those who had been affected. Ophthalmia commencing in measles often persists for weeks or months. It may give rise to granulation of the lids, and cases have been reported of violent inflammation of a purulent character, producing ulceration of the cornea, and destroying vision. The ophthalmia is sometimes very intractable. Inflammation of the Schneiderian membrane, commonly present during measles, sometimes continues

as a sequel, extending back as far as the Eustachian tube, where it may cause swelling, with impairment of hearing, and forward to the lip, where it may produce chronic eczema.

Anatomical Characters.—I have made, or witnessed, according to remembrance, some six post-mortem examinations of those who have died in, or immediately after, an attack of measles. In all there were lesions due to complications. Indeed, death directly from measles is so rare that few have had an opportunity of studying the anatomical characters which are peculiar to this affection. In those who have died without any obvious coexisting disease, and these cases chiefly occur in the malignant form, there has been congestion of the internal organs, especially marked in the lungs, and sometimes the tissues appeared softened. The blood, also, in the malignant form, has a darker hue than natural, and ecchymotic patches have been observed upon the mucous surfaces and elsewhere, corresponding in character with the petechiæ under the skin which sometimes occur in this form of measles. In cases resulting fatally from bronchitis or pneumonia the bronchial glands are commonly tumefied in the same manner as the mesenteric glands are enlarged in enteritis, and the glands of the mesocolon in dysentery.

Nature.—Rubeola, like the other exanthematic fevers, is due to a materies morbi, the exact nature of which is unknown. It is highly contagious through the air. It has been inoculated by the serum from vesicles which sometimes occur in connection with the rubeolous eruption, and also by the blood from a patient. Inoculation does not appear to moderate the disease, and as measles, when contracted in the ordinary way, is not in itself dangerous, but dangerous only from complications, inoculation is not performed, except as a matter of scientific interest. The usual mode of propagation is through the air. It is communicated both by the breath and clothing. By fomites the virus is sometimes conveyed a long distance. The question is still undecided whether rubeola does not sometimes occur spontaneously. I have met cases, and have heard of others, one in a sparsely settled district, in which there was no evidence of exposure. Yet the immunity of certain islands for centuries, till infected through commerce, renders the doctrine of an origin *de novo* improbable.

Twelve to fourteen days elapse from the time of infection to the commencement of the eruption. In cases observed in the children's department of Charity Hospital, this period was ascertained to be about twelve days. In those who have been inoculated, the incubative period is said to have been about one week. Rubeola prevails epidemically, like the whole class of infectious diseases, and in different epidemics the type varies somewhat, as well as the character of the complications.

Diagnosis.—The diagnosis of measles, previously to the eruption, is often difficult. The catarrhal symptoms then predominate, and these are such as may occur independently of any constitutional or blood disease.

The first stage, therefore, of measles, is often mistaken for coryza, or mild bronchitis. The points of differential diagnosis are the suffused appearance of the eyes, the greater degree of fever on the first day than would be likely to arise from so moderate an amount of local disease, and on subsequent days remission and exacerbation of the fever. Measles in the first stage has been mistaken for remittent fever. The catarrhal symptoms should prevent such an error.

Sometimes roseola closely resembles measles in appearance, but the rash of roseola appears within a few hours after the commencement of febrile symptoms, and almost simultaneously over the whole body, and without those local symptoms referable to the mucous surfaces, which characterize measles.

Variola on the first day of the eruption has sometimes been diagnosticated as measles. I recollect once being called to an infant with fatal confluent smallpox, who was said to have measles. A physician, a few days previously, observing the red points in the commencement of the eruption, had made this absurd diagnosis, and, predicting a favorable result, had not thought it necessary to repeat his visit. In case of doubt, it is the part of prudence to defer making a positive diagnosis. A few hours suffice to show the distinctive characters of the rubeolous and variolous eruptions. But the anxiety of friends often necessitates the expression of an opinion. The absence of catarrhal symptoms, the earlier appearance of the eruption, and its papular feel under the finger in smallpox, enable us to discriminate between the two diseases in the commencement of the eruptive stage. Moreover, the symptoms in the initial periods are different, as will be seen in our description of smallpox.

Prognosis.—This is favorable, provided that there is no serious complication. With internal inflammatory complication, on the other hand, the disease becomes much more grave. A large proportion thus affected die. The prognosis is also less favorable in feeble children with scanty eruption, or an eruption appearing at a late period and irregularly. Dyspnœa, persistent and great acceleration of pulse, and coma, indicate an unfavorable ending. Convulsions occur much more rarely in the course of measles than in scarlet fever, and when they occur after the initial period they usually end in coma and death.

Treatment.—Uncomplicated measles require no medicinal treatment except to palliate symptoms. The child should be kept in an airy apartment, at a uniform temperature of about 70°. A temperature so elevated as to be uncomfortable to the nurse is injurious to the patient. But while the popular idea is erroneous, that he should be kept in a heated atmosphere, it is correct that currents of air and sudden reduction of temperature are dangerous. A violent and fatal attack of croup occurred in my practice in a girl of fifteen, in consequence of exposure at an open window at the close of the eruptive stage. The diet should be mild, and for the

most part liquid. The patient, indeed, refuses solid food, but, on account of the thirst, takes liquids more readily. Farinaceous substances, with milk, afford sufficient nutriment in ordinary cases. If the previous health has been poor and the vital powers reduced, or if there is a complication, more sustaining diet is required. Stimulation by wine or brandy is needed in these cases. During the two or three weeks succeeding an attack of measles, care should be taken to avoid exposure to cold, or changes of temperature, since during this period there is great liability to inflammations of the mucous surfaces.

The cough ordinarily requires treatment, inasmuch as the suffering of the child and loss of sleep are largely due to this symptom. Demulcent drinks, as flaxseed tea, infusion of slippery-elm bark, or solution of gum Arabic, are useful, to which, to render them more palatable, lemon-juice may be added. A small Dover's powder, or the following mixture given occasionally, relieves the severity and diminishes the frequency of the cough:—

℞. Tinct. opii camphorat.,
Syr. scillæ,
Syr. ipecac., āā ℥ss;
Spts. æther. nitr., ℥ij. Misce.

Dose, one teaspoonful to a child of five years, repeated according to circumstances.

As the chief danger in measles is from inflammation of the respiratory organs, local treatment directed to the chest is important. The chest should be covered with oil silk, unless in the mildest cases. This increases the amount of eruption upon the surface underneath, and, I believe, tends greatly to prevent complication by bronchitis and pneumonia. If the eruption is tardy in its appearance, or indistinct, it is well to produce moderate counter-irritation by some gentle irritant underneath, as camphorated oil, to which one-third part of turpentine is added.

Affections which complicate measles should receive, for the most part, such treatment as is appropriate for them when idiopathic. Secondary diseases, however, require sustaining measures more than primary. In bronchial and pulmonary inflammations, which, if they occur early in measles, prevent the regular appearance of the eruption, or, if in the eruptive stage, cause its disappearance, prompt counter-irritation over the chest by sinapisms, or otherwise, is required. Trousseau states that he has derived benefit, in these cases, from what he designates urtication. This is produced by stroking the chest two or three times daily with the nettle (urtica dioica or urtica urens). This causes a prompt and abundant eruption, and with a less amount of suffering than one would suppose. The fever abates, and the respiration becomes more natural in proportion to the amount of nettlerash. On the second day the effect is less than on the first, and after three or four days, says Trousseau, no further irritation

results from the nettle. When counter-irritation is produced, by whatever method, the chest should be covered with a warm and soft poultice, as the ground flaxseed; derivatives to the extremities are useful in such cases. In capillary bronchitis and pneumonia stimulating expectorants are required, as carbonate of ammonia. The following I employ for a child of two to three years.

℞. Tinct. ipecac. comp.
(Squibb's liq. Dover's pulv.), gtt. viij–xvj.
Ammon. carbonat., gr. xvj–ʒss.
Syr. bal. tolut.,
Aquæ, āā ʒj. Misce.
One teaspoonful every 2 or 3 hours.

Quinia to reduce the fever, and digitalis as a heart tonic, are also very useful in these inflammations, given alone or alternately with the above.

The cases of gangrenous vulvitis alluded to above were treated with a flaxseed poultice, and iodoform dusted over the surface each day or second day, with a satisfactory result. As regards the treatment of other complications, the appropriate measures are detailed elsewhere.

CHAPTER II.

SCARLET FEVER.

The terms scarlet fever, scarlet rash, and scarlatina are identical. They are employed to designate one of the most frequent and fatal of the contagious diseases, a disease which may occur at any age, but is most common in childhood, an exanthem attended with more or less pharyngitis. In this city, on account of its great frequency, and its large percentage of fatal cases, it causes more deaths than any other contagious malady. Though not more common than measles, it is attended, with us, by more than double its mortality.

There is no disease that presents a greater difference, as regards character and severity of symptoms, than scarlet fever, and this has led to the recognition of different forms of it. Rilliet and Barthez describe two, the normal and abnormal: Meigs two, the mild and grave; and most other writers, three or more. I shall, for convenience, follow Bouchut, who makes three varieties, namely, the regular, irregular, and malignant.

Symptoms. *Regular Form.*—Scarlet fever usually begins abruptly. It is possible, often, to tell the exact time of its commencement. If there are any premonitory symptoms, they are ordinarily slight, so as scarcely to attract attention, amounting to little more than dulness, or the appearance of fatigue. In some the first symptom is chilliness, and occasionally

a distinct chill is experienced. This is the ordinary mode of commencement in the adult. With or without the chilliness, fever, usually intense, arises, accompanied by such symptoms as ordinarily occur in a febrile state of system, such as cephalalgia, perhaps delirium, anorexia, thirst. The pulse rises to 110, 120, or more, per minute; the skin is hot, face flushed, the eyes bright, and the temperature is 102° to 104°. In many, there is sudden starting or twitching, with a degree of stupor, showing that the cerebro-spinal system is profoundly affected.

In most cases there occurs within the first twenty-four hours a symptom which has considerable diagnostic value, namely, vomiting. In 117 cases in which I have recorded its presence or absence, it occurred in 90, usually not at the very commencement, but within the first twelve or eighteen hours. It commonly occurred before the appearance of the rash, but not always. In a few of the cases it is recorded as a symptom of the second day. Vomiting at this period is, probably, in most cases, sympathetic, due to the irritating effect of the scarlatinous virus on the brain. It is not a severe symptom, occurring in most patients but once or twice. Great and persistent irritability of stomach indicates a serious form of scarlet fever, and is, therefore, prognostic of an unfavorable ending. When this symptom is absent or slight, or there is merely nausea, I have found the case ordinarily mild, so that, as regards the frequency of vomiting, the statistics of different epidemics vary according to the mildness or gravity of the type. The bowels are regular or somewhat constipated in this form of scarlet fever, or, if diarrhœa occur, it is slight and transient.

When the symptoms described above have continued six to eighteen hours, the rash appears. It is first observed about the ears, neck, and shoulders, in reddish indistinct patches, fading into the normal hue. These patches extend and unite, and in the course of a few hours the trunk and upper extremities, and finally the legs, are covered. The scarlatinous rash bears considerable resemblance to that produced by external heat or the redness from a sinapism, but there are numerous minute points of a deeper or duskier red than the surface generally. On passing the finger over the eruption, no distinct prominences are observed, but a sensation of roughness is sometimes imparted from engorgement of the cutaneous papillæ. The rash disappears by pressure, but in robust children, and in favorable cases, it immediately returns when the pressure is removed. Slow return of the rash is evidence of sluggish circulation, and, when marked, it indicates the malignant form of the disease. The rash gives rise to an itching or burning sensation, which adds greatly to the discomfort of the patient. The degree of redness is not uniform over the surface, and sometimes, especially in mild cases, it is absent in places.

Early in the disease, even before the cutaneous eruption, the buccal and faucial mucous membrane presents a pretty general red appearance, and the papillæ of the tongue are elevated. Pharyngitis has already com-

menced, with more or less stomatitis and tonsillitis. The inflammation renders deglutition painful, so that difficulty is often experienced in giving the necessary drinks. This state of the buccal and faucial membrane continues through the disease. There is sometimes a slight fibrinous exudation over the tonsils; the tongue is covered with a moist fur, and the secretion from the follicles of the inflamed surface is increased and mucopurulent. The Schneiderian membrane also participates in the inflammation, and, as the disease advances, a thin, irritating discharge, containing pus-cells, flows from the nostrils.

The temperature in the first days of scarlet fever is ordinarily from 102° to 105°, in grave cases even 105° to 107°. The cutaneous transpiration during this period is nearly checked, so that the skin is hot and dry. The respiration is moderately accelerated, but not so as to attract attention, unless there is a complication; often there is slight cough from mucus in the throat or bronchial tubes. Bronchitis, common in measles, and giving rise to prominent symptoms in that disease, is either absent or slight in scarlet fever.

The symptoms pertaining to the digestive system during the initial period of scarlet fever have been sufficiently described. The subsequent symptoms do not differ materially in regular scarlet fever, except that there is no vomiting. The lips are dry and often cracked. The inflammation of the mouth and throat continues unabated, with anorexia and thirst. The urine is high-colored, and in robust children, during the first days of scarlet fever, it frequently deposits the urates on cooling.

The symptoms continue with undiminished intensity for a period of from four to six days, when the fever begins to abate, the pungent heat becomes less, and the rash fainter. There is a gradual decline of the disease, which, in its inception, was so abrupt. In mild, and even pretty severe cases, which pursue a regular and favorable course, convalescence commences by the close of the first or beginning of the second week. In the second week, the rash, becoming less and less distinct, finally disappears, as do also the redness and swelling of the buccal and faucial surfaces. The engorgement of the papillæ of the tongue and that of the tonsils subsides; the appetite returns; the countenance brightens and becomes natural, and the child who, during the height of the fever, scarcely noticed objects, or noticed them with indifference, or even repugnance, can be amused as before his sickness.

The period of desquamation succeeds. Exfoliation of the epidermis occurs over the whole body. This commences about the face and neck, and it occupies several days, during which there is progressive improvement in the condition of the child. Where the skin is thin, the epidermis, as it is detached, presents a furfuraceous appearance; where it is thick, as upon the palms of the hands and soles of the feet, it separates in a layer of considerable thickness.

Such is a brief account of scarlet fever, when it pursues its normal course, without complication or sequelæ. But there is no disease which has so many unfavorable complications and sequelæ as this. The liability to these accidents renders the prognosis in all cases doubtful, and in many instances they are the immediate cause of death. They occur both in mild and severe cases of scarlet fever.

The great difference in different cases of scarlet fever, as regards intensity of symptoms, is well known. It is sometimes so mild, its characteristic features so slight, that diagnosis is necessarily uncertain. Examples in corroboration of this statement are not infrequent. In the spring of 1866 I was called to an infant thirteen months old, who had slight pharyngitis, and an indistinct rash over a part of the surface. In two days the eruption had disappeared, and soon after the health was apparently fully restored. Diagnosis would have remained doubtful, except for sequelæ. In another instance, two children passed through the entire course of scarlet fever, playing every day in the street. Although the intelligent grandmother saw the rash upon them, its nature was not suspected till nearly two weeks afterwards, when one was taken with fatal nephritis and general anasarca. In cases so mild as these, the heat of surface is not greatly increased, nor is the pulse much accelerated. There is no restlessness, nor is the digestive function materially impaired. The rash does not have so deep a color, nor is it so continuous over the surface, as in cases of ordinary gravity. The patient begins to improve in from two to four days, and is soon well. So mild a form of scarlet fever is, however, quite exceptional, but there are all gradations, from this mildness to that malignant form which I shall presently describe.

There is usually considerable faucial inflammation, even when scarlet fever pursues a regular and favorable course. If the pharyngitis is intense and protracted, many writers designate the disease scarlatina anginosa. There is, in these cases, not only general and pretty severe inflammation of the mucous membrane of the fauces, with swelling of the tonsils, and submucous infiltration, but also more or less tumefaction around the angle of the jaw, due to extension of the inflammation to the lymphatic glands, and connective tissue of the neck. In these cases the suffering of the patient is greatly increased by the amount of local disease. The adenitis and cellulitis, unless slight, do not subside with the disappearance of the rash, or they subside more slowly. They render the febrile movement more protracted. The swelling due to these inflammations often continues one or two weeks after the disappearance of the rash, or even longer, when it disappears by resolution, or frequently by suppuration, the abscess opening externally.

Irregular Form.—The irregular form of scarlet fever is commonly due to some perturbating cause. This cause is often a pre-existing or coexisting disease, or, if not actual disease, at least disordered state of system. For

example, a little girl, in my practice, had the symptoms of scarlet fever, such as febrile movement and inflammation of the buccal and faucial surface, nearly a week before the scarlatinous eruption appeared. During this period there were symptoms of enteritis, which declined when the rash occurred. The abdominal affection was the apparent cause of the irregularity in the malady. If scarlet fever occur during an attack of entero-colitis, there is frequently no eruption. Most practitioners have met cases like the following, which I now recall to mind: In a family where scarlet fever was prevailing, a little child, early after the commencement of symptoms which seemed to be plainly referable to the exanthematic affection, was seized with vomiting and purging, and the latter continued two or perhaps three days, when death occurred. There were the symptoms and appearances of severe scarlet fever, but without the eruption. In another instance, an infant, in the warm months, having protracted entero-colitis, the usual summer epidemic of this city, was apparently affected with scarlet fever, which was present in the family. There were the characteristic symptoms, but the diarrhœa continued, and there was no rash.

In those that are much reduced by any antecedent disease, as phthisis, or that have a disease, chronic or acute, which produces a decided afflux of blood towards an internal organ, the eruption is commonly tardy in its appearance, indistinct, or wholly absent. The diseases which most frequently render scarlet fever irregular are those of an inflammatory nature. Some affections, occurring in connection with scarlet fever, do not change its symptoms, but themselves undergo modification. Scarlet fever occurring in a child having pertussis does not itself undergo any material change. The cough, not the fever, is sometimes modified during the coexistence of the two.

Scarlet fever may also be irregular in those that are robust and free from any other disease, assuming this form without any appreciable perturbating cause. In 1867 I attended a young lady, whose previous health was excellent, and whose brother was sick at the time with scarlet fever. This patient had considerable fever, with pretty severe pharyngitis, and, though her surface was repeatedly examined, no eruption could be discovered. Two weeks subsequently she became affected with severe nephritis, anasarca, effusion into at least one of the pleural cavities, and probably into the pericardium, the case ending fatally.

Rilliet and Barthez mention the irregular and incomplete character of the eruption in second attacks of scarlet fever, which, though uncommon, are met from time to time. Scarlet fever occurring a second time sometimes presents all the features of the regular disease and pursues its normal course, but it is much more apt to be incomplete and irregular than the first attack. It is more apt to be irregular if the interval between the two has been short than if several years have elapsed.

Malignant Form.—This form of scarlet fever is in some epidemics common, while in others it is rare. It usually commences with severe symptoms, those pertaining to the nervous system predominating, such as intense cephalalgia, with delirium. Many pass rapidly into coma and die within two or three days. They succumb to the virulence of the scarlatinous poison, while the disease is still in its commencement. The rash in malignant scarlet fever is dusky. It disappears by pressure, and returns slowly when the pressure is removed. There is, therefore, extreme sluggishness of the capillary circulation. In some there is great restlessness. If placed in one position on the bed they soon throw themselves, in a half-conscious or unconscious state, into another. They do not speak at all, or they mutter like those affected by the graver forms of typhus, calling the names of playmates, or talking about things which interested them when well. There is great elevation of temperature, the thermometer, placed in the axilla, rising above 103° to 105°, even to 107°, and the heat of surface is pungent, except when the case approaches a fatal termination. The pulse from the first is rapid, numbering from 130 to 160 per minute. Sometimes there is great heat of head and body, while the limbs are cool. This is an unfavorable sign.

Severe and dangerous nervous symptoms, as convulsions and coma, occur chiefly within the first three or four days. After this period the danger is mainly from exhaustion. Those who survive the onset of the disease, often have, in the course of a few days, severe pharyngitis, with inflammation of the lymphatic glands, and connective tissue around the angle of the jaw, accompanied by external swelling. The pharyngitis is attended by more or less secretion of mucus or muco-pus, which, sometimes collecting around the entrance of the larynx, causes noisy respiration, or even, if the system is greatly prostrated, embarrasses respiration by entering the larynx. The chief danger, however, from the pharyngitis, is due to the exhaustion which it causes. By rendering deglutition difficult, it interferes seriously with nutrition.

Complications.—Complications may occur in any form of scarlet fever, but they are most frequent in malignant or grave cases. The most common and serious complication, as regards the nervous system, is clonic convulsions. These occasionally occur at the commencement of the disease, before the appearance of the rash, and many then recover, but I have not seen, nor have I heard, in my intercourse with physicians, of any case which recovered when convulsions occurred after the complete development of the eruption. On the other hand, some of the physicians of this city, of largest experience, inform me that they consider convulsions during the eruptive stage an almost certain precursor of death. Convulsive attacks in scarlatina are probably due, in part, to congestion of the nervous centres, for we sometimes find, in young children, at the time of the seizure, and immediately before it, the anterior fontanelle pro-

minent, and forcibly pulsating. The convulsions uniformly increase the congestion, but, as the latter antedates the former, its causative relation seems to be established. But the most important element in the causation of convulsions in scarlet fever is, probably, the presence in the blood of the scarlatinous virus. This, whatever its exact nature, may, in my opinion, cause convulsions, with or without the co-operating influence of congestion, as urea gives rise to them in cases of uræmia. Convulsions occurring at the commencement of scarlet fever are usually single. If repeated, they become more serious. Convulsions after the appearance of the eruption, either end at once in coma, or they return at short intervals, with gradually increasing drowsiness, till coma supervenes.

The anginose affection in scarlet fever may be so severe, or assume such features, as to constitute a complication. It may become more serious than the primary disease itself, so as to require the chief treatment. Within the last few years diphtheria has so frequently complicated scarlet fever, that physicians have learned to make daily examinations of the fauces till convalescence is fully established. So common is this complication, that scarlet fever has been justly regarded as affording conditions which are especially favorable for the development of diphtheria. Diphtheria may begin early in scarlet fever, or not till the latter begins to decline, when it produces sudden aggravation of symptoms, and renders the case, which before was perhaps favorable, one of great gravity. As has been stated elsewhere, a pseudo-membranous formation upon the faucial surface, especially over the tonsils, is not uncommon in severe anginose scarlet fever, but is soft or pultaceous, in isolated points or patches, and easily detached. On the other hand, in the cases to which I have alluded, of diphtheritic complication, the pseudo-membrane is firm and thick, penetrating the mucous membrane so as to produce bleeding when forcibly detached, as in primary diphtheria. Besides affecting the fauces, the diphtheritic inflammation is very apt to attack the nostrils, causing swelling and exudation, so as often to embarrass respiration. This complication obviously greatly increases the severity of the case. It intensifies the febrile movement, and renders it more protracted. It produces or increases the adenitis and cellulitis around the angle of the jaw, causing within a few days, if unchecked, such tenderness and swelling of these parts as to render movements of the jaw and deglutition painful.

An occasional result of severe pharyngitis in scarlet fever is suppuration, or gangrene occurring in the subcutaneous connective tissue of the neck. Whether suppuration occur, and an abscess form, or gangrene result, this complication is often serious. Suppuration or gangrene indicates an intense grade of inflammation or a low vitality; but many with this complication recover through a protracted convalescence.

If suppuration is extensive, it may so increase the debility that death occurs in consequence. Gangrene is a more serious complication; unless

slight, it renders a fatal termination highly probable. The connective tissue, subcutaneous or intermuscular, is the part which primarily sloughs. The skin over the gangrene becomes brown or dark, and separates with the slough. In the majority of cases the slough is not large. Exceptionally it extends so deeply that, when it separates, the muscles and even vessels of the neck are laid bare, and the appearance is revolting. In a case of this sort, which I saw a few years since in the practice of another physician, the cavity, after the slough had separated, was irregular, and sufficiently large to admit a hen's egg. It extended a considerable distance out of sight under the skin, and finally opened a vessel from which fatal hemorrhage occurred.

Gangrene of the mouth also occurs in rare instances, either as a complication or sequel. I have met it in two cases, one of which recovered. In the fatal case it began while the patient was still under treatment for the fever, and was first discovered by the loss of two incisors. The one that recovered also lost two incisors, and a part of the superior maxillary bone. The one that died was scrofulous, but under good hygienic conditions; the other lived in a tenement-house, and was ill-cared for. Rilliet and Barthez relate three cases of gangrene of the mouth, occurring, however, not as a complication, but sequel, of scarlet fever. One of these patients had, within eighteen days, varioloid, scarlet fever, and measles; these diseases ending in fatal gangrene of the pharynx and cheek. The second child was taken, on the seventeenth day after the commencement of scarlet fever, with gangrene of the pharynx, succeeded by that of the cheek, and died on the twenty-fourth day. In the third case the gangrene was preceded by smallpox as well as scarlatina. Other observers have recorded similar cases.

Another complication, to which allusion has already been made, is entero-colitis. This may antedate the scarlet fever. In other cases, entero-colitis commences either with the scarlet fever, or during its course. Diarrhœa often occurs in connection with the vomiting, in the first hours of the fever; and it commonly ceases during the first or second day. Occasionally it continues with greater or less severity, when it constitutes a serious complication; it is in these cases due to intestinal inflammation. Bronchitis and pneumonia, so common in measles, do not often complicate scarlet fever.

A not infrequent complication is articular rheumatism, occurring when the fever begins to decline. Mild cases are more liable to it than those having a severe form. Attention is called to it by the complaint of the child of pain or tenderness in the affected joints; or, if he is too young to speak, by evidences of pain when the joints are pressed or moved. There are usually but little swelling and redness, and there are fewer joints affected than in most cases of acute primary rheumatism. In my practice, a common seat of scarlatinous rheumatism has been the areolar tissue of

the wrist. The inflammation and infiltration are less than in primary acute rheumatism. This complication is not, ordinarily, serious; nor does it, as a rule, materially retard convalescence. A physician of this city, however, informs me of two cases in which cardiac inflammation occurred in connection with the articular affection, as it so frequently does in idiopathic rheumatism. The urates are not so commonly present in the urine in scarlatinous as in ordinary acute rheumatism.

Serous inflammation, especially that affecting the peritoneum, pleura, or pericardium, is a common complication, independently of the rheumatic affection. It occurs during the desquamative period, and, continuing afterwards, becomes a sequel. Many such cases are fatal. Pericarditis may be with difficulty diagnosticated, if it is slight, and attended by only a moderate amount of effusion, and it is, doubtless, often the cause of death in those who die suddenly and unexpectedly during or soon after an attack of scarlet fever. The pleuritis is often suppurative (empyema), usually requiring thoracentesis for its cure, but recovery by ulceration is possible. Thus in 1865 I attended a little girl in a mild attack of the fever, and when the case was about being discharged, severe pleurisy began on the right side. The pleural cavity was soon half filled with liquid, and after a sickness of two months, this liquid, mainly pus, communicated with a bronchial tube, and was expectorated. She immediately recovered.

In the following case, the records of which are from my note-book, pericardial and peritoneal inflammation occurred as a complication of scarlet fever:—

Case.—April 7th, 1860, C——, girl, five years and ten months old, had measles two years, and whooping-cough one year ago. With the exception of a slight cough, she has since remained well, till the present sickness. Scarlatina commenced April 4th, and on the 5th the eruption appeared. Symptoms severe, but regular; pulse 158, full; surface hot, and covered with the eruption; delirium at night; stomach irritable; constipation. April 8th to 10th, symptoms about the same; no delirium, however; pulse varying from 124 to 153 per minute; a deposit of urates in the urine.

11*th*. To-day, for the first, has severe pain in the epigastrium, accompanied by tenderness on pressure, and moderate distension at this point. The symptoms otherwise are favorable, though pretty severe; pulse 140; respiration moderately accelerated, but the rhythm natural; respiratory murmur distinctly heard in all parts of the chest, vesicular in character, and without râles. Has taken till to-day mainly diaphoretic mixtures; to-day pulv. ipecac. comp., gr. iij, every three or four hours, is ordered; a flaxseed poultice to be applied to the epigastrium; diet nutritious, with moderate use of stimulants.

12*th*. Epigastric pain still severe; great tenderness on pressure; considerable distension at this point, and percussion elicits a dull sound; passed a restless night; when asked where she feels pain, she points to the throat and epigastric region; pulse 130 to 140 per minute; rash fading; surface warm; bowels somewhat relaxed; urine passed in usual quantity. The treatment by Dover's powder and poultices is continued, and a leech is to-day applied to the epigastrium.

13*th*. Pain less severe, but considerable tenderness on pressure; pulse about the same as yesterday; has had through her sickness a slight cough. She talks rationally, and sits much of the time in bed.

14*th*. Continued in the same state as described in yesterday's records, till 3 P.M. yesterday, when she became suddenly worse; her respiration was short and gasping; she spoke, with an effort, in a whisper, but continued conscious; and her pulse was strong. Death occurred at 5 P. M., apparently from obstructed respiration. In the last days of her sickness there was but little pharyngitis, and little or no external swelling.

Autopsy twenty-four hours after death.—Body a little emaciated; heart large for a child of five years; about one ounce of turbid serum in the pericardium; a soft deposit of lymph within the pericardial sac at the base of the heart around the origin of the great vessels, an evidence of recent circumscribed pericarditis; from four to eight ounces of transparent serum in each pleural cavity; no fibrin upon or opacity of the pleural surfaces; mucous membrane of bronchial tubes injected in streaks, and mucopus can be pressed from them; both lungs can be readily inflated, with the exception of small portions of both the lower lobes, which are hepatized, and can be but partially inflated; liver enlarged, presenting a congested appearance, and extending some four inches below the free border of the ribs; upon its convex surface in the epigastrium, corresponding with the seat of the pain, is a white, rough patch of fibrin, about one and a half inches in diameter; kidneys congested; stomach and small intestines apparently healthy; mesenteric glands moderately enlarged; mucous membrane of transverse and descending colon somewhat injected and thickened, showing mild colitis; no ulceration noticed; brain not examined.

Microscopic examination was made of the blood, hepatized portions of lung, etc., but nothing of special interest in this connection was observed.

This case is instructive as showing the liability which exists in and after scarlet fever to serous inflammations, and the difficulty of diagnosticating them in certain cases on account of their circumscribed character.

Sequelæ.—The complications described above *may* occur as sequelæ, but there is another pathological state which may be a complication, and is a common and serious sequel. I refer to nephritis with albuminuria. This occasionally commences in scarlet fever, but usually not till the disappearance of the rash. There is sometimes, during the course of scarlet fever, and even subsequently, slight albuminuria due to simple congestion of the kidneys, but the albuminuria to which I allude, and which requires treatment, is more serious. Its anatomical character is as follows: Hyperæmia, and perceptible increase in volume of the kidneys; proliferation of the renal epithelial cells like that of the epidermis, and a granular deposit in them; the escape of albumen from the engorged capillaries, and its appearance in the urine; the formation of hyaline or granular casts, or both, in the tubuli uriniferi, these casts often containing epithelial cells; the escape of the casts from the kidneys with the urine; diminution of amount of urea excreted, and, therefore, its accumulation in the blood;

and, finally, rupture of the engorged capillaries of the kidneys, and mingling of the elements of the blood with the urine.

The presence, therefore, of this renal affection can be readily ascertained by examining the urine. The quantity of albumen which this liquid contains can be approximately ascertained by adding nitric acid or applying heat. If the quantity is small, simple cloudiness is produced; if large, the urine becomes thick and white, and in extreme cases almost semi-solid from coagulation of the albumen. The character of the urine can, however, be more accurately ascertained by the microscope than by the tests which have been mentioned, since by it we discover the casts, altered epithelial cells, and blood-corpuscles.

Nephritis, with the consequent uræmia, soon gives rise to evident symptoms. Serous effusion takes place in consequence of the altered state of the blood, the most common form of which is anasarca, occurring upon the face and limbs, and sometimes in the connective tissue of the trunk. Often the effusion occurs only in the external connective tissue, and the result may then be favorable; but in other cases it occurs, and in the order mentioned as regards frequency, in the lungs (œdema pulmonum), serous cavities, and, lastly, in the submucous connective tissue of the larynx (œdema glottidis.) Obviously the danger in itself from this escape of serum depends on its location, but, whenever and wherever observed, it indicates the beginning of an unpleasant sequel, and the urine should be carefully examined, in order to ascertain the gravity of the renal disease, from the amount of albumen and casts.

Scarlatinous nephritis, with consequent uræmia, is due to the direct effect of the scarlatinous poison on the kidneys. I have known it occur in the nurse who attended a child through the fever, but did not suffer from the fever herself. It sometimes begins quite abruptly, and often when the patient has been progressively convalescing, and, perhaps, has seemed out of danger. In most cases, however, there are well-marked premonitory symptoms, as fever, restlessness, and loss of appetite. The anasarca is first observed in the face or about the ankles. Sometimes it remains inconsiderable, but in other cases it increases day by day, more or less rapidly, till the appearance of the patient is much altered. In marked cases of anasarca the features are so bloated that their natural expression is lost. The volume of the trunk and legs is augmented, and more slowly, that of the arms. In the male child the penis and scrotum frequently attain three or four times their normal dimensions, in consequence of serous infiltration.

The duration of the anasarca or dropsy is very different in different cases. If the form be œdema pulmonum, œdema glottidis, or intracranial effusion, death is speedy. It may occur even within a day. Hydrothorax and hydropericardium are also ordinarily fatal, though not so speedily; while in ascites the prognosis is much more favorable. The duration of

anasarca under the most favorable circumstances, unless it is very slight, is commonly not less than two or three weeks, and is often much longer. But the chief danger in a majority of these cases proceeds not from the dropsies, but from the poisonous effect of the retained urea on the nervous centres, so that in grave cases, nervous symptoms are common, as in Bright's disease of the adult. Headache, convulsions, and coma are apt to succeed the scanty flow of urine, and uræmic vomiting in fatal cases, even when the amount of serous effusion is moderate.

The liability to this renal malady is greatly increased, and in some cases is mainly attributable to the close relationship, as regards their functions, which exists between the skin and kidneys. A common exciting cause is exposure to vicissitudes of temperature or currents of air, by which the surface is chilled, and cutaneous transpiration checked, at the time when the old epidermis is being detached. The increased burden thrown upon the kidneys results in the pathological state which has been described. This remark does not conflict with the statement already made, that the nephritis is due to the direct effect of the scarlatinous principle on the kidneys, the disturbance of the function of the skin merely increasing the functional activity of these organs and rendering them more susceptible to the disease. All who have seen much of scarlet fever can recall to mind cases in which the patients had nearly recovered, when from some needless exposure in the streets, or by chilling of the body in a cold room, or open window, this affection occurred, with perhaps a fatal result. Elsewhere I have alluded to a case in which scarlet fever was only detected by this sequel, which began when the child was daily exposed in the open air. But many children who have been attended with the utmost care, and who, through the whole desquamative period, are kept in a uniform temperature, nevertheless become affected with albuminuria and dropsy, so that there is sufficient cause of this sequel in the state of the child and the nature of the disease through which he has passed, apart from extraneous influences. It is an interesting fact that albuminuria seems more apt to occur after mild than severe cases of scarlet fever, and observations appear to show that this difference in liability to nephritis is intrinsic; in other words, that it does not depend, as some have supposed, on a difference in the hygienic management of mild and severe scarlatina.

The *symptoms* in scarlatinous nephritis vary not only according to the degree of the inflammation, but also according to the amount and seat of the effusion. I have stated that it usually commences with languor and more or less fever. The pulse remains accelerated, the skin is hot and dry, and the appetite poor. This affection, if slight, may occur without appreciable effusion, either in the connective tissue or the cavities, but ordinarily in these mild cases a little puffiness is observed around the eyes or upon the extremities. In the majority of cases more extensive anasarca results. The skin is then pallid, distended, and pitting on pressure. The

anasarca does not, in most instances, give rise to any marked symptoms. If œdema glottidis or pulmonum occur, the respiration becomes rapidly more embarrassed, till soon the blood is no longer sufficiently oxygenated for the purposes of life. The chief symptom in hydrothorax is accelerated and difficult respiration; in hydropericardium the symptoms are such as arise from embarrassed action of the heart; in ascites there are either no marked symptoms, or, if the amount of liquid is large, there may be more or less embarrassment of respiration from compression of the lungs.

Otitis.—Too little attention has unquestionably been given to the state of the ear in scarlet fever, and yet the middle ear, lined like the nostrils and fauces by a mucous membrane, and in direct continuity with the fauces, through the Eustachian tube, is often the seat of an inflammation which, if neglected, involves serious ulterior consequences. This inflammation commonly commences, or becomes so pronounced as to cause symptoms, in the declining stage of scarlet fever, or during convalescence. The history of the patient is somewhat as follows: The scarlet fever has probably pursued a normal course; the naso-pharyngeal surface has been for some days inflamed, and the redness may be declining, when the child begins to complain of earache. The delicate mucous membrane lining the Eustachian tube and middle ear is injected and swollen, and the tube becomes impervious by the swelling, so that the tympanum is no longer an open, but a closed cavity. The serum, mucus, and pus produced from the inflamed tympanic surface, therefore, unable to flow away, collect, and by their presence and pressure cause the severe throbbing and aching which attend this disease. The effusion, at first largely serous, becomes more and more purulent, and, as the quantity increases, the drum is pressed outward, the mastoid cells become filled and tender to the touch, and often the collateral œdema causes tumefaction and narrowing of the external ear. After a variable time, perhaps two or three days, or not till after a week of suffering, the drum becomes thinner at one point from ulceration and bursts, and the imprisoned secretions escape into the external ear. If this terminated the history, it were well; but, unfortunately, while in a certain proportion of cases the aperture in the drum heals kindly, and the inflammation abates without impairment of hearing or permanent injury of the auditory apparatus, there is in a large proportion of cases a subsequent unpleasant history. The mucous membrane which lines the bony walls of the middle ear has the function of a periosteum, and, therefore, when intensely inflamed, and subject to pressure, is liable to ulcerate. As in other parts of the skeleton under similar conditions, superficial caries or necrosis of the underlying bone is apt to occur. The delicate chain of small bones stretching backward from the drum may be irreparably damaged, the aperture in the drum may be so large that it never heals, and the ossicles, becoming detached, may be lost in the discharge. Cases are not rare in which one ear has received this extent of injury, but fortu-

nately the hearing is seldom totally destroyed in both ears. I now recollect only one such case, although I have met many whose hearing was greatly impaired on both sides, indeed nearly lost. The carious or necrotic process may extend to the mastoid cells. An offensive otorrhœa continuing for months or years indicates the persistence of the inflammatory process within the ear, which is often rendered so obstinate by the presence of dead bone.

But a more melancholy result is yet in store for certain cases. The tympanum is, in a certain part of its extent, separated from the meninges of the brain by only a thin layer of bone. The otorrhœa, after months or years, suddenly ceases, the child complains of constant severe headache, and is feverish, and in a few days death closes the scene in convulsions or coma. Fatal meningitis has supervened, produced by extension of inflammation from the bony wall of the tympanum. Strumous children are more liable than others to these serious sequelæ of scarlet fever, which originate in or proceed from the internal ear.

Anatomical Characters.—There is some difficulty in determining what are the anatomical characters of scarlet fever, since so many who die of this disease have a complication, and the lesions of this are superadded to those of the fever. The following, however, are the facts which have been ascertained in reference to this point. In many the brain, its membranes, and the lungs are congested; often, also, the Peyerian, solitary, and mesenteric glands are enlarged, and the spleen enlarged and softened. The liver and kidneys do not present any notable alteration, though the latter are so often affected during the period of convalescence. Dr. Samuel Fenwick (London *Lancet*, July 23d, 1864) has made post-mortem examinations in sixteen cases of scarlet fever, and concludes from them that there is inflammation of the mucous membrane of the stomach and intestines like that of the skin, and that there is desquamation of the epithelial cells from those portions of the digestive tube like that of the epidermis. I have had opportunity of examining the stomach and intestines in a few instances in those who died in the eruptive stage, in the Nursery and Child's Hospital, and did not find any ususual hyperæmia of the gastro-intestinal surface, unless when gastro-intestinal inflammation had occurred as a complication. In malignant cases, in which the cardiac systole is feeble in the last hours of life, ante-mortem coagulation of fibrin frequently occurs in the cavities of the heart, obstructing the circulation, and being the immediate cause of death. These clots are large and whitish, or yellowish-white.

Nature.—Scarlet fever presents in a marked degree the distinguishing features of the infectious maladies. It is highly contagious, and is inoculable. Stoll, d'Amboise, and others successfully inoculated with the scarlatinous virus, using the blood, but without diminishing the intensity of the disease. Whether scarlatina ever originates spontaneously is un-

certain; but if it do so, such cases are rare. It is disseminated by exposure to patients or to fomites, but the distance to which it is contagious is short, probably not more than two or three yards. Some consider the distance to be even less than one yard. Knowledge of this fact is important, as by isolating in a family a child attacked by scarlet fever, and allowing no communication with the nurse, the other children often escape. A very common mode of communication is by clothing, so that a third person is the medium of transmission. I have noticed that when scarlet fever, as well as measles, is epidemic in this city, a large proportion of the cases, nearly all, indeed, of the first cases, can be traced to the public schools. Exposure occurs through those children who come from apartments where cases are under treatment. Physicians, and especially nurses, are sometimes the medium of communication. A medical friend of mine went directly from some children with scarlet fever, whom he was attending, to another family, where he took a little girl upon his knee. This girl in a few days became affected with scarlet fever and died. The two remaining children in the family were then attacked, and one died. Murchison alludes to similar cases (London *Lancet*, August 13, 1864). In one instance in my practice scarlet fever was communicated to an infant by a washerwoman whose own child had the disease, and who, on reaching the house where she had been engaged to work, threw her shawl over the cradle where the infant was sleeping. Six days later the infant was attacked. Mason Good cites a case in which a box of toys was the medium of communication; and it is said that even a letter has been. The scarlatinous virus may remain for weeks and even months in apartments, clothing, or in or upon the person of one who has been affected, without any appreciable diminution in its effectiveness. A physician of this city, in whose family scarlet fever occurred, excluded a child from the room occupied by the patients, and from the patients themselves, for a month after the last case occurred, and yet, although precautions had been taken in reference to clothes and bedding, this child was taken with scarlet fever soon after it was allowed to mingle with the other children. The father believes that the exposure was through the otorrhœa of one of the children. Observations, indeed, appear fully to establish the fact that the discharge from the ear or nostrils, and the particles of epidermis which have exfoliated, may retain the virus and be the medium of communicating the malady several weeks after the fever has terminated. In a case in my practice a little girl returned home six weeks after her brother had scarlet fever, and, within a few days, took the disease. A more striking example occurred in the practice of Dr. Kearney Rogers, formerly a prominent and much-esteemed surgeon of this city, and was related to me by an intelligent friend of the family since the doctor's death. Six children in a family had scarlet fever. Three and a half months subsequently another child, living at a distance, was allowed to visit them in

the apartments where they had been sick. One week from that day this child also sickened with the same malady. Dr. Elliotson states that a patient with scarlet fever was admitted into one of the wards of St. Thomas's Hospital, and, for two years subsequently, young persons who were admitted into this ward were apt to take the disease. Dr. Richardson relates the case of a family of four children, residing in the country. One died of malignant scarlet fever, and the rest, who had been removed, escaped. Some weeks subsequently one of the children returned, but within twenty-four hours took scarlet fever and died. The cottage was now thoroughly cleaned, whitewashed, and the clothing destroyed. Four months then elapsed, when the third child returned home, who also took scarlet fever in a malignant form and died. It was believed that the virus remained attached to the thatch, which extended close to the children's bed. Other similar examples might be mentioned, sufficient to establish the fact of the great permanence of the scarlatinous virus.

The period of incubation in scarlet fever varies. It is seen in the remarkable example of contagion, given above, that it was only twenty-four hours. Trousseau also relates an interesting example of short incubation. "An English gentleman with his daughter was returning from Pau to London, and was joined at Paris by another daughter, who came direct from London. Scarlet fever was prevalent in London, but there was not a case of it at Pau. The second daughter was seized with scarlet fever in crossing the Channel, and joined her relatives in Paris seven or eight hours later. She occupied the same room in the hotel as her sister, who was also attacked within twenty-four hours." The incubative period is, however, seldom so short. It is usually from three to eight days. I might cite several cases in which this was its duration. Some writers allude to cases in which two, three, or even four weeks elapsed from the time of exposure to the appearance of the disease. It is, however, a question whether in such cases there may not have been a second and more recent exposure. Rostan alludes to cases in which scarlet fever was communicated by inoculation, and in which the period of incubation was seven days.

Scarlet fever occurs most frequently between the ages of three and ten years. It is infrequent under the age of one year, and infants under the age of three months may be considered safe from an attack of it, though fully exposed. Cases have been reported of scarlet fever occurring in the fœtus, and manifesting itself by the usual signs at birth. But a clear diagnosis in such instances is necessarily difficult, on account of the character of the scarlatinous eruption on the one hand, and the nature of the cutaneous circulation in the newly born on the other. It is probable that, in the cases alluded to, there was an error of diagnosis. Certainly in two instances I have known women immediately after their confinement (within a week) take scarlet fever, and although they communicated the disease to others, did not to their infants. Murchison states that twice he

has known women with scarlet fever to be confined, and in both instances the infants were healthy.

Most adults possess immunity from scarlet fever, although not ptotected by an attack of it in childhood. Parturient women, however, are liable to it, and there is considerable danger that the physicians who attend them, if at the same time visiting cases of scarlet fever, may communicate it to them.

Scarlet fever is sometimes sporadic, but, as we meet it in this country, it occurs most frequently as an epidemic. The epidemics vary greatly in type. Some are mild, and attended by few complications, so that the result of treatment is eminently satisfactory. In other epidemics the type is malignant, the complications frequent, and the percentage of deaths large. There is sometimes a succession of epidemics of one type, and then the character of the disease changes. This fact of a variable type is important as regards the value of statistics relating to treatment. Each epidemic has its prevailing character, but when the form is mild, there is now and then a case of severity, and when it is malignant, now and then one of unusual mildness. The epidemic influence is sometimes manifested in those exposed to scarlet fever by the occurrence of pharyngitis, and, as we have seen, nephritis. Professor George B. Wood, of Philadelphia, says (*Treatise on the Practice of Med.*): "I seldom attend cases of scarlet fever without having sore throat."

Scarlatina usually occurs but once in the same individual, but a second attack after the lapse of several years is not uncommon, and there are even cases of a third attack, one of which I have witnessed. But physicians sometimes mistake roseola or erythema for scarlet fever, and, though afterwards aware of their mistake, do not correct their diagnosis. Hence there is a belief in community that second attacks are more frequent than they really are.

Diagnosis.—In the commencement of scarlet fever, prior to the eruption, there are no symptoms or appearances which will enable us to make a positive diagnosis. Positive statement in reference to the nature of the disease might better be deferred, for the credit of the physician. Still, if a child with regular bowels, and no appreciable local disease, a few days after exposure to scarlet fever, is suddenly seized with intense fever, the pulse rising to 110, 120, or more, and the temperature to 102°, 103°, or 105°, there is little doubt that the disease is scarlet fever. The diagnosis is rendered more certain if there is vomiting, and especially if, as is usual, there is redness of the fauces at this early period,

When the eruption has appeared, the nature of the malady is, in most cases, apparent. Still, roseola or erythema, due to intestinal derangement or other causes, has often, as already stated, been mistaken for scarlet fever. A day or two suffices to show the error. In scarlet fever there is more inflammation of the faucial and buccal surface, more continuous and

persistent redness of the skin, and greater intensity and persistence of symptoms, than in those diseases. Scarlet fever is also further distinguished from them by the papular elevations upon the tongue, and the minute papulæ upon the skin. Besides, in scarlet fever, except in the mildest cases, there is from the first the aspect of serious sickness, which roseola and erythema do not present.

Scarlet fever and measles were long considered identical by the profession, and, though the ordinary forms of the two diseases can be readily distinguished from each other, there are instances in which the differential diagnosis is attended by some difficulty. Measles occurring in a robust child, with an active cutaneous circulation, sometimes presents a continuous eruption over a considerable part of the surface, like the eruption of scarlet fever. But the longer period of invasion, the coryza and bronchitis, and the absence or slight degree of pharyngitis, in connection with other symptoms, enable us to distinguish these cases from scarlatina. Moreover, in those cases of measles in which there is continuous redness of surface where the circulation is most active, as upon the face, the characteristic rubeolous eruption is present in other parts, so that, with care in examination, error of diagnosis may be avoided. Scarlet fever and measles may indeed occur together, but such a complication is rare.

The greatest difficulty of diagnosis occurs in abnormal scarlatina, especially when the rash is partial and indistinct. There is apt to be, in this form of the disease, an inflammatory complication, which causes withdrawal of blood from the surface, and it is sometimes very puzzling to decide whether this is a complication, or the sole disease. The points involved in diagnosis are numerous, but they are sometimes not sufficient to show the character of the affection. Generally, however, by observing the clinical history from day to day, the diagnosis is established. In cases of doubt it is safest to adopt such hygienic management as is appropriate to scarlet fever.

Prognosis.—The prognosis depends on the form of the disease, whether mild or severe, the presence or absence of complications, and the strength of the patient. The mortality varies greatly in different epidemics, in those of a mild form, not being more than one in twelve or twenty, and the ratio may be less; while, in those of a severe form, not more than one recovers in every two, three, or four. The hospital statistics of Rilliet and Barthez show forty-six deaths in eighty-seven cases, while in some of the mild epidemics in the New York institutions the mortality has not been more than one or two per cent. Scarlet fever, like measles, is liable to sudden changes, either from complications which may arise or other causes, so that a case which gives a favorable promise in its commencement may, in a few days, present alarming symptoms. While, in measles, death nearly always occurs from a complication, in scarlet fever not a few perish from the direct toxic effect of the scarlatinous poison, and not a few also from complications or sequelæ.

If the symptoms are mild, the temperature not exceeding 104°, with little or no delirium or drowsiness, and the efflorescence full, and appearing at the usual time, we may confidently predict recovery. Nevertheless, nephritis, which is one of the gravest sequelæ, is so apt to occur after the mildest cases, that families should always be warned of the danger, that they may avoid needless exposure at the time of the decline of the fever and during desquamation.

The symptoms which indicate an unfavorable ending are convulsions, except at the very commencement, great drowsiness with jactitation, a temperature exceeding 104° and especially 105°, rapid pulse, duskiness of the eruptions, feeble capillary circulation, persistent vomiting, and diarrhœa. At a later period, particularly at the close of the first or in the second week, other unfavorable symptoms may occur in severe cases. The inflammation of the fauces is often so violent that it extends to the neighboring glands and connective tissue, producing severe adenitis and cellulitis. These inflammations, in proportion to their severity, increase and protract the fever, interfere with the proper use of nutriment, and, as they are apt to end in suppuration and sometimes in sloughing, they retard convalescence, and render recovery more doubtful.

As dangerous complications and sequelæ, such as have been enumerated above, are liable to occur suddenly and unexpectedly in mild as well as severe cases, it is unwise to make an unconditional favorable prognosis till the patient is well advanced in convalescence. Safety is not insured till two or three weeks after the eruption.

Some patients, who have passed through scarlet fever, die of asthenia, in consequence of the anæmic state which the fever has produced. They have not sufficient vigor to recover, although no serious complication or sequel has occurred. Death in the desquamative stage or subsequently is more frequently due to the renal affection than to any other cause. The nephritis gives rise to dropsies, which are fatal, or to uræmic convulsions and coma. Sudden and unexpected deaths are not uncommon in scarlet fever, and although they may, sometimes, occur from uræmia, their usual immediate cause, as others and myself have had the opportunity to observe in the cadaver, is the formation of ante-mortem heart-clots.

Treatment.—It should be borne in mind that scarlet fever cannot be shortened or aborted, and that the indications are to sustain the strength, reduce excessive fever, and prevent complications. There is no known remedy which destroys the poison, when once it has obtained lodgment in the system, and begun to produce its characteristic symptoms. Those agents, as carbolic acid, salicylic acid, etc., which are most highly esteemed, as disinfectants, cannot be safely used in efficient doses to antagonize the poison in the system, since such doses would seriously impair the nutrition and molecular action in the tissues. The expectations raised in the minds of many, by the employment of salicylic acid, in the treatment both of scarlet fever and diphtheria, have been disappointed, and the use

of the sulpho-carbolates has not, I think, been attended by any better success.

The following is the plan of treatment which can be confidently recommended as appropriate in ordinary cases: The patient should remain in the same room till desquamation is accomplished, and he should stay in bed till the fever and the eruption have ceased. The temperature of the room during the eruptive and febrile stage should be about 60°; during the desquamative stage, when the patient may be allowed to leave the bed for some hours, the temperature of the room should be uniformly at 70° to 75°, and the air should be constantly pure from sufficient ventilation, without exposing the patient to currents. The linen should be changed every day or second day.

The external treatment of scarlet fever by measures designed to abstract heat is important. A temperature not exceeding 103° is usually safe, so as not to require special treatment, but a temperature at or above 104° rapidly exhausts the strength and involves great danger. The high temperature can be reduced without shock or injury to the child by the judicious use of cold water externally, and by inunctions. The cold-water treatment is not required unless the temperature exceeds 103°, and it is urgently required if it exceed 105°. It has been applied in different ways. At one time in the N. Y. Foundling Asylum the patients were stripped, and placed for a short time in a bath at 80°, but it caused such fright and excitement with a portion at least of the cases, that this treatment was discontinued. A preferable way of applying this treatment is by Ziemssen's bath, in which water is employed at a temperature of 90°, and gradually cooled to 77°. In most cases, however, I prefer to reduce the temperature by the constant application to the head of cloths wrung out of cold water, or of a bladder containing ice, around which are placed two or three thicknesses of muslin or one of flannel, which will insure the proper degree of cold. At the same time the hands and arms should be bathed every few minutes with cool water, to which alcohol may be added.[1]

Trousseau employed cold effusions in sthenic cases, which were attended by high temperature, and other grave symptoms. He employed them in the first stage of the malady, and considered them especially useful when nervous symptoms predominated. He placed the patient naked in a bathing-tub, and directed three or four pailfuls of water to be thrown over him in a space of time varying from a quarter of a minute to one minute, after which he was returned to the bed, and covered with the bedclothes without being wiped. Reaction immediately occurred, often with more or less perspiration. This treatment was repeated once or twice daily according

[1] The intelligent and observing sister, who for years has had charge of the quarantine wards of the N. Y. Foundling Asylum, tells me that sponging has uniformly operated better than the bath, the gradual, but continued abstraction of heat, better than the quick and great abstraction.

to the gravity of the symptoms. Trousseau, alluding to the affusion, says, "I have never administered it without deriving some benefit." I am sure, however, that the cautious physician, who wishes to avoid measures which excite and frighten the patient will prefer Ziemssen's bath or frequent sponging of the face and arms, with cold applications to the head, especially when aided by inunction of the body and extremities now to be described.

Frequent inunction of the surface in scarlet fever has long been in use. An unpleasant symptom in severe cases, and one which increases the restlessness of the patient, is the pungent heat of surface. Frequent inunction reduces this, relieving the dryness of the skin, and so increasing the comfort that the patient asks for it. Leaf lard answers for this purpose, and being inexpensive, is within the means of the most destitute family. I prefer using the butter of cocoa in cake, or the vaseline to each ounce of which five or six drops of carbolic acid may be added. Not only does inunction have the local effect which has been described, but it is stated to diminish sensibly the rapidity of the pulse, and the general temperature of the body.

Scarlet fever when mild, and without complication, requires little treatment, but every case, however mild, should be kept quietly in bed. If there is restlessness, an occasional dose of bromide of potassium with a warm mustard foot-bath will give relief, and this with the inunction would suffice for most of those lightly affected. There is, however, in all cases more or less pharyngitis, and as mild cases as well as severe may become complicated with diphtheria in localities where diphtheria is endemic or epidemic, I employ the following mixture even in the mildest cases :—

℞. Tinc. ferri chloridi, ʒij ;
Potas. chlorat., ʒij ;
Syr. simplic., ℥iv.

Give one teaspoonful every hour or every second hour, to a child of four or five years. The mildest cases are not less liable to nephritis than those of a severe type, so that during the disease, and in convalescence, they require cautious management as regards exposure to currents of air, or sudden changes of temperature, for all those agencies which check cutaneous transpiration, may lead to development of nephritis.

In the average cases, that is, in those in which the temperature is about 102° or 103°, and there are no dangerous symptoms, I prescribe the above potash and iron mixture, to be given as above, except that on each fourth or sixth hour I administer quinine, dissolved in the elixir adjuvans, or other convenient vehicle, two grains to a child of four or five years. If the pharyngitis begins to abate, or is mild, I often prescribe the following mixture in place of the iron and potash. In all cases it will be found useful during the declining period.

℞. Ammon. carbonat.,
Ferri et ammon. citrat., āā ʒss;
Syr. simplic., ʒiv. Misce.
Dose, one to two teaspoonfuls every second or third hour.

In severe cases, in which the pulse is quick and weak, the temperature above 104°, the capillary circulation languid, the stomach irritable, and perhaps the bowels loose, while the nervous system is profoundly affected, as shown by drowsiness, delirium, or great restlessness, the condition is one of great danger, and measures designed to give relief are urgently required. As a temperature above 104° and especially above 105° rapidly exhausts the system, the antipyretic treatment by water, recommended above, should be employed, and the anti-pyretic dose of quinine prescribed. Aconite and veratrum viride should never be employed in these cases, as they are depressing. Digitalis is preferable to them, but it is less antipyretic than quinine. Five grains of quinine may be given three times daily to one of five years. If the stomach is irritable, and it often is in these cases, ten to fifteen grains may be given in a clyster, and repeated after twelve hours. While all but the mildest cases require the use at regular intervals of alcohol, either in the form of wine whey or milk punch, these severe cases, which are designated malignant, require alcoholic stimulants in larger and more frequent doses. If the nervous system is profoundly affected, so as to produce great restlessness, or other symptoms precursory of convulsions, the use of the bromide of potassium is indicated. While cool water may be employed externally for its antipyretic effect, it is proper to aid in allaying the nervous symptoms, by a hot mustard foot-bath. If convulsions occur, which are usually attended by the disappearance of the eruption, this bath should be employed at once, or a general warm bath.

The large antipyretic doses of quinine should in general only be employed for two or three days, as its longer use might involve danger from its toxic properties. Afterwards the smaller dose should be given. Digitalis will often be found useful, as a heart tonic, when the pulse is rapid and weak. One teaspoonful of the infusion, or four or five drops of the tincture, may be given every four hours to a child of five years. In these grave cases, which are characterized by great elevation of temperature, rapid pulse, and prostration, carbonate of ammonia will also be found useful, administered in decided doses, between the quinine or digitalis. I prescribe it dissolved in water, so that each teaspoonful contains from three to five grains, and direct it to be given in milk, which is the best vehicle for it.

If the patient with malignant scarlet fever live till the fifth or sixth day, the urgent neuropathic symptoms begin to abate, and the angina then commonly demands more attention. The treatment of the throat has of late years become very important, since so many cases are nowadays

complicated with diphtheria. For external treatment I prefer the compress wrung out of cool water, and applied from ear to ear, during the first three or four days, if the case is severe, and there is much elevation of temperature. If the fever be mild, camphorated oil or a light flaxseed poultice is preferable. The poultice appears sometimes to give more relief to the tenderness than any other application; in the declining period it is preferable for most patients if any application be needed. I do not, however, consider external treatment of the neck important, and I limit its use to those cases in which the pharyngitis is most pronounced. The treatment of the faucial surface is of more importance, and for this I prefer the use of the hand atomizer. This should be used every two to four hours, and if the instrument be well constructed, as Richardson's hard-rubber, or Delano's metallic, and in good condition, six to twelve compressions of the bulb are sufficient, if the following mixture be used:—

℞. Acid. carbolic., gtt. xxxij;
Potas. chlorat., ʒiij;
Glycerinæ, ℥iij;
Aquæ, ℥v. Misce.

This spray should be employed at least every two hours, if any exudation adhere to the inflamed surface. For infants I dilute the mixture with an equal quantity of water.

The muco-purulent discharge from the nostrils in connection with the pharyngeal swelling often so impedes respiration, that it proves annoying to the patient and increases his suffering. For this, warm water, with about one-two-hundredths part of carbolic acid should be injected into the nostrils; or, which I prefer, thrown into the nostrils in the form of spray by the atomizer. Richardson's and some others have a cap or point designed for the nostrils. The atomizer employed for the fauces is very effectual in removing the muco-pus, which often renders the respiration noisy and embarrassed in severe cases, for it dilutes the secretion and provokes a strong cough.

The abscess along the neck, which often results from severe adenitis and cellulitis, should be punctured early, since it is painful, causes protraction of the fever, loss of strength, and restlessness, and, as it is apt to be diffused, endangers absorption of the elements of pus.

The renal affection is often more dangerous than the scarlet fever. A clear appreciation of its therapeutic indications is important, since by judicious treatment many recover whose lives would inevitably be sacrificed by improper measures. As there is in these cases active hyperæmia of the kidneys, having an inflammatory character, diuretics which stimulate these organs should not be given, at least till this pathological state has, in a measure, abated. As the eliminative functions of the skin and of the intestinal mucous surface are to a considerable extent vicarious with that of the kidneys, diaphoretic and purgative remedies are required. By

free diaphoresis the ill effect of arrested or diminished renal secretion is, for a time, averted. Treatment to produce diaphoresis should vary somewhat in different cases. It should in most patients be commenced by the use of a warm general or foot-bath, and the patient then be covered in bed. If free perspiration is not produced, it may be promoted by surrounding the body, either with hot dry or moist air. Hot dry air may be produced by burning alcohol in a thin layer upon a plate under a chair upon which the patient sits, while he is surrounded by a blanket, or he may be covered in bed, and the hot air introduced under the bedclothes by a common small sheet-iron pipe, the further extremity of which resting on the floor contains an alcohol lamp. Hot moist air may be produced by placing against the patient one or more bottles of hot water, surrounded by a wet cloth. The steam arising from this, and enveloping the body and limbs, produces a prompt sudorific effect. There is in use in this city, in the treatment of these and similar cases requiring diaphoresis, a convenient apparatus for generating steam. It consists of a cylinder pierced with holes for the admission of air, and containing a spirit-lamp over which is a pan or pail holding a little water. The patient, nearly denuded, is placed in a chair, with the apparatus by his side, and is covered with a blanket so that the steam surrounds the body. This gives rise to free perspiration, which continues after the patient is placed in bed. This treatment may be repeated each day, if the patient require it, while diaphoretics and laxatives are given. The diaphoretics which are most serviceable in this affection are the acetates of ammonia and potassa, the bitartrate and citrate of potassa, and spiritus ætheris nitrosi. These agents used singly or variously combined, increase the diaphoretic effect, if used in connection with the external measures described above, which are calculated to produce diaphoresis. If employed with the surface cool, they act rather as diuretics than diaphoretics.

Diuretics, which do not stimulate the kidneys, are proper at an early period of the renal malady, and in my opinion digitalis is more useful than any other internal remedy. I do not hesitate to administer it from the first day, often in combination with acetate of potash, which in addition to a diaphoretic and diuretic has a laxative action. Digitalis has the confidence of the profession of New York more than any other medicine, both for the nephritis of children and of adults. One teaspoonful of the infusion should be given every fourth hour to a child of three to five years. The following is a good formula for a child of five years in good general condition :—

℞. Potas. acetat., ℥ss ;
Infus. digital., ℥vj. Misce.

For the older robust children with scarlatinous uræmia and serous effusions no medicines afford so much relief in the commencement as cathartics of a hydragogue nature. A mixture of jalap and cream of tartar, pulvis

jalapæ compositus of the Pharmacopœia, meets the indication. Even in children somewhat reduced medicines of this nature are often required. Cathartics are more certain in their effects than either diaphoretics or diuretics, and, therefore, they should be given in urgent cases in which it is necessary to remove the urea or serum as speedily as possible. An excellent prescription in many of these cases, and one from which I have obtained a good result, is the following:—

℞. Podophyllin, gr. j;
Sacch. alb., ℈j. Misce.
Divid. in chart. No. viii-xii.
Dose, one powder, according to circumstances.

After the use of laxative agents, the kidneys, being less congested on account of the diversion that has occurred, often begin to excrete more freely. But if the patient be at all anæmic, or enfeebled, and the symptoms are not urgent, cathartic or other depressing remedy is inadmissible. Cases like the following, from my note-book, are not infrequent. A little boy, pale and scrofulous, began to have anasarca, after scarlet fever, chiefly of the scrotum, and accompanied by a moderate degree of ascites. The urine, which was passed in nearly the normal quantity, contained albumen. This patient gradually and fully recovered, with no treatment except the use of an oil-silk jacket over the kidneys and abdomen, to promote diaphoresis, and the use of iron. Such a case actively treated by eliminatives would, probably, have proved fatal. Variation in measures is therefore demanded, according to the state of the patients, but digitalis, being a heart tonic, is very useful in the asthenic as well as sthenic cases.

It is evident from what has been stated above that the condition of the ear should be closely observed in and after scarlet fever. If the patient have earache, considerable relief may be obtained in the commencement by dropping a few drops of laudanum and sweet oil into the ear, and covering the ear by some hot application, either dry or moist, which will retain the heat. A favorite popular remedy in the tenement houses of New York, is a bag of dry and hot chamomile flowers, bound over the ears. Hot water syringed into the ear is also beneficial, and sometimes one or two leeches applied close to the ear aid materially in checking the inflammation in the first day or two. In most cases, however, the otitis continues, and the drum of the ear should be inspected daily.

Dr. Albert H. Buck, of New York, in a highly instructive paper on this subject, read before the International Medical Congress in 1876, writes: "This is the time when paracentesis of the membrana tympani produces such beneficial effects. In this one slight operation, which in itself is neither dangerous nor very painful, lies the power to prevent the whole train of disagreeable and dangerous symptoms." Dr. Buck relates an instructive example. The age of the patient was three years, and the earache had been complained of only about twenty-four hours. "Towards

morning," says he, "I was sent for, as the pain had become constant. . . . An examination with the speculum and reflected light, showed an œdematous and bulging membrana tympani (posterior half), the neighboring parts being very red, though as yet but little swollen. In the most prominent portion of the membrane I made an incision, scarcely three millimetres (one-tenth inch) in length, and involving simply the different layers of the membrana tympani. This was almost immediately followed by a watery discharge (without the aid of inflation), which ran down over the child's cheek. At the end of three or four minutes the child had ceased crying, and in less than a quarter of an hour she was fast asleep. At first the discharge was very abundant and mainly watery in character, but it steadily diminished in quantity, and became thicker, till finally on the fourth day it ceased altogether. On the tenth day the most careful examination of the ear could not detect any trace of either the inflammation or the artificial opening." This simple operation had probably saved the ear from ulceration of the drum, long-continued suppurative otitis, and perhaps from permanent impairment of hearing. It is evident that the operation should be performed early, before the ear is irreparably injured.[1]

But if the otitis have continued unchecked by treatment till the pent-up secretions, after days and nights of suffering, have escaped by ulceration through the drum, the opportunity for prompt and certain cure is passed. Still the patient under these circumstances may quickly recover, or there may be the other alternative described above, in which the ear is badly damaged, and a chronic inflammation established in the walls of the tympanum, giving rise to an offensive otorrhœa. Under such conditions, the same internal treatment is indicated, which we make use of in suppurative

[1] Dr. O. D. Pomeroy, an experienced and skilful aurist of New York, has kindly furnished the following particulars in reference to this operation. "The forehead mirror should be worn in order to leave the hands free to operate, using either artificial or daylight. A good-sized speculum is introduced into the meatus. Then an ordinary broad needle, about one line in diameter, with a shank of about two inches, such as oculists use, for puncturing the cornea, should be held between the thumb and fingers, lightly pressed, so as not to dull delicate tactile sensibility. The part being well under sight, the most bulging portion of the membrane should be lightly and quickly punctured, with a very slight amount of force. The posterior and superior portion of the membrane is most likely to bulge. The chorda tympani nerve ordinarily lies too high up to be wounded. The ossicles are avoided by selecting a posterior portion of the membrane. After puncture the ear should be inflated by an air-bag, whose nozzle is inserted into a nostril, both nostrils being closed, so as to force the fluid from the tympanum. The puncture may need to be repeated, at intervals of a day or two, provided that the pain and bulging return. In my opinion paracentesis may frequently be rendered unnecessary by the timely use of one or two leeches applied to the meatus. Leeching employed at the right time rarely fails to subdue the pain and inflammation.

"New York, Dec. 13, 1878."

"The leech should be applied at the base of the tragus, either internally or externally." Mittendorf.

inflammations of bone in other parts of the system. The internal use of cod-liver oil and iodide of iron is indicated, especially in such cases as occur in those who seem to have the strumous diathesis, the object being to prevent extension of inflammation, and to produce a more healthy state of system, which will facilitate the healing process. The following, or some equivalent carbolized solution should be syringed from one to three times daily into the ear. It should be used warm with an ear syringe:—

℞. Acid. carbolic., ʒss;
Glycerinæ, ℥ij;
Aquæ, ℥iv. Misce.

We have stated above that during convalescence precautions should be taken to prevent the patient's catching cold, so as to diminish the liability to the sequelæ, which have now been described. He should not be allowed to go in the open air in unpropitious weather till a month after the fever. An oil-silk protection, worn over the under-clothes for a month or two, from the time that the febrile symptoms begin to decline, and covering the lumbar region, affords considerable protection to the kidneys.

Prophylaxis.—Since the period of Jenner's discovery of the prophylactic power of vaccination, as regards smallpox, the attention of the profession has been frequently directed to the prevention of scarlet fever. Belladonna has been employed as a prophylactic, and recommended, but its use for this purpose has been fruitless, and is now nearly or quite discontinued. The most reliable, and, indeed, the only efficient prophylactic, is isolation, and the proper employment of disinfection in the sick-room and upon the patient. There can be no doubt that most of the excretions of a child sick with this malady contain the scarlatinous virus, as do also the cells of the epidermis, which are thrown off during convalescence, and minute particles of which are wafted away as motes in the air. By the proper application of washes, which contain carbolic acid, to the fauces and nostrils, the secretions from these surfaces are to a great extent disinfected. If otorrhœa occur, the ear should be syringed with warm water containing carbolic acid in the proportion of one drachm to the pint, and this should be continued after convalescence, for cases occur which show that the discharge from the ear has probably been the medium by which the virus was communicated, even as late as the fourth week after the disappearance of the rash. Children in the midst of the fever usually experience a degree of relief from inunction of the surfaces, and if carbolic acid be added to the substance, which is employed for this purpose, and the inunction be made twice daily over the entire surface, contamination of the air through the exhalations and exfoliations from the skin is in great part prevented. A convalescent child should not be allowed to mingle with other children till three or four weeks have elapsed, and all who are liable to take the malady should be excluded from the room in which a case has occurred for a longer period.

The New York Health Board enforce the following excellent regulations against scarlet fever as well as measles:—

"*Care of Patients.*—The patient should be placed in a separate room, and no person except the physician, nurse, or mother, allowed to enter the room, or to touch the bedding or clothing used in the sick-room, until they have been thoroughly disinfected.

"*Infected Articles.*—All clothing, bedding, or other articles not absolutely necessary for the use of the patient, should be removed from the sick-room. Articles used about the patient, such as sheets, pillow-cases, blankets, or clothes, must not be removed from the sick-room until they have been disinfected, by placing them in a tub with the following disinfecting fluid: eight ounces of sulphate of zinc, one ounce of carbolic acid, three gallons of water.

"They should be soaked in this fluid for at least one hour, and then placed in boiling water for washing.

"A piece of muslin, one foot square, should be dipped in the same solution and suspended in the sick-room constantly, and the same should be done in the hallway adjoining the sick-room. . . .

"All vessels used for receiving the discharges of patients should have some of the same disinfecting fluid constantly therein, and immediately after use by the patient be emptied and cleansed with boiling water. Water closets and privies should also be disinfected daily with the same fluid, or a solution of chloride of iron, one pound to a gallon of water, adding one or two ounces of carbolic acid.

"All straw beds should be burned. . . .

"It is advised not to use handkerchiefs about the patient, but rather soft rags for cleansing the nostrils and mouth, which should be immediately thereafter burned.

"The ceilings and side walls of the sick-room after removal of the patient should be thoroughly cleaned and lime washed, and the woodwork and floor thoroughly scrubbed with soap and water."

By such measures of prevention there can be no doubt that the number of cases of scarlet fever would be greatly reduced. Dr. William Budd, of Bristol, England, has for years recommended similar precautions in the families which he attends, and the following is his testimony in regard to the result: "The success of this method, in my own hands, has been very remarkable. For a period of nearly twenty years, during which I have employed it in a very wide field, I have never known the disease to spread in a single instance beyond the sick-room, and in very few instances within it. Time after time I have treated this fever in houses crowded from attic to basement with children and others, who have nevertheless escaped infection. The two elements in the method are, separation on the one hand, and disinfection on the other." (*British Medical Journal*, January 9, 1869.)

CHAPTER III.

RÖTHELN.

The disease known as rötheln is rare in this country. On the Continent, especially in Germany, on the other hand, it has been known many years, and German writers describe it under the term rubeola, which we apply to ordinary measles. This nomenclature produces confusion in terms, and hence rötheln is sometimes designated German measles. Meagre and imperfect descriptions of this malady have appeared in some of the British journals, and cases quite fully detailed have also been published by British physicians.

In this country rötheln is not entirely new, though most physicians have never seen a case of it. Cases occurring in or about Boston were described by Dr. Homans, Sr., in 1845, and at later dates, namely, in 1853 and 1871, B. E. Cotting, M.D., Harvard, saw cases, and described them in papers read before local societies. (See *Boston Med. and Surg. Journal*, March 15, 1873.) In 1874, Dr. Caleb Green, of Homer, Cortland County, N. Y., an accurate and intelligent observer, also witnessed an epidemic.

An epidemic of this rare and interesting malady has recently prevailed in New York city, the first, so far as I am aware, in this locality. In a general practice of more than twenty years, extending over a considerable portion of this city, I had previously observed nothing like it, and other older physicians having a large general practice, have informed me that they consider it an entirely new disease with us. Those who think that they have occasionally seen isolated cases of it previously to the recent epidemic, evidently refer to roseola.

This epidemic of rötheln commenced in New York, near the close of 1873, and attained its maximum prevalence in March and April, 1874, when it declined, occasional cases occurring throughout May. The first case which I observed occurred in the middle of December, in Seventy-first Street, being in the suburbs of New York, on the north. A few weeks later, cases were so numerous in the thickly settled portions of the city as to attract the attention of many physicians. It was evident that a disease had appeared with which we were not familiar, and as the eruption occurred in points, or small circumscribed patches, it was, I think, usually designated by the physician, in want of a more accurate name, epidemic roseola, or was spoken of as a spurious measles. Those physicians who were familiar with foreign medical literature saw the resemblance between these cases and those of rötheln as described by British and continental observers, but in certain, at least, of the foreign cases the duration of the

rash was said to be seven days (Liveing, *Lancet*, March 14, 1874, and *Medical News and Library*, May, 1874), whereas in the cases in New York it commonly disappeared by the fourth day. But this discrepancy was not sufficient to invalidate the belief in the identity of the New York disease with the foreign rötheln. It was readily explained by the difference in the seasons in which the cases occurred, for Liveing observed his cases in June and July, and the greater the external heat the longer the duration of the eruption, as we will see.

Between the middle of December and the 1st of May I had observed and treated this malady in eighteen families. Cases occurred in three other families living in the same houses with some of those which I attended, and as they were fully and clearly described to me, so that there could be no doubt as to their nature, I have included them in my statistics. Forty-eight cases were observed in the twenty-one families. During May, when the epidemic was declining, I saw six additional cases occurring singly in families, making a total of fifty-four.

Age.	Cases.
From 8 months to 1 year	2
" 1 year to 2 years	4
" 2 years to 5 "	16
" 5 " 10 "	23
" 10 " 15 "	3
" 15 " 30 "	6
Total	54

The age of the youngest patient was eight months, and that of the oldest thirty years. Seventy-two per cent. of the cases were between the ages of two and ten years, so that rötheln is pre-eminently a disease of childhood. Individuals in and beyond the middle period of life seem to have nearly an immunity from it. The age of the oldest patient of whom I have been informed, was about forty years. On March 25th, when I was on duty in the New York Catholic Foundling Asylum, rötheln occurred in a boy aged four years, following closely an extensive epidemic of measles among the inmates. In April, during the attendance of Drs. O'Dwyer and Reid, about thirty children were affected with it in this institution, while among the large number of female nurses and employés, who were chiefly between the ages of twenty and thirty years, all but three escaped.

Premonitory Stage.—Premonitory symptoms are in most instances either absent, or so mild as to attract little attention. It not unfrequently happened in the New York epidemic, that the parents were first made aware of the sickness of their children by observing the eruption. In one or two instances in my practice, children were sent from school not because they felt too ill to remain, but on account of the unusual appearance of the skin. Commonly, however, in those old enough to express their sensations, a premonitory stage of some hours, or a day, or even of longer duration was present, consisting of slight languor with headache, and sometimes

nausea. Now and then patients vomited previously to the eruption, as they frequently did during the first and second days of the eruptive stage. In only one instance did I observe grave prodromic symptoms. A boy, aged eight years, was suddenly seized with clonic convulsions, and while he was in the hot bath for the relief of these, the rash appeared along his back.

SYMPTOMS.—*Tegumentary System.* (*a*) *Skin.*—The eruption may appear first upon the back as in the above case. In other instances it is first observed upon the chest or neck, and in others still upon the cheek or forehead. As in morbilli it travels downward, appearing after some hours or a day upon the legs. It occurs upon all parts of the body unless upon the scalp and the palmar and plantar surfaces of hands and feet. The eruption in a majority of the cases which I have observed, gradually faded and disappeared, as already stated, by the fourth day. Children who were kept warm in bed, or in warm apartments, had it longer than others. In many instances traces of it were still visible when the patients were heated by exercise or excitement several days after recovery. A girl aged thirteen years, presented traces of it at times, though indistinctly, for three weeks. In most of the cases in the New York epidemic the rash commonly occurred in small circular patches, having nearly the size as well as color of those in morbilli, interspersed with which were numerous smaller eruptions, scarcely more than points of the same color. Between these patches and points the skin presented the normal appearance, unless an occasional gooseflesh contraction. In exceptional instances the rash resembled that of scarlet fever, extending continuously over a considerable extent of surface. Thus in a boy of three years it presented so closely the appearance of the scarlatinous efflorescence over the trunk, that were it not that the temperature was constantly below one hundred degrees, and within three or four days all febrile movement had ceased, I would probably have considered the malady a mild scarlatina. In certain patients the eruption, being in circumscribed patches and points, in the beginning like that of measles, becomes in two or three days confluent, so as to resemble the scarlatinous efflorescence, while over other parts the patches remain discrete. This was the character of the eruption upon the third and fourth days upon the extremities of a little boy in the Foundling Asylum. The rash is attended by considerable itching, disappears on pressure, produces slight roughness of the surface as ascertained by passing the fingers gently over it, and it usually disappears without desquamation. Exceptionally there is slight branny exfoliation, and in one instance which I observed the exfoliation was as considerable over the abdomen as in cases of scarlatina.

(*b*) *Mucous Membrane.*—In connection with the cutaneous eruption, a mild inflammation also occurs of the mucous membrane covering the fauces, buccal cavity and nostrils, and of the reflection of this membrane over the eyes and eyelids, namely, of the conjunctiva. In certain patients

this inflammation is scarcely appreciable, but in the majority it arrests attention at once. It produces more or less soreness of the throat, swelling of the tonsils, and even of the lymphatic glands in the vicinity of the tonsils, sneezing, and sometimes a slight discharge from the nostrils. It produces also a suffused, reddish, or weak appearance of the eyes, with a moderately increased lachrymation. On inverting the eyelids the palpebral conjunctiva is seen to be injected. In certain patients a moderate puriform secretion collects at the inner angle of the eyelids. The eyelids are probably in most cases more or less œdematous, but the swelling is usually slight, and is apt to be overlooked by the physician. In three cases, which I now recall, mothers have directed my attention to this œdema. In one of these, to wit, an infant of twenty-three months, there was so great tumefaction of the eyelids, commencing about the time when the eruption began to fade, that light was totally excluded from the eyes, and it was impossible to ascertain their condition. The skin covering the eyelids retained nearly its normal appearance, and the puriform secretion alluded to above, appeared between the lids. In three or four days the œdema of the lids, and the hyperæmia of the conjunctiva rapidly declined.

Pulse—Temperature.—The largest number of accurate daily observations relating to the temperature made during the epidemic in this city, were, I think, those of Dr. Reid in the Foundling Asylum in East 68th Street in March. He has kindly furnished me his statistics relating to this symptom, as follows: "The number of closely observed cases in which the temperature was taken was twenty-four. In seventeen of the cases the temperature ranged from 97° to 99°; in six it reached 100°, 100¼°, and 100¾°; in one it reached 103¼° on the second day of the eruption, but remained so elevated only one day." In certain patients Dr. Reid observed what he designates "a tendency to the development of an ephemeral fever." These observations correspond closely with those made by myself in private practice. Thus in sixteen cases I found the temperatures taken each day constantly between 98° and 100°, with a pulse under 110 per minute, except in one case in which it numbered 124. In certain other cases there was a more decided febrile movement, lasting from one to two or three days, occurring usually in the commencement. Thus a girl aged three and a half years had a temperature of 101¾° and a pulse of 128. In another case the pulse was 124 and temperature 102°. In another, a girl aged three and a half years, there was active febrile movement on Saturday night, occurring without apparent cause. This abated on the following day, and she seemed well till Tuesday, when the febrile movement returned, and the eruption appeared. On Thursday the temperature from 102° to 103° fell to 99½°, and within a day or two she was convalescent. In two other patients from two to four days after the disappearance of the eruption, an accession of fever occurred, lasting about one day, and attended by complaint of pain or distress in the epigastric region, but without vomiting or diarrhœa. In one of these the tempera-

ture was 103¼° and the pulse was 130 per minute; in the other case temperature and pulse did not seem to be below these figures, but they were not accurately ascertained. Occasionally in the New York epidemic the febrile movement was obviously due more to complications than to the primary disease. Thus in two cases which I observed the febrile movement was mainly attributable to mild diphtheritic inflammation which had attacked the fauces.

The observations therefore of Dr. Reid in the Foundling Asylum and my own in private practice, show that the febrile movement is constantly mild in most cases of uncomplicated rötheln, but that certain patients have temporary exacerbations of fever in which the temperature is as elevated as in scarlet fever or severe measles.

Respiratory System.—The mucous membrane of the larynx, trachea, and bronchial tubes does not participate or participates but slightly in the inflammation which involves the nasal, buccal, and faucial surfaces. A large proportion of my patients had no cough whatever, but others had an occasional slight cough. A few had a cough commencing so long previously that it was evidently accidental and not a symptom.

Digestive System.—The tongue in rötheln is moist and of normal appearance, or covered with a slight fur. The appetite is impaired but not lost, there is slight or no thirst and the bowels are regular. Nausea is a common symptom both during the premonitory stage and in the period of the eruption. Vomiting was present in several cases which I observed as one of the first premonitory symptoms; in certain patients it occurred likewise on the first or second day of the eruption. In other patients there was no nausea so far as could be ascertained, either immediately before, or during the disease. This symptom is less common in rötheln than in scarlet fever, but is as common apparently as in morbilli. Foreign observers have occasionally remarked the presence of albumen in the urine of patients affected with rötheln. I am not aware that it was observed in the New York epidemic, but I think that the urine was seldom examined by the appropriate tests. I made the examination in three different cases, but found no albumen unless a slight trace in one.

Complications—Prognosis.—The only complications which occurred in my cases were those already alluded to, namely, mild diphtheria in two patients. Diphtheria being at the time prevalent, the diphtheritic inflammation occurred by preference upon those faucial surfaces which were already the seat of inflammation. We see the same preference in cases of scarlet fever and measles. In the Foundling Asylum varicella complicated one case and pneumonia another. In a third case pneumonia appeared three days after the disappearance of the eruption. The prognosis in rötheln is very favorable. Patients do not die from the severity or depressing effect of the disease, as we observe in cases of scarlet fever, and with the exception of diphtheria there does not seem to be in it any tendency to the development of complications.

NATURE.—Is rötheln a malady *per se*, or is it a malady with which we have been familiar under another name, but whose form and character are modified by unusual meteorological conditions? Most of the cases in the New York epidemic bore considerable resemblance to cases of measles, both as regards the appearance and duration of the eruption, and the mucous inflammations. Parents often diagnosticated measles before the arrival of the physician, and the physician himself at first glance sometimes made the same diagnosis. But in rötheln the shortness and mildness of the premonitory stage, lack of uniformity and certain peculiarities of the eruption already pointed out, absence of bronchitis and general mildness of symptoms, with uniform favorable prognosis, afford a strong contrast with measles. But the decisive proof that rötheln is not a modified measles is found in the fact that the one does not prevent the occurrence of the other. Of the forty-eight cases observed by myself prior to May 1st, nineteen at least had had measles, and one who had rötheln took measles a month subsequently. I have already stated that in the Foundling Asylum rötheln closely followed an epidemic of measles. A considerable number of the children affected with the former disease had recently recovered from the latter.

That rötheln is not a form of scarlet fever is evident from the fact that, as regards at least the New York epidemic, the rash was in most instances quite different from the scarlatinous efflorescence, occurring, as we have seen, in small more or less circular points and patches. Moreover, there is in rötheln a slight febrile movement and general mildness of symptoms quite unlike what we observe in scarlatina; or if there is a considerable febrile movement, it has a short duration. But the conclusive proof of an essential difference between these two diseases, is found in the fact already stated in regard to measles, namely, that an attack of the one malady does not prevent the occurrence of the other. There are, it is true, cases in which it is difficult to make the differential diagnosis between rötheln and mild measles or mild scarlatina at first, but when the course of the malady has been closely observed for three or four days, it will rarely happen, I think, that we are unable to make out its character.

The first cases of rötheln observed in the New York epidemic were often, as I have stated, designated by the name epidemic roseola by the physicians who were called to treat them, since they were ignorant of their true nature, and in want of a better name. But rötheln differs so widely from the peculiar form of dermatitis known as roseola, that it may be properly said to have no kinship with it. The successive occurrence of the eruption in rötheln over the upper and then the lower part of the body, but covering the whole surface, its definite duration of three to five days, its size, usually larger than that of roseola, are points of difference. Moreover, roseola would not, without so great a change in its character as to become virtually a distinct disease, occur in the cool months, without any appreciable dietetic cause, as an epidemic over a certain area, and for a

limited time, affecting whole households of children, and sparing other households as well as individuals of a certain age. We, therefore, conclude that rötheln, though presenting certain resemblances to roseola, as well as to measles and scarlet fever, is a disease *per se*.

The cases of an epidemic malady, which occur when its causes or conditions are most strongly operative, and which are at this time apt to be typical, obviously afford the best data for studying its nature. Such were the forty-eight cases which I observed. In thirteen of the twenty-one families, the first cases were children who, up to the time of the seizure, were attending the public or private schools, and in certain instances those who were nearly simultaneously attacked, living perhaps in streets widely apart, were attending the same school. We see in this a close resemblance to the mode in which those common exanthematic diseases of childhood, which are universally admitted to be contagious, as scarlet fever and measles, spread in a community. It is largely through the schools that these diseases are introduced into families.

In most of the families containing two or more children, the cases were multiple, not occurring simultaneously but in succession, as if the malady were contracted from the one first affected. This is what we daily witness in the spread of the exanthematic fevers. In the first of the above families, to wit, Mr. E——'s, a girl attending one of the public schools takes rötheln in the middle of December. The two remaining children sicken with it, one week and two weeks later. A niece visiting in the family at the time when the first child was sick, but returning home to another street soon after, also has the eruption on December 27th. Alice R., aged ten years, a frequent visitor at Mr. E——'s, living in the same street and several times exposed to his children during their sickness, takes rötheln about January 4th. West Seventy-first Street, where this family resided, is suburban and thinly settled, and I could not learn of other cases in that locality.

These facts and cases seem to me to demonstrate the contagiousness of rötheln, at least during the time in which the conditions are most favorable for its development, or during the time in which the epidemic influence is most pronounced. During the declining period of the New York epidemic, the cases which I observed, as they occurred singly and without known exposure, lent no support to the theory of contagiousness.

From facts and observations like the above, we infer that rötheln is one of the exanthematic fevers. It resembles varicella in general mildness of symptoms, in the absence of dangerous complications or sequelæ, and in the uniformly favorable prognosis, while its symptoms and history show its close alliance with measles and scarlet fever. If this view is correct, we must believe that it possesses an incubative period, which in the cases detailed above apparently varied between seven and twenty-one days. The incubative period, therefore, resembles that of scarlet fever, which, as is well known, is very unequal in different instances.

Rötheln, like varicella, requires little treatment. I commonly gave small doses of quinine to my patients.

CHAPTER IV.

VARIOLA—VARIOLOID.

Variola, or smallpox, is a specific febrile affection, accompanied by a vesiculo-pustular eruption of the skin. Since the discovery of the protective power of vaccination it has been shorn of much of its terror, but it is still the most loathsome and most dreaded of all the fevers. Two forms of this disease are recognized, depending on the fact whether there has been previous vaccination. If the patient has been vaccinated at some period in his life, the disease, which is rendered milder in consequence, is designated varioloid. If there has been no vaccination, it is called variola or smallpox. Both forms are identical in nature, the one communicating the other; they differ only in gravity.

Smallpox presents four stages: the initial, or that of invasion; the eruptive; that of desiccation; and, lastly, that of desquamation. It is called discrete when the pustules remain separated from each other; confluent when they unite. This division is made according to the character of the eruption upon the face and hands. There are parts of the surface, as the abdomen, where the pustules are always discrete, even in the confluent form.

Incubative Period.—During the last half of the last century inoculation with variolous matter was extensively practised in Great Britain and on the Continent, as it was found that smallpox thus communicated was milder than when received by infection. This operation enabled physicians to determine the period of incubation, which was found to be from eight to eleven days. When variola is communicated through the air, the incubative period is somewhat longer, namely, from twelve to fourteen days.

Stage of Invasion.—Smallpox begins abruptly with chilliness. In children of an advanced age there is often, as in the adult, a distinct chill. This is followed by fever and such symptoms as usually accompany febrile movement, namely, lassitude, anorexia, and thirst. In addition certain symptoms arise which, though not peculiar to smallpox, are so marked in the commencement of this disease, that they possess considerable diagnostic value. These symptoms, which pertain to the nervous system and occur in the initial stage of varioloid as well as variola, are severe frontal headache, pain in the small of the back, and great drowsiness, sometimes with delirium. In many children convulsions occur, preceded and followed by a degree of stupor which is almost as profound

as coma. Trousseau suggests the name rachialgia for the pain in the back, as he believes that it is located in or around the spinal cord. This belief is based on the fact which he, as well as other observers, has noticed, that there is sometimes in connection with this symptom an incomplete paraplegia, indicated by numbness of the legs, or even inability to use them, and sometimes more or less paralysis of the bladder. These paraplegic symptoms pass off in a few days. Vomiting is also a common symptom in this stage, and one also of diagnostic value. It occurs at short intervals for twenty-four to thirty-six hours. The same symptom is common in scarlet fever, and not infrequent in measles, but in both these maladies irritability of stomach is much less persistent than in smallpox; vomiting does not occur in normal rubeolous and scarlatinous cases more than once or twice.

The tongue is covered with a moist fur. If the disease is to be discrete, constipation is commonly present in the stage of invasion; if confluent, diarrhœa is a common symptom, continuing till the fourth or fifth day, or even longer. Roseola or erythema sometimes occurs in this stage, and this may lead to error of diagnosis, the disease being mistaken for one of these cutaneous affections, or even for scarlet fever. The symptoms in the stage of invasion are usually more violent in confluent than in discrete variola, but there are exceptions.

Stage of Eruption.—The eruption commences about the third day, earlier in some cases, later in others. The average duration, therefore, of the first stage is somewhat shorter than in measles, but considerably longer than in scarlet fever. Sydenham has stated, and observations show the truth of the remark, that the shorter the first stage, the more severe the disease will prove to be; and, conversely, the longer the period, the milder will be its form. Therefore, if the eruption begin on the second day, it will, as a rule, be confluent; if not till the fifth or sixth day, it will be scanty and the disease light.

The eruption commences in minute red spots, somewhat like those of lichen, which gradually enlarge. It is first observed around the lips and upon the neck, then upon the face, scalp, upper part of chest, arms, and finally upon the lower part of the chest, the abdomen, and legs. It is sometimes, especially in young children, first observed in the folds of the skin, as about the genitals or in the groin. If the cuticle is irritated, as by a sinapism, the eruption often appears first upon this part of the surface and in greater abundance than elsewhere. The eruption commencing in a minute reddish point, as stated above, rapidly enlarges, and soon its central part begins to be indurated and raised. It feels round and hard to the finger, is tender, and its diameter does not ordinarily exceed two lines. This is the papular stage. The papulæ increase and become more elevated, and in twenty-four to forty-eight hours from the commencement of the eruptive stage they become vesicular. On the fifth

day of the eruption, or eighth of the disease, the vesicle has attained its full size. Its diameter is then about one-fourth of an inch, and its elevation is two or three lines. Its base is circular and indurated, and it is surrounded by a narrow zone of inflammation, indicated by redness and tenderness of the skin. The pock commonly, as it passes from the papular to the vesicular stage, loses its acuminate form, and becomes depressed in the centre, but in most cases, mixed with the umbilicated vesicles, are some which remain acuminate.

In proportion as the eruption becomes developed in discrete variola and in varioloid, the symptoms which accompanied the stage of invasion abate; the fever, headache, pain in the back, and thirst cease, and the appetite returns. In the confluent form, the febrile action continues with little abatement.

Simultaneously with the eruption upon the skin, an eruption also occurs upon the buccal and faucial surface, and often upon that of the air-passages. It occurs sometimes, also, upon the conjunctiva, producing dangerous ophthalmia, and even ulceration, with loss of sight, and upon the mucous surface of the genital organs. The form which it presents upon mucous surfaces is somewhat different from that upon the skin. There is at first a deposit of fibrin, producing a small, round, grayish spot at the point of eruption—firm, slightly elevated, and covered, if not by the entire mucous membrane, at least by its epithelial layer. Ulceration soon occurs, as in ulcerous stomatitis, and, if the patient live, the reparative process succeeds, as in simple ulcers. The eruption upon mucous surfaces increases considerably the suffering of the patient, in consequence of the tenderness of the ulcers; and if its seat be the surface of the larynx or trachea, it may be the immediate cause of death, especially in young children, by obstructing respiration.

The cutaneous eruption has been traced to the vesicular stage. On or about the fifth day of the eruptive period, or eighth of smallpox, the vesicles gradually change their character, their contents becoming thicker and turbid. At the same time they increase somewhat in size, and the central depression disappears. This is designated the stage of maturation, or of suppuration, though it is known that the turbidity is due chiefly to another substance than pus. The pock having undergone these changes, is termed the pustule.

In discrete variola, and in varioloid, the fever returns during the pustular stage; or, if the form of the disease be confluent, and the fever has continued, it now becomes more intense. The return of fever, or its increase, is denoted by increased frequency of pulse, elevation of temperature, dryness of skin, anorexia, and thirst. A tendency to constipation remains throughout the disease in varioloid and discrete variola; in the confluent form, diarrhœa more frequently occurs, which, if it continue, is an unfavorable prognostic sign.

Other changes occur. The pustules increase somewhat in size, and become more globular. Some of them, when most distended, break through friction of the clothes, or scratching of the child, and, their contents escaping, add to the loathsomeness of the disease. There is in the pustular stage more or less redness of the surface between the eruptions, and, except in the mildest cases, tumefaction from subcutaneous infiltration occurs. In the confluent form, at this period, the features are often so swollen that the friends would not recognize the patient. The eyelids may be so œdematous that the eyes are for a time concealed from view. This œdema of the surface is not altogether absent in the vesicular stage, but it increases during the time of maturation, after which it subsides.

Stage of Desiccation.—This immediately succeeds the full development of the pustules. The liquid portion of the contents of the pustules, which are broken, evaporates, leaving a crust. If there is no rupture, the liquid is absorbed, and a scab results, which, though smaller, preserves in a measure the form of the pustule. While the pustule desiccates, the surrounding inflammation rapidly abates. The crusts occur first upon the face, and on other parts in the order in which the eruption appeared. The odor from the patient, at this time, is peculiar. In the confluent form, especially, it is very offensive, and can be noticed at a distance from the bedside. Rilliet and Barthez call it nauseous and fetid. As desiccation progresses, the symptoms, local and general, abate. The pulse and temperature, if the case is favorable, return to their normal standard. The cough, hoarseness, and thirst disappear, while the appetite returns; the sleep is more tranquil, and the functions, generally, are more regularly performed.

The last stage is that of desquamation; it commences between the eleventh and sixteenth days. The scabs, which present a dark or brownish appearance, are successively detached. This period lasts several days; sometimes two or three weeks even elapse before all the crusts separate. In the meantime the patient gradually recovers his health and former strength. After the fall of the crust, the cicatrix underneath presents a reddish appearance. This color gradually fades, and there remains an irregular depression, or pit, of a lighter color than the surrounding surface; and if there has been a full development of the eruption, disfiguring the patient for life.

Such is the clinical history of variola, when it is favorable, and its course is regular. The disease is sometimes irregular. In rare instances the eruption occurs almost at the commencement of the attack. The form is then very apt to be confluent. There are irregularities, also, in consequence of diarrhœa, hemorrhages, or other complications. I have known the eruption appear first on the limbs, and last on the trunk and face, and the appearance of the eruption is not always the same. In the anæmic and feeble child it often presents a pale color, with some indura-

tion at its base, but without the red areola around it, or with this quite indistinct. In rare instances the vesicles have a reddish color, their contents being tinged with blood. This form of variola is designated hemorrhagic. It indicates a profoundly altered state of the blood. The eruption in this form is of small size, and if the pock is broken, blood oozes from it.

Varioloid.—The course of varioloid is similar to that of variola, but it is somewhat shorter. It commences with rigors, followed by fever, headache, pain in the back, vomiting, drowsiness, and sometimes delirium, or even convulsions. The symptoms in the stage of invasion are, indeed, the same in character, and often nearly as severe as in variola. With the initial symptoms, there is also sometimes a scarlatiniform eruption, so that the disease may at first be mistaken for scarlatina. On the third or fourth day the variolous eruption commences. The number of pocks is commonly few, often not more than twelve to twenty. In the mildest form of varioloid, if the physician is not summoned in the stage of invasion, he is not apt to be called at all, so that the patient may pass through the disease in ignorance of its nature. The true character of the malady is not ascertained till others are affected, either with variola or varioloid.

The eruption pursues a more rapid course in varioloid than in the unmodified disease. By the fifth or sixth day the pustules are fully developed, though often smaller and less likely to be ruptured than in variola. Often, in varioloid, the eruption aborts. It remains papular two or three days, and then declines, or it may reach the vesicular stage, and decline without pustulation.

The constitutional symptoms in varioloid abate with the commencement of the eruptive stage. The secondary fever is slight or absent.

Such is the usual mild course of varioloid, but not always. If several years have elapsed since the vaccination, its protective power is greatly impaired, and varioloid may then exhibit as severe a form as ordinary smallpox. In some instances it is fatal.

The term varioloid is, as has been stated, applied to cases of variolous disease where there has been previous vaccination. It is also applied by writers to second attacks, whether the first occurred from infection or from variolous inoculation, but such cases are rare.

Mode of Death.—Death in smallpox occurs in several different ways. The most fatal period is the pustular stage. Feeble children not unfrequently die from exhaustion at or about the time that the pustules attain their greatest size. The eruption appears and becomes developed as usual, but there are evidences of weakness in the patient, and suddenly the progress of the vesicle or pustule ceases. It begins to subside, and its walls shrivel. There is evidently absorption, in part, of the liquid contents. These phenomena are of the gravest character. Death is the

common result, and within twenty-four hours. In other cases death occurs from apnœa. The pock increasing in size in the larynx and trachea, obstructs inspiration, or there may be the formation of a pseudo-membrane, as in true croup. This is not an unusual mode of death in young children, in whom the calibre of the larynx and trachea is small. Sometimes convulsions and coma occur in the last hours of life. In other cases the stage of desquamation is reached, but convalescence does not occur. The patient each day becomes more anæmic and feeble, and finally death results from failure of the vital powers. Again, after small-pox has run its course, purpura hæmorrhagica may be developed. Hemorrhages occur from the gums, throat, nostrils. Blood is vomited, and evacuated in the stools. I have known death to occur in all these ways, but that from purpura is least frequent. Sometimes, as in scarlet fever, death occurs suddenly and unexpectedly in confluent, and even in discrete variola, when the previous symptoms had apparently been favorable. The patient is overpowered by the intensity of the virus.

Anatomical Characters.—In those who have died of variola, without inflammatory or other complication, the heart-clots have been found small, dark, and soft. The blood is dark and thin. The vessels of the brain and its membranes are injected, so that numerous red points appear on the cut surface of this organ. The vessels of the lungs and the abdominal organs are congested, while the muscles present a deep red color. The variolous eruption penetrates more deeply than that of any other exanthematic fever. It has been stated elsewhere that it occurs not only on the skin, but often on the surface of the mouth, fauces, and air-passages. The mucous membrane in these situations is frequently also the seat of catarrhal inflammation, being thickened and softened, and in some parts, as the larynx, a pseudo-membrane is occasionally produced, as in croup. The inflammation, whether catarrhal or pseudo-membranous, may occur without as well as with the presence of the specific eruption.

The eruption very seldom, perhaps never, appears upon the gastro-intestinal surface, but the solitary follicles and patches of Peyer are often enlarged, as in some other zymotic affections. The liver, spleen, and kidneys are commonly congested in those who have died of variola. The spleen, especially, is increased in volume and softened; the kidneys are enlarged, as if from commencing nephritis, and sometimes softened.

The minute structure of the pock is described by Rilliet and Barthez, and others. The vesicle is multilocular, consisting of at least five or six compartments, with distinct partitions. Its centre is united by fibrous bands to the derm beneath, which union gives rise to the umbilicated appearance. The giving way of these minute bands in the pustular stage occurs when the form changes from the umbilicated to the convex. In the pustular stage also, according to some, a fibrinous formation occurs within the pustule; according to others, this substance is of the nature of the

epidermis, presenting the appearance of the cuticle when macerated. Mixed with this epidermic or fibrinous formation are pus-cells.

Complications.—There are several different complications of variola. One is salivation. This is common in the adult, but rare in the child. When it occurs in the child, it is slight, commencing with or about the time of the eruption, and disappearing in from one to four or five days. Ophthalmia is another complication. Simple conjunctivitis, often quite intense, may occur in consequence of pustules developed under the lids. This inflammation subsides without injury to the eye, as the primary disease abates. A more serious inflammation occurs at an advanced stage of the disease, commencing in or near the desquamative period. This produces more or less chemosis, and sometimes opacity or ulceration of the cornea. A similar inflammation may occur in the ear, giving rise to otorrhœa, and even in some patients to rupture of the drum of the ear. Abscesses in the subcutaneous connective tissue have been occasionally observed, especially in the confluent form. Subcutaneous infiltration and feebleness of constitution favor their occurrence. Suppuration within the joints is a somewhat rare complication or sequel, rendering convalescence protracted, if, indeed, the case is not fatal.

M. Béraud has published a memoir to show that orchitis in the male and ovaritis in the female may complicate variola. These inflammations are believed to be accompanied by a small and imperfect variolous eruption upon the tunica vaginalis and the peritoneal covering of the ovary. Trousseau states that he has often met this complication in the male, since his attention was called to it. It is mild, and subsides with the disappearance of the eruption. Laryngitis, simple or diphtheritic, bronchitis, pneumonia, pharyngitis, purpuric hemorrhages, gangrene of the mouth or other parts, œdema pulmonum, and œdema glottidis are occasional complications, some of which are frequent, others rare.

Prognosis.—This depends on the age, vigor of system, form of the disease, and the presence or absence of complications. The younger the child, the greater the danger. Trousseau says: "Confluent variola, and even discrete variola, are almost always fatal in individuals less than two years old." Above the age of three or four years discrete variola usually ends favorably, but the confluent form is still, as a rule, fatal. Varioloid in the child is a mild disease, terminating favorably in a large proportion of cases. It is milder at this age than in the adult, on account of the more recent period of vaccination, and if a case of supposed varioloid is severe, and the eruption abundant, it is probable that the vaccination was spurious.

It is not necessary, from what has been said, to specify the favorable prognostic signs. The unfavorable prognostics are, great violence of the initial symptoms; early appearance of the eruption; an abundant eruption, especially if pale, and without swelling of the surface; rapid decline

of the eruption in the vesicular or pustular stage; hemorrhagic eruption, or hemorrhages from the surfaces; fever continuing after the appearance of the eruption; diarrhœa persisting beyond the third or fourth day; delirium or great drowsiness; a frequent and feeble pulse; and, finally, obstructed respiration—if slow, indicating a pseudo-membrane or variolous eruption in the larynx or trachea; if rapid, indicating bronchitis or pneumonia.

Diagnosis.—The diagnosis cannot be made with certainty prior to the eruptive stage. If, however, smallpox is prevalent, if the patient has not been vaccinated, and the symptoms which pertain to the period of invasion are present, as headache, pain in small of back, repeated vomiting, drowsiness, and perhaps convulsions, there is ground for the gravest suspicion. If, in addition to these symptoms, reddish points begin to appear on the second or third day, the diagnosis may be made with confidence. At this early period, even before there is any distinct cutaneous eruption, ash-colored spots may sometimes be observed on the buccal or faucial surface, the commencement of the variolous eruption; these possess considerable diagnostic value.

The scarlatiniform efflorescence, in the first stage of variola, sometimes leads to the belief that the disease is scarlet fever. The absence of the pharyngitis, and the appearance of the variolous eruption soon after the efflorescence, correct the diagnosis. Smallpox has, in the beginning of the eruptive period, sometimes been mistaken for measles. The points involved in the differential diagnosis have been presented in treating of that disease. After the development of the eruption, it may be mistaken for varicella. The eruption of varicella is, however, preceded by symptoms which are milder and of shorter duration, and its appearance is different. It is irregular, instead of round; is not umbilicated, and it does not have the round, inflamed, and indurated base, which characterizes the variolous eruption. The eruption of ecthyma is sometimes umbilicated, but the symptoms of ecthyma and variola, and the progress of the eruptions in the two diseases, are very different.

Treatment.—Smallpox, like the other essential fevers, is self-limited, and therefore the constitutional treatment should be sustaining and palliative. In the first stages of the disease, the diet should be simple; gentle laxatives and refrigerant drinks are required if there is much febrile excitement. Lemonade is a grateful drink, and may be given in moderate quantity. Spiritus Mindereri in carbonic acid water may be allowed. As the disease advances, more nutritious food should be recommended; and in severe cases carbonate of ammonia, and even alcoholic stimulants, are required.

As confluent smallpox is nearly always, and the discrete form often, fatal in infancy, the physician should carefully watch the progress of the case in the infant. By judicious treatment, some, in this period of life, may be

saved, who otherwise would perish. In the infant depressing measures should be avoided. A laxative may be given, at first, if there is much fever, and the bowels are constipated; but the diet should be nutritious, and many soon require tonics and stimulants. If the pulse become more frequent and feeble, or if, with frequency of the pulse, the face and extremities become cool; or if, in the vesicular or pustular stage, the eruption suddenly subsides, alcoholic stimulants must be immediately employed, or the patient dies.

Such is an outline of the constitutional treatment required in smallpox. Sydenham inculcated a mode of treatment which experience has shown to be injurious in infancy and childhood. He had observed that the severity of the disease was ordinarily proportionate to the amount of eruption, and concluded from this fact that measures which retarded the development of the eruption were salutary; cold drinks, a cold apartment, scanty covering of the body, cathartics that caused derivation of blood from the surface, even sometimes the abstraction of blood, were considered according to Sydenham's theory, to be useful as means of preventing full development of the eruption.

Sydenham's treatment, however appropriate it might sometimes be in case of robust adults, is unsuitable for children, because they do not, as a rule, tolerate, in this disease, measures which reduce the strength. Moreover, smallpox is rendered more dangerous by what Rilliet and Barthez designate perturbating treatment—treatment which renders it abnormal. The regular appearance and development of the eruption are requisite in order that the case may progress favorably. On the other hand, the opposite plan of treatment, which families, if left to themselves, are apt to adopt—namely, the employment of measures to promote perspiration, as hot drinks, and confinement in a heated room—is also injurious.

The patient should be kept in a temperature such as he has been accustomed to, and such as is agreeable to him; his diet should be simple and nutritious; laxative medicine should only be given to procure the natural evacuations. In smallpox, as in all infectious diseases, free ventilation of the apartment is required.

While the general eruption in smallpox should not be interfered with, it is proper to endeavor to diminish, so far as possible, the size of the pocks, on parts exposed to view, so as to prevent disfigurement. Professor Flint, in his *Treatise on the Practice of Medicine*, has published an excellent summary of the various measures which have been recommended for accomplishing this end. First: The opening and breaking up of the vesicle by means of a fine needle. This is tedious practice in confluent variola, but it can readily be performed in the discrete form—at least as regards the vesicles upon the face. This treatment was proposed by Rayer, and it is recommended by many who have tried it. Secondly: After the evacuation of the liquid, the cauterization of the vesicle by a pointed stick

of nitrate of silver. Rilliet and Barthez say, in reference to this mode of treatment, "Individual cauterization of the pustules is, on the other hand, an almost infallible means of causing them to abort. To be successful, it is necessary to penetrate into the interior of the pustule with a pointed crayon of nitrate of silver, in order to cauterize the derm. . . . It is only the first or second day of the eruption that it (cauterization) has certain success; nevertheless, we have often seen it succeed the third or the fourth day, or even the fifth."

Thirdly: The application of tincture of iodine once or twice daily over the eruption when in the papular stage. Some writers, who have employed iodine, state that it does not prevent pitting, but diminishes it. Its favorable effects are produced by coagulating the contents of the papule. Fourthly: The exclusion of light and air by means of a plaster. A mixture containing tannate of iron has been employed for this purpose in one of our hospitals. This produces a black mask. Light and air may also be excluded by smearing the face with sweet oil, and dusting twice daily upon the oiled surface a powder containing equal parts of subnitrate of bismuth and prepared chalk. Fifthly: The application of mild mercurial ointment upon the face or other parts of the surface, where it is desirable to render the eruption abortive. This mode of treatment does diminish the size of the vesicles and the pitting, but I should not recommend it for children. I have known in the adult severe mercurialization from its employment for four or five days, and, though young children do not exhibit so readily the effects of mercury, the use of the ointment, unless for a very limited period, increases, in my opinion, their feebleness, and diminishes the chance of their recovery. Calamine made into a paste with sweet oil is said to be equally effectual with mercurial ointment, and it produces no constitutional effect. Its effect is obviously similar to that of the bismuth and chalk employed with sweet oil as stated above. Also, I have employed pulverized charcoal made into a thin paste with sweet oil or glycerin, and applied daily or twice daily to the face. It effectually excludes the light, and the result appeared to be good as regards pitting, but it is a disagreeable application. Curschmann recommends as preferable to any of these methods, the use of iced compresses to the face and hands. The pain, redness, and swelling are diminished by their use, but without change in the copiousness of the eruption. (*Ziemssen's Encyclop.*) If fissures or excoriations occur, an application may be made of oxide or carbonate of zinc in glycerin, one drachm to the ounce.

The prevention of smallpox, so far as practicable, is one of the important incidental duties of the physician. Isolation of the patient, and precautions in reference to his clothes and bedding, are imperatively required, so great is the contagiousness of this disease. The only certain means of prevention is confessedly vaccination, and providentially the incubative period of the vaccine disease is much less than that of variola. Therefore,

smallpox may be prevented after the virus is received in the system, by timely and successful vaccination. Vaccination, at any period between the time of exposure and the commencement of the symptoms of invasion, will either prevent the occurrence of smallpox or modify it. If the symptoms of invasion have already commenced, it is uncertain whether it produces any modifying effect.

CHAPTER V.

VACCINIA.

Vaccinia is a mild eruptive disease, which occasionally occurs among cattle, and has been propagated from them to man. It is characterized by the appearance upon the surface of one or more papules, which soon become vesicular, and then pustular. It is communicable by contact, but, unlike the other eruptive fevers, it is not contagious through the air. It is inoculable, both by the liquid contained in the vesicle, which is designated vaccine lymph, and by the scab which results from the desiccation of the pustule.

To Gloucestershire, England, the honor belongs of discovering and utilizing the fact that vaccinia, a mild and comparatively harmless disease, is transmissible from the cow to man, and that it affords protection from smallpox. It appears that a vague opinion prevailed among the farmers of this dairying section, that a disease, which has since been designated vaccinia, was occasionally received from the cow in milking, the virus passing from a pustule on the teat to a sore or chap on the hand of the milker, and that those who thus contract the disease receive immunity from smallpox. As usually happens with important discoveries, so dull of apprehension is human intellect, these people, to whom Providence had revealed so important a fact, were blind to its real value. Finally, in the year 1774, Benjamin Jesty, whom the world has not sufficiently honored, "an honest and upright man," according to his epitaph, a farmer of Gloucestershire, had the courage to vaccinate his wife and two children. His excellent moral character did not shield him. He was regarded by his neighbors as an inhuman brute, who had performed an experiment on his own family, the tendency of which might be to transform them into beasts with horns.

The first essay in vaccination appears to have been entirely successful, but the prejudice against the operation continued. A fifth of a century passed, during which there was no extension of the benefits of this great discovery. At last, towards the close of the last century, Dr. Edward

Jenner, a physician of Gloucestershire, and inoculator of his district, began to investigate this disease of the cow, about which little was known, and the grounds for the belief that it afforded protection from smallpox. Fortunately for the world, Jenner had been educated under John Hunter, and had learned from his great master to study nature rather than books, to be guided by experience and observation rather than by the dogmas of his predecessors or of the schools.

Jenner performed his first vaccination on the 14th of May, 1796, twenty-two years after Benjamin Jesty had lost his good name among his neighbors for vaccinating his own family. The popularizing of vaccination, mainly through Jenner's perseverance, affords one of the most interesting and instructive chapters in the history of medical science. How he went up to London, full of the importance of the discovery, and was there advised by his medical friends to desist from his wild schemes, lest he should injure the reputation which he had gained from a creditable paper on the habits of the cuckoo; how he was allowed to vaccinate in the hospital wards, and gained some adherents to the new faith among the leading physicians of the metropolis; and finally, how, as the claims of vaccination began to be recognized, at the close of the last century and commencement of the present, a most acrimonious discussion arose, which filled all the medical journals of that period. The opponents of vaccination resorted to every device to prevent the acceptance of Jenner's views. They attempted to prejudice the people against them by specious arguments, by ridicule, and even by caricatures. One of the leading journals contained the picture of a cow covered with sores, and devouring children, and it was urged that vaccination was a bestial operation, degrading man to the level of the brute. But the truth had gained a firm hold, and the practice of vaccination extended.

The discovery of vaccinia, and of its protective power, cannot be too highly appreciated. It has, probably, done more to relieve human suffering than any other discovery of the last one hundred years, unless we except that of anæsthetics, and more to save human life than any other instrumentality of a purely physical kind.

The fact was established in the time of Jenner that the virus of smallpox inoculated in the cow produced vaccinia, which, in its propagation back to man never returned to its original form, but always remained vaccinia. Moreover, Jenner believed that the disease known in the horse as the grease was identical in nature with vaccinia in the cow. He failed, however, in his experiments to communicate vaccinia from the horse, but other experiments have been more successful. In 1801, a Dr. Loy, of the county of York, England, met two cases of vaccinia in persons who had taken care of a horse affected with the grease, and, from the lymph which he obtained, was able to produce vaccinia in the cow. In 1805, Viborg, a Danish veterinary surgeon, after many failures, succeeded also

in communicating vaccinia to the cow by means of the virus taken from a horse.

From this time little light was thrown on this subject till within the last twenty years. Although Loy and Viborg, and perhaps a few others, had recorded their success, other experimenters had failed to communicate vaccinia from the horse. In the absence of additional cases, the profession began to question whether there might not have been some error in the observations of the gentlemen whose names I have mentioned, and the problem was still regarded as undetermined, whether a disease identical with vaccinia occurred in the horse, or a disease which might communicate vaccinia to the cow or to man.

Observations confirmatory of those of Loy and Viborg were at length, however, made, which must be regarded as conclusive. In 1856, in the department of d'Eure-et-Loir, France, M. Pichot was consulted by a boy who had on the back of his hands vaccine pustules, which had apparently reached the eighth or ninth day. He had not taken care of nor been in contact with a cow, but had a few days before taken care of a horse affected with the grease. Vaccination was performed by means of the lymph taken from these pustules, and genuine vaccinia was produced.

Again, in 1860, an epidemic prevailed among the horses in Riemes and Toulouse, France. A mare sickened with the disease, and there was swelling of the hough, with discharge of sanious matter. M. Delafosse vaccinated two cows with this matter, and communicated genuine vaccinia. This epidemic was believed by the veterinary surgeons to be an eruptive fever, differing in its nature somewhat from the disease or diseases which have ordinarily been designated the grease. It has been conjectured that two or more distinct affections of the horse have the same appellation, one of which, it is now admitted, is identical with vaccinia of the cow, and may communicate it. And the reason why so many experimenters have failed to vaccinate the cow from the horse is that they have used the virus of the wrong disease, or have taken matter from horses which had been affected with the true disease, but from ulcers which had lost their specific character.

Prior to the time of Jenner variolous inoculation was practised in most civilized countries, since variola produced in this way was found to be milder than when arising from infection. This practice is now obsolete; forbidden in some places by legislative enactments. It is superseded by vaccination. Vaccination, or the introduction of vaccine lymph into the system, is quickly and conveniently performed by scarifying with a lancet, and pressing into the incisions the lymph, or a little of the scab pulverized and dissolved in a drop of cold water. It may also be performed by scraping off the epidermis with the edge of the instrument till the blood begins to ooze; and also, though with less certainty of success, by puncturing the

skin with the point of the lancet, or by an instrument called the vaccinator.

If the child has a vascular nævus, this may be selected as the point of vaccination. Unless of large size, it can usually be cured by the inflammation which vaccinia produces. Statistics collected by Simon, as well as Marson, show that of those who contract varioloid, the larger the number of vaccine cicatrices the milder the disease, and the less the proportionate number of deaths. In Simon's statistics of those who stated that they had been vaccinated, but who presented no cicatrix, $21\frac{3}{4}$ per cent. died; of those who had one cicatrix, $7\frac{1}{2}$ per cent. died; of those who had two, $4\frac{1}{8}$ per cent. died; of those who had three, $1\frac{3}{4}$ per cent. died; while of those who had four or more cicatrices, only $\frac{3}{4}$ per cent. died. These statistics would seem to indicate the propriety of vaccinating in several places. But, so far as appears, when two or more cicatrices were observed, the patients may have been vaccinated at different times, at intervals, perhaps of several years, and if so, the inference would not follow that more complete protection is produced by vaccinating in several places than in one. Moreover, if vaccination is performed in the usual manner by several incisions on the arm, and the virus is fresh and active, usually two or more distinct vesicles arise, which unite in their development, and probably protect the system as much as if they were separated by a wider space.

Appearances—Symptoms.—In genuine vaccination no effect is observed, except the slight inflammation due to the operation, till the close of the third day. Then the specific inflammation commences. This is indicated by a small red point, at first scarcely visible, indurated and slightly elevated, as determined by the touch, rather than by the eye. This increases, and on the fifth day the cuticle over the inflamed part begins to be raised by a transparent and thin liquid. The vesicle increases in diameter, and by the sixth day presents an umbilicated appearance, and is surrounded by a faint and narrow red zone. At the close of the eighth day the vesicle is fully developed. Its size varies considerably. It is usually from a sixth to a third of an inch in diameter, and oval or circular. If the vaccination has been performed by incisions, the size of the matured vesicle may be considerably larger, and its shape irregular, in consequence of the union of two or more vesicles. The eruption now presents a whitish or pearl-colored appearance, due to the whiteness of the cuticle, and the transparence of the liquid underneath. If the vaccination was performed by incisions, it is not unusual to observe over the centre of the vesicle, and adhering to it, a small yellowish scab, which has resulted from the scarification, and which contains none of the virus.

The vaccine vesicle, like that of variola, consists of compartments, commonly eight or ten, with complete partitions, so that there is no intercommunication. On the ninth day the inflamed areola becomes more distinct, and its diameter rapidly increases. Its color is deep red, its temperature

is considerably elevated, and it is accompanied by more or less induration of the subcutaneous tissue, and it is tender to the touch. On the tenth day the pock has reached its full development. The areola then extends from one to two inches away from the vesicle, becoming fainter at its outer circumference, and gradually disappearing in the healthy skin. The shape of the outer circumference of the areola is irregular, projecting further at one point than another, though its general form is circular.

On the tenth day, when the inflammation has reached its maximum, the heat, itching, and tenderness in and around the pock are such that the child is often feverish and restless. Occasionally the glands of the axilla become swollen and tender. In other cases, in which there is but a moderate amount of inflammation, the constitutional disturbance is slight.

At the close of the tenth day, or on the eleventh, the imflammation begins to decline; the areola becomes narrower and then disappears; the induration and tenderness abate; and with this change the pustule desiccates, its liquid is absorbed, and there results a brownish or a dark mahogany-colored scab, which is detached, ordinarily, between the fourteenth and twenty-first days. The cicatrix, at first reddish, like all recent cicatrices, gradually becomes paler, and remains whiter than the surrounding integument. It presents several minute depressions or pits, which indicate the genuineness of the vaccination.

Anomalies, Complications, and Sequels.—The vesicle is often broken, accidentally, or by the nails of the child. If the top of the vesicle is destroyed, or most of the compartments are opened, the inflammation is commonly increased, considerable suppuration occurs, and there results a large, irregular, yellowish scab, consisting of the virus mixed with desiccated pus. This scab is entirely unreliable, and unfit for the purpose of vaccination, though the protective power of the disease is not diminished by injury of the vesicles, even if it is totally destroyed. The cicatrix which results from extensive injury of the vesicle is apt to be large, and without the indented points which characterize the normal cicatrix.

In rare cases when the inflammation which surrounds the vesicle is intense and deep seated, suppuration occurs in the subjacent connective tissue, giving rise to an abscess. This abscess is commonly of small size, but it increases the fretfulness and constitutional disturbance which attend vaccinia. This subcutaneous suppuration is believed to occur most frequently in those who have a scrofulous or vitiated state of system. Inflammation of the lymphatic glands of the axilla I have spoken of as not infrequent in vaccinia. This sometimes proceeds to suppuration, producing an unpleasant, though not serious, complication.

It sometimes happens that vesicles appear in other parts besides the points where the virus was inserted. These supernumerary vesicles commonly occur where the cuticle has been removed by scalds or injuries.

Trousseau relates the case of an infant whom he had vaccinated. On

the eleventh day he was astonished to find twenty-seven vaccine pustules on the face, trunk, and limbs. This infant had, however, before the vaccination, a simple non-specific eruption over the whole body, and it was believed that it had produced these vaccinations by transferring the lymph, with its nails, to the various parts where the cuticle was denuded.

It is not unusual, also, to observe minute papules appearing on parts of the surface simultaneously with or soon after the vesicle, and in a few days declining. These seem to be abortive vaccine eruptions.

One of the most serious complications is erysipelas. This may occur directly from the operation, or from the inflammation caused by the vesicle, when the virus possesses no deleterious property; and, again, it may result from some unknown element in the virus. It may occur immediately after the operation, when it commonly prevents the working of the virus, or during the vesicular or pustular stage; or, again, after desiccation and separation of the scab. I have observed it commencing at all these periods.

Erysipelas, occurring as a complication of vaccinia, is invariably referred by the friends to the virus employed, and the physician who has had the misfortune to vaccinate is often unjustly blamed. In many of these cases there was a strong predisposition to erysipelas at the time of the vaccination, and the operation or the inflammation which accompanied the normal development of the vesicle served simply as an exciting cause. Erysipelas would occur as soon from a non-specific sore; indeed, we not unfrequently are called to cases of this disease in young children, which commenced from non-specific sores upon the genitals, or on one of the limbs. That the fault is not in the virus employed, is evident from the fact that other children, vaccinated with the same, have simple uncomplicated vaccinia.

Sometimes, on the other hand, the cause of erysipelas, whatever it may be, exists in the virus. For further facts in reference to this subject, the reader is referred to our remarks on erysipelas.

The fact is established by many observations that syphilis is communicable by vaccination. The symptoms of it may not appear till vaccinia has terminated, or for a little time subsequently, but it then constitutes a very serious sequel. A physician of this city, well known in this community as skilful in the diagnosis and treatment of skin diseases, and therefore not likely to be mistaken as regards the nature of the diseases, states that he communicated syphilis to two infants by vaccinating with the same scab. Both had the characteristic syphilitic eruption. In January, 1868, an infant was brought to Prof. Alonzo Clark's clinique, in this city, having syphilitic rupia, which, in the opinion of the physicians present, was undoubtedly the result of vaccination.

Trousseau relates the case of a young woman, eighteen years old, who was vaccinated with virus taken from an infant apparently in perfect

health. The vaccination was unsuccessful; but twenty-three days subsequently his attention was called to an eruption which had appeared in two places on the woman's arm, corresponding with the points where the virus had been inserted. The eruption was that of ecthyma, which, by the next examination, which was five days subsequently, had been transformed into rupia. The axillary lymphatic glands were tumefied and indolent, and finally roseola appeared, which removed all doubts as to the syphilitic character of the disease. There was syphilitic infection, which first manifests itself in the points where vaccination had been performed (*Article de la Vaccine*). It is not ascertained in Professor Clark's case, nor is it stated in Trousseau's, whether the lymph or scab was employed for vaccination. There can be little doubt that the pure lymph never communicates anything but vaccinia, and if by vaccination any other disease is imparted, a little blood has mingled with the lymph, or the scab has been employed.

The vesicle in genuine vaccinia is sometimes very small, not having a diameter of more than two lines. Occasionally the development of the vesicle is retarded. It does not appear till two or three days later than the usual time, or even a longer period.

Vaccinia is modified by certain diseases. It is arrested by measles and scarlet fever, pursuing its course after the subsidence of the exanthem. On the other hand, it arrests the paroxysmal cough of pertussis, which returns when the pock begins to desiccate. Eczematous eruptions sometimes occur after vaccinia, as they often do after the other eruptive fevers; or, if already present, they may be aggravated.

Subsequent Vaccinations.

A second vaccination, performed prior to the ninth day after the first vaccination, is successful. A genuine vaccine eruption results, which is smaller the more advanced the primary disease. This second eruption overtakes the first. On the ninth day the susceptibility to vaccinia is, in most cases, lost; so that vaccination performed on the tenth, or subsequent days, is unsuccessful.

As a rule, an acute contagious disease occurs only once in the same individual. Vaccinia is an exception. In most cases, after a few years, it can be produced a second time; and cases of a third or fourth successful vaccination, at intervals of a few years, are not uncommon. Now, subsequent cases of vaccinia differ from the first, which has been described above. The period of incubation is shorter, and the vesicular, pustular, and desiccative stages succeed each other more rapidly, so that the whole period of the disease is less. The variation from the appearance and course of the first vesicle is proportionate to the degree of protection which the first vaccination still affords, both as regards smallpox and

vaccinia. If several years have elapsed since the first vaccination, and the protective power which it afforded is nearly lost, the second vaccinia differs but little from the first. If, on the other hand, the first vaccination still affords nearly complete protection, the result of the second is slight; the eruption is insignificant, lacking the characteristic appearance of the vaccine vesicle, resembling a common sore, and disappearing within a week. It is not accompanied by the inflamed areola, or any appreciable constitutional disturbance.

Vaccination often produces no result. This is sometimes due to the fact that the lymph or scab employed is useless. It has spoiled by keeping, or never has been good. In other cases it is due to a lack of susceptibility in the person. Some take vaccinia with difficulty, and only after several vaccinations; just as children, though fully exposed, often fail to take measles or scarlet fever, on account of a condition of the system which prevents the reception of the virus, or antagonizes and controls its action. In some instances, after vaccination, an eruption is produced, which may or may not be genuine; but it immediately becomes purulent, and is soon broken. A large, yellow, uneven scab results, having none of the appearance and containing little or none of the vaccine virus. This scab, as well as the liquid matter which preceded the formation of the scab, is utterly useless for the purpose of vaccination, and, if so employed, will probably cause a sore from its irritating effect, but not of a specific character. If, in place of the true vaccine vesicle, the eruption presents the appearance which I have described, namely, that of a pustule, soon breaking and forming a large, irregular, yellowish scab, the vaccinia—if it is correct so to designate it—must be considered spurious. A sore has been produced by the animal matter which was employed in the vaccination along with the virus, which has modified the action of the virus, and probably has rendered it useless as a means of protection; or there may have been no virus inserted with this animal matter. The physician should in such cases insist on a second vaccination.

Cases like the above are of frequent occurrence, and the parents of the child are often satisfied with the result. They see an eruption following the vaccination, accompanied by considerable inflammation, and leaving a cicatrix. Unless undeceived by the physician, they are apt to remain in the belief of the child's security, until, perhaps, it takes smallpox. Such cases, obviously, tend to diminish the confidence which the public should have in vaccination as a means of protection from smallpox, and on account of their frequent occurrence it is important in all cases that the physician should see the result of his vaccination. It has been proposed, as a means of determining the genuineness of the vaccinia, to revaccinate when the eruption begins, and if the first is genuine, the second will overtake it. This is called Brice's test; but it is not necessary, since the physician, familiar with the appearance of the true vesicle, can determine at once its genuineness by the sight.

Protection from Vaccination—Revaccination.

It was believed by the early advocates of vaccination that the general performance of this operation would soon eradicate smallpox from the community, so that it would be interesting only to the medical historian as a scourge of past ages. This result, however, is not achieved. As a rule, the greater the benefit of any measure designed to ameliorate the condition of mankind, the greater and more numerous are the obstacles which diminish its effectiveness. Science is full of examples of this. Fortunately these obstacles, as regards vaccination, are not such as to impair the confidence of physicians in its protective power, and it is not too much to expect that this simple operation will yet be the means of rendering smallpox a disease almost unknown, unless in its modified form.

Vaccination should be performed in the first year of life. In the country, where there is little danger of exposure to smallpox, it may be deferred till the age of ten or twelve months. In the city, on the other hand, where there is constant intercourse of people, and where contagious diseases are often contracted in ignorance of the time and place of exposure, an earlier vaccination is advisable. Some physicians recommend performance of the operation as early as the age of four to six weeks. The objection to this is, that if erysipelas occur, so young an infant is apt to perish from it, whereas an infant three or four months old ordinarily recovers. For this reason I believe that the most suitable age is about four months for the city infant, in ordinary times ; but if smallpox is epidemic, vaccination should be performed at an earlier age. I have vaccinated even the new-born infant when smallpox had broken out in adjoining apartments.

Vaccinia usually extinguishes, for a time, the susceptibility to smallpox. According to M. Gintrac, varioloid does not occur within two years in those who have been vaccinated. It may, however, in exceptional instances, occur in a mild form within a few months after vaccination. The protection afforded by vaccination gradually diminishes by time, but it does not, probably, as a rule, cease entirely. Varioloid, however, occurring thirty or forty years after a successful vaccination, is apt to be severe, and it may even be fatal, showing that it has been but slightly modified. In other cases, even after so long an interval, the symptoms present a degree of mildness which indicates that the protective power of the vaccination is not entirely lost.

If a second vaccination is practised soon after the scab from the first vaccination has fallen, it will usually produce no result, but in other cases it gives rise to a little redness, swelling, and induration, which show that vaccinia has been reproduced, though in a very mild and insignificant form. It is probable that in these cases varioloid might also occur by exposure, though with a mildness corresponding with that of the vaccinia. The longer the period after the first vaccination, the greater the number of

those in whom a second vaccination is effective, and, as has already been intimated, the greater also the liability to the variolous disease if a second vaccination is not performed. Therefore a second vaccination should be performed about the sixth or eighth year, and again between the fifteenth and twentieth year. And if smallpox is epidemic, it is proper to vaccinate all who have not been vaccinated within three or four years.

Selection of Virus.

The lymph is preferable to the scab for vaccination, provided that it can be obtained fresh. The scab is more easily preserved, and, therefore, if the lymph and the scab are old, the latter is to be preferred. The lymph should, if the vesicle is sufficiently developed, be taken on the fifth day. It may also be taken on the sixth, seventh, or even eighth day, provided that the areola has not formed. The lymph of the fifth day acts with greater energy, though that of the sixth or seventh day is not much inferior. Lymph obtained after the formation of the areola is less efficient, though it may communicate the genuine disease.

There is no mode of vaccination so reliable as the use of lymph, taken directly from the arm and immediately inserted—the arm to arm vaccination. Lymph can be preserved for a few days on a flattened surface of whalebone, or the segment of a quill, and if employed within a week, it will usually communicate vaccinia. Lymph may be preserved a longer period between two surfaces of glass, but the best way of preserving it is in capillary glass tubes. The end of the tube is placed within the vesicle, and the lymph ascends by capillary attraction. When a sufficient quantity is received, the ends are sealed, by holding them for a moment in a flame. Care is requisite in doing this, so as not to heat the lymph, as it is spoiled by a temperature much above the body. When the lymph is used, the ends of the tube are broken, and by blowing gently through it, a sufficient quantity is received on the point of a lancet.

If the scab is genuine, it presents a dark-brown or mahogany color, and has a circular, oval, or at least a rounded form ; it is firm, or compact, and has a lustre. Soft, yellowish, and irregular scabs are not genuine, and those of a dull appearance, or without lustre, have usually spoiled in the keeping. The scab is best preserved in soft beeswax, which excludes the air, and it should be kept in a cool place. It is the belief of many that the vaccine virus gradually becomes weaker by passing successively through the human system (Condie, *American Journal of the Medical Sciences*, April, 1865), and that therefore different specimens of virus work with different energy, according to the degree of removal from the cow. To what extent this view is correct is not fully ascertained, but, certainly, if the virus employed continues to produce a small vesicle, attended only by a little inflammation, there is reason to believe that the protection

which it imparts is less than that from virus which works with greater energy, and it should be exchanged for such. In New York we are able to obtain at any time lymph directly from the heifer. It has never passed through human blood, for the original lymph came from cattle in one of the provinces of France, where vaccinia was prevailing epidemically. The popular objection to vaccination is obviated by the use of this lymph, but it works with great energy, producing a large pock, and a sore which is often a month in healing. I have found it very reliable, and prefer to use it in ordinary cases.

CHAPTER VI.

VARICELLA.

Varicella, chicken-pox or swine-pox, is the shortest and mildest of the eruptive fevers. It is highly contagious, so that few children escape who are exposed to it. Its period of incubation is from fifteen to seventeen days. It is not inoculable, or at least those who have attempted to inoculate with the lymph of varicella have failed. I endeavored to communicate the disease in this way some years ago, but without result. It attacks the same individual but once, and it occurs as an epidemic. It has been thought by some, to prevail most, immediately before, during, or after epidemics of smallpox, and it has been conjectured that it is a modified form of variola, and hence its name, which signifies little variola. This idea is, however, entertained by few, and it is opposed by the following facts: Varicella may occur after variola, or variola after varicella, without any modification, and the two diseases are very dissimilar as regards gravity of symptoms and duration. The variolous disease, whether smallpox or varioloid, often occurs in the adult; varicella, on the other hand, is a disease of infancy and childhood. Professor Flint states that he has observed it in the adult, but its occurrence at this period of life is rare. Moreover, varicella and variola have been known to occur simultaneously in the same individual. Such a case was reported by M. Delpech, in a memoir published in 1845.

Symptoms.—Varicella usually commences with such symptoms as usher in ordinary mild febrile attacks, namely, headache, languor, chilliness, and sometimes aching in the back and limbs. Fever supervenes, which is usually moderate, the pulse rising perhaps to 100 or 112, and the thermometer showing an increase of temperature, but less than occurs in the other eruptive fevers. These symptoms which precede the eruption are sometimes absent, or are so mild as to escape notice. The fever usually

ceases on the second day, but it may return on the following night. The appetite is rarely lost, and most children continue, more or less, at their amusements.

When the above symptoms have continued about twenty-four hours, the eruption appears first over the trunk, and soon afterwards, over the face and limbs. The eruption consists of minute papules, which become vesicular in the course of a few hours. The occurrence of the vesicular stage is nearly simultaneous on all parts of the surface. The vesicles lack the hard indurated base of the variolous eruption, though they are sometimes surrounded by a faint zone of redness. They differ also from the variolous eruption in the absence of umbilication, and in irregularity of shape. Some are small and acuminate, some hemispherical, and of medium size, and others oval or elongated, and of large size. The inflammation is quite superficial, not involving the subcutaneous tissue, and scarcely affecting the deepest layer of the skin.

The vesicles vary in size from the diameter of half a line to that of even three lines. They occasionally give rise to slight itching. On the second day of the eruption, or third of the disease, the vesicles are still fully developed, their liquid contents being nearly transparent. At the close of this day the liquid begins to be somewhat cloudy, and its absorption commences. On the fourth day of the disease desiccation progresses rapidly, and by the fifth the liquid has for the most part disappeared, and there results a scab, small and thin, of a yellowish-brown color. The scabs are soon detached, the redness which indicated their seat disappears, the epiderm which had been raised and removed by the eruption is reproduced in its normal state, and in a few days all evidence of varicella is effaced. A cicatrix occasionally results, but it is due not to the simple varicellar eruption, but to a sore produced from the eruption by the scratching of the child.

The number of vesicles varies considerably in different cases. They are never, so far as I have observed, confluent; but they are sometimes so abundant in young children that, if the disease were variola, it would be called severe discrete.

Diagnosis.—Obviously the only diseases with which varicella is liable to be confounded are such as present vesicles at some stage of their course. From the local vesicular eruptions this disease is diagnosticated by the fact that the vesicles appear on all parts of the surface. It is sometimes mistaken for variola or varioloid or *vice versa*—a mistake very damaging to the reputation of the physician. The points of differential diagnosis are the symptoms of invasion—severe, and lasting three or four days in the one; mild, and continuing only one day in the other—an eruption passing slowly through its stages from the papulæ to the pustulæ, umbilicated, with circular, raised, aud inflamed base, appearing first on the face and neck, and not till a day later on the legs, in the one disease; while in the other

the evolution, shape, and course of the eruption, as described above, are materially different. By proper attention to these distinctive features it is rarely difficult to diagnosticate the two diseases.

The PROGNOSIS in varicella is always favorable. It does not, of itself, endanger life, nor seriously incommode the patient; nor does it give rise to complications or sequelæ. The TREATMENT, therefore, is the simplest possible. Mild diet, and a laxative, may be prescribed during the febrile period; but nothing further is required.

SECTION III.

NON-ERUPTIVE CONTAGIOUS DISEASES.

CHAPTER I.

DIPHTHERIA.

Diphtheria is a disease of antiquity, dating back at least as far as the commencement of the Christian era. Aretæus, at the close of the first century after Christ, described the Malum Ægyptiacum as a malady, which occurred chiefly among children, and was characterized by a white concretion, spreading over the tonsils, a fetid breath, and in some patients by a return of food through the nostrils, and by great dyspnœa, ending in suffocation. Since the commencement of the sixteenth century, numerous epidemics of it have been observed in Europe and America, and at the present time, it is one of the most common and fatal epidemic maladies in both continents, while in many localities, especially in large cities, it is established as an endemic.

Age.—Diphtheria is pre-eminently a disease of childhood, a large majority of the cases occurring between the ages of two and ten years. Under the age of one year the younger the child the less the liability to it, and it rarely occurs prior to the fourth month. The age of the youngest patient in my practice, so far as I recollect, whose disease was undoubtedly diphtheria, was three months and a few days; but in one instance, I observed upon the fauces of an infant of six weeks, whose brother had just died of diphtheria, a few white specks, like grains of salt, over each tonsil, which disappeared in three or four days, without the occurrence of any marked symptoms, by the application of a solution of chlorate of potassa. Certain physicians, having charge of maternity wards, have observed a disease, occurring in new-born infants, which bears some resemblance to diphtheria, but which, if it be true diphtheria, presents anomalous features. Thus, Dr. W. S. Bigelow reports in the *Bost. Med. and Surg. Journ.* for March 11, 1875, ten cases, occurring between September and December, 1873, in the Boston Lying-in Asylum, all fatal but two. The prominent symptoms and anatomical characters were: dark hue of skin, hæmaturia, pseudo-membranous exudation upon certain mucous surfaces, dark green stools, spleen enlarged and dark, kidneys engorged, and in some of the cases

effusion of blood into the pelves of these organs, and along the urinary tract, brownish casts in the renal tubes, etc. Since, so far as can be learned from the account, the mothers and other inmates were not affected with diphtheria, we must doubt the genuineness of these cases. Cases are infrequent after the middle period of life, and old age seems to possess nearly an immunity from diphtheria.

Incubation.—It is only in exceptional instances that we are enabled to ascertain the incubative period of diphtheria. I was enabled to fix it very nearly in the following cases which occurred in my practice. A boy of nine years was in the same room, about one hour on Saturday, with a child who had fatal diphtheria. On the following Tuesday, without any other exposure, he sickened with a malignant form of the same disease. Mrs. E. assisted in nursing a fatal case of diphtheria, from November 11 to 13, 1874, after which she returned home, several blocks away. On the evening of the 15th she complained of sore throat, and on the following day the diphtheritic pseudo-membrane was observed over her tonsils. On the 19th the exudation had disappeared, and she was convalescent. On the 20th her sister residing with her, and who had not been elsewhere exposed, was similarly affected, and after three or four days also convalesced. The only other case in the family, a boy, sickened with diphtheria on December 2. In the first of these cases the incubative period seems to have been from two to four days; while in the last, it was apparently longer. In April, 1876, a little girl died of malignant diphtheria in West 41 Street, New York city. Her sister, aged one year, remained with her from April 14 to 17, when she was removed to a distant part of the city, and placed in a family where there was no sickness, and had been no diphtheria. On the night of April 24, seven days after her removal, this infant was observed to be feverish, and on the following day, when I was called to examine her, the characteristic diphtheritic patch had begun to form over the left tonsil. In April, 1875, two sisters, aged seven and five years, resided with their parents, in a boarding-house, in West 22d Street, New York. A playmate in the same house had symptoms which were supposed to be due to a cold, but which were diphtheritic, when one night severe laryngitis occurred, and ended fatally the next day. The physician who had been summoned diagnosticated diphtheria, and the two sisters were immediately removed to a hotel. But seven days subsequently, diphtheria commenced in the older child. The younger was then removed to a distant part of the same hotel, but on the sixth or seventh day subsequently she also became affected with a fatal form of the disease. It is seen that the period of incubation in diphtheria, like that in scarlet fever, varies in different cases. It is from two to eight days, with perhaps an occasional case outside these limits.

Nature.—Diphtheria resembles scarlet fever in certain particulars; in its incubative period, as we have seen above, in its variability of type from

a very mild to a malignant form, in the common seat of its inflammations, namely, upon the fauces and nasal passages, in the profound blood poisoning and prostration in the graver cases, and in the frequent occurrence of nephritis as a complication or sequel. It resembles both scarlet fever and smallpox in the fact that it is communicable both through the atmosphere and by contact or inoculation. It resembles erysipelas in the variableness of its duration, and in the fact that one attack does not protect the system from another. In its etiology it resembles typhoid fever, for it is not only communicable from person to person, but it is produced by foul exhalations, as sewer gases. But while there are certain resemblances, it is distinguished from all these infectious diseases by marked peculiarities.

Diphtheria is primary or secondary. The secondary form most frequently occurs during epidemics of the other infectious diseases, and as a complication of them. Those infectious diseases which are accompanied by inflammation of the fauces and air passages, are most liable to this complication if they occur in a locality where diphtheria prevails; the inflammations of the mucous surfaces in those diseases being transformed into the diphtheritic. In New York, scarlet fever beyond any other disease appears to furnish the conditions, which are most favorable for the occurrence of diphtheria, and if these maladies are epidemic in the same locality, not a few of the scarlatinous patients are affected with diphtheria in the latter part of the first, or in the second week, though the converse seldom happens, that a patient with diphtheria contracts scarlet fever. The other infectious diseases, which are most liable to the diphtheritic complication, are measles, variola, whooping-cough, and typhoid fever, the bronchitis of these diseases changing to a pseudo-membranous inflammation.

It is an interesting fact that in a patient suffering from diphtheria, the specific inflammation is apt to occur upon such surfaces as are already the seat of inflammation. A catarrhal inflammation however produced is liable, under the influence of the virus, to become diphtheritic and pseudo-membranous. Thus, if I recollect correctly, four children in the New York Foundling Asylum have had diphtheritic conjunctivitis, occurring upon trachoma, and Billroth remarks "catarrhal conjunctivitis, which is so very common, may become diphtheritic" (*Surg. Pathol.*, translated, page 267). All who have seen much of diphtheria are familiar with instances in which a catarrhal inflammation, as from a burn, blister, or wound, as from tracheotomy, becomes diphtheritic. This general fact, in regard to the nature of diphtheria, and its mode of manifestation, namely, that in one affected by diphtheria, the diphtheritic inflammations appear by preference upon such surfaces as are already inflamed, has an important practical bearing. In a number of instances during epidemics of diphtheria, I have known careful and experienced physicians suppose that they were treating catarrhal inflammation of the air passages, when suddenly

indubitable signs of diphtheritic disease occurred, usually with a fatal ending. They were obliged to confess to the friends of the patients that they had erred in diagnosis and prognosis, and their reputation was sometimes seriously compromised. Now may there not, at least in a certain proportion of such cases, be an actual change of a non-specific catarrhal or may be croupous to a diphtheritic inflammation, such as occurs in the scarlatinous angina or rubeolous laryngitis in those who contract diphtheria?

The frequent occurrence of epidemics of diphtheria during the last twenty-five years, and the great mortality which has attended them, have awakened an interest in this malady which has led to a careful study of its causes and nature. Till recently these inquiries were entirely clinical, but, during the last few years, a new line of investigation has been followed, namely, that of experimenting on animals, the results being observed by the microscope; and while it has led to the confirmation of facts already ascertained, important discoveries have been made, and more important ones are probably in waiting. Among those who have taken the lead in this new field of investigation are Oertel, Bühl, and Hueter, of Germany. These microscopists, and several other experimenters of equal reputation who uphold their views, believe that they have discovered the cause of diphtheria, standing, as Oertel says, "on the very borders of the visible," with a high power of the microscope.

This discovery is so important, not only in itself, but from the promise which it gives of the results of future research, and from the stimulus which it imparts to such inquiries, that a brief statement of the facts in reference to it cannot fail to be interesting at the present time, when diphtheria is so prevalent and fatal in this city and country. The minute objects which the observers alluded to have discovered in patients affected with diphtheria, and which, they suppose, cause the disease, are endued with life and motion. They belong to the class of microscopic vegetable parasites, which have been designated *bacteria*. The bacteria have been divided by Cohn into four genera, with species; but only two of these, it is thought, sustain a casual relation to diphtheria, namely, the spherobacterium or spherical bacterium, or, as Oertel designates it, the *micrococcus;* and secondly, though in less degree, because less numerous, though coexisting with the other form, and penetrating the tissues with it, the *micro-bacterium*, or rod-like bacterium.

The microscope, in the hands of various observers, has revealed the following important facts relative to diphtheria: In every tissue which is the seat of diphtheritic inflammation, and in every diphtheritic pseudo-membrane, the spherical bacteria occur in immense numbers, accompanied by a smaller number of the other kind. In severe cases, in which the system is infected, they occur also in the blood. Ordinarily, as the symptoms of diphtheria become more grave, a proportionate increase in the number of

spherical bacteria can be demonstrated by the microscope. They are found in the discharge from the edges of the wound produced by tracheotomy, performed in the treatment of diphtheritic laryngitis, and upon these edges they multiply rapidly, just before a pseudo-membrane forms. If, upon any surface, which is the seat of ordinary catarrhal inflammation, other vegetable organisms, as the leptothrix buccalis, or oidium albicans, are present — if diphtheritic inflammation supervene, these organisms diminish and disappear, as if deprived of the required nutriment, and are succeeded by the sphero- and micro-bacteria, which increase in numbers as the specific inflammation extends. On the other hand, when the diphtheritic inflammation abates, these bacteria disappear, and other vegetable forms may succeed. In the very commencement of diphtheria, the grayish-white spots which appear upon the inflamed surface consist entirely of these bacteria, with epithelial cells and mucus, while fibrin and pus appear at a later period, as a result of inflammatory reaction.

These facts having been ascertained, various experiments were made by Oertel, Hueter, Von Trendelenburg, Nasseloff, Eberth, and others, in order to determine more fully the exact relation of the sphero-bacteria and micro-bacteria to diphtheria. These organisms were not found in the croupous membrane, produced by the application of a powerful chemical agent, as ammonia, nor upon the inflamed surface underneath the membrane, "although the fibrous exudation afforded a soil which varied little or not at all in its bistological and chemical composition from that induced by diphtheria." (Oertel.) The mucous membrane of the air passages, the cornea and muscles in animals, were inoculated with diphtheritic matter, and these two kinds of bacteria were found to increase rapidly, penetrating the tissues in a short time, and infecting the system. Oertel says: "I have noticed in numerous inoculations that if various bacteria, besides the micrococcus, as, for instance, bacillus, spirillum, and bacterium lineola, were present in the matter to be inoculated, only micrococci (sphero-bacteria) and the bacterium termo (in its most minute forms accompanying them) showed evidence of prolific growth, while all the other forms disappeared altogether." Nasseloff and Eberth inoculated the cornea with diphtheritic matter, and found that the sphero-bacteria and micro-bacteria penetrated its layers, forcing them apart, and causing within a few days intense keratitis and the death of the animal by infection of its blood. "In the same way," says Oertel, "according to my experiments, the bacteria spread over the mucous membrane of the trachea, beset the cellular elements, crowd especially into the young exudation cells, or are taken up by them, and gradually cause their dissolution; they fill the blood- and lymph-vessels, and bring about, in a mechanical way, a damming up of the fluids, and, as a consequence, serous exudation. As they close up the capillary vessels, they occasion stagnation in the blood circulation, which induces disturbance of nutrition in the walls of the capillaries, and even

rupture of the same. Muscular fibres, also, which are covered and filled with colonies of micrococci, degenerate and slough; in like manner, in severe cases, immense numbers of bacteria appear heaped up in the uriniferous tubules and Malpighian corpuscles of the kidneys, and occasion there parenchymatous inflammation, capillary embolism of the glomeruli of the kidney, with ruptured vessels and formation of epithelial casts in the tubes. In the lymph and blood streams (compare also Hueter), in long-continued sickness of the animal experimented on, these bacteria also accumulate in masses. They induce, as exciters of decomposition and disorganization of organic nitrogenous bodies, septicæmia, through the vegetative process they undergo, and through their relation to oxygen."

Finally, Erfurth repeatedly inoculated the cornea with a negative result, using for the purpose diphtheritic material from which the bacteria had been so far as possible separated.

The importance of such experiments cannot be too highly estimated. In the opinion of those who have performed them, the conclusion is inevitable that diphtheria is produced by bacteria, which, coming in contact with the mucous membrane, or the cuticle deprived of its epidermic covering, adhere to it; and these, multiplying rapidly, burrow through the tissues, and, entering the vessels, infect the whole system. The reason assigned why diphtheritic inflammation in most cases appears primarily and chiefly upon the faucial and nasal surfaces is, that the air, which contains the germs of the bacteria, constantly passes over these surfaces, and, as regards the fauces, the ingesta also, which may contain them. The important practical inference from this theory is, that diphtheria is entirely local in its commencement, and is amenable to local measures.

These experiments, apparently so conclusive, and the brilliant results claimed for them, probably produce at first in most persons engaged in microscopical or pathological studies, a degree of enthusiasm in the belief that a new era is dawning in our knowledge of the contagious and miasmatic diseases. And since the German microscopists and pathologists are close and accurate observers, we accord to their researches and opinions a degree of credence which we are reluctant to yield to our own scientists who are engaged in similar studies.

But the causes and nature of a disease cannot, in general, be fully elucidated by experiments alone, such as have been detailed. They should be aided or supplemented by clinical observations, and of these, as regards diphtheria, we have had an abundance in New York during the past fifteen years. Clinical observations may modify or correct the theories derived from the results of experiments.

Two distinct propositions are evidently included in the bacterian theory, to wit: that bacteria cause diphtheria, and secondly, that this disease is at first local, and that afterwards it becomes constitutional or general by the entrance of the specific principle into the blood. Whether diphtheria is

primarily local or primarily constitutional, or is in some at first local and in others at first constitutional, is of course a distinct proposition from that regarding the relation of bacteria to the malady; and whatever the truth may be in reference to the one, does not affect the other.

It is evident that the truth regarding the relation of bacteria to diphtheria is either that they are the specific principle, and therefore cause the disease, or that the cause is something more subtle, not yet discovered, which produces such deterioration of the tissues and blood, that they become a nidus, in which bacteria are early and rapidly developed. My own belief is more and more established, that the latter is the true theory, and that those who believe otherwise have mistaken an effect for the cause. As a deteriorated condition of the buccal surface and its secretions furnishes the nidus, in which the *oidium albicans* springs up, so, it seems to me not improbable, that those minute organisms found in and upon the tissues in the infectious diseases, as that seen by Letzerich in pertussis, and the bacteria in diphtheria, will yet be shown to be secondary productions, and not causative agents. From the very early appearance of bacteria in diphtheritic processes, we may believe that they sustain a close relation to the specific principle, and that this principle is even attached to them, so that they are agents of infection, and yet withhold our assent from the doctrine that they are, themselves, the specific principle, or that it proceeds from them.

With an experienced microscopist of New York, I have examined the secretions and exudations upon the fauces in various cases of pharyngitis, both diphtheritic and non-diphtheritic, and we ordinarily found the micrococcus in abundance in the inflammatory product, whether diphtheritic or non-diphtheritic, a secretion or exudation, if it had remained some time upon the surface of the fauces. In one case of simple pharyngitis, no bacteria could be discovered on the first day in the secretion which lay in the depressions over the tonsils, while, on the second day, numerous micrococci had appeared. Micrococci, then, which are not distinguishable with our present means of observation from those in a diphtheritic exudation, may occur in great numbers in the secretions of non-specific inflammations, so that their presence does not afford certain indication of the diphtheritic disease. It is also well known that bacteria, which seem to be identical with those in diphtheria, are frequently found upon the gums and between the teeth in health. Moreover, in the intervals of epidemics, and in localities where diphtheria has not occurred, or has occurred rarely, the microscope discloses the existence of bacteria, which resemble in form and activity those found in diphtheritic products, and in sufficient numbers to justify the belief that they frequently pass over the fauces in the inspired air. How remarkable, if the bacterian theory is true, that fungi, which, under ordinary circumstances, are innocuous, should exhibit the fearful energy and destructive power which we observe

in diphtheria! It has however been suggested to me, that the diphtheritic bacteria may possess peculiar functions and properties, since it is very difficult to observe differences which may exist and classify organisms which are "just on the borders of the visible." A fact which, till it is satisfactorily explained, must, I think, throw doubt on the bacterian theory, is that the bacteria do not irritate the lungs. If, during inspiration, they are carried along the current of air, and certain of them lodge upon the fauces, where they produce the specific inflammation, a larger number must enter the lungs, where we would suppose, from the delicate structure of these organs and their proneness to inflammation, they would produce severe results; so far from this occurring, bronchial and pulmonary catarrhs are rare at the commencement of diphtheria, and not common at any stage of the malady.

Since the publication of the bacterian theory, I have made microscopic examinatlons of diphtheritic pseudo-membranes, in order to observe the form and movements of the micrococci, and the effect upon them of the medicinal substances which I have been in the habit of applying to the throat in diphtheria. With a magnifying power of 500 diameters, these parasites are seen as dancing or oscillating points, or rather as minute cells, shining or opaque, according to their distance from the eye. No one can, I think, observe their constant motion without admitting that they may, when in colonies, be irritants of the tissue with which they are in contact in the system, diverting nutrition and disturbing the function; and without also believing, since they are so much smaller than the blood-corpuscles, that multitudes of them may enter the circulation, since, in the deepest portion of the pseudo-membrane, they are in immediate relation with the capillaries and lymphatic vessels. It is not improbable, in view of these facts, that the spanæmia of diphtheria is partly attributable to these organisms in the lymph and blood, for they could hardly exist in these liquids in any number without interfering seriously with the nutritive process.

We may, therefore, believe that bacteria play a certain part in producing the diphtheritic cachexia, while we hold that the specific principle has probably thus far eluded the very thorough search instituted for its detection. Does not also the prevalence of inflammatory throat affections, some of which are very mild, during an epidemic of diphtheria, indicate an obscure meteorological cause of the disease quite distinct from the bacteria? Moreover, does not that common sequel of diphtheria, namely, paralysis, indicate that there is something peculiar in the diphtheritic virus, that it is distinct in nature and action from the bacteria and from septic poison?—for those who recover from septicæmia, as it occurs in surgical and other cases, and in which disease bacteria are abundantly developed in the blood, have no special liability to paralysis. Another fact, indicating a cause distinct from the bacteria, but a cause acting pro-

bably in the same manner as that of scarlet fever and measles, is the long incubative period in certain cases, as we have seen above. Fungi visible under the microscope, and multiplying with great rapidity, would not probably remain a whole week in or upon the tissues without producing the least symptom, and then suddenly produce a dangerous disease.

If the views expressed above be correct, it seems probable that diphtheria is a constitutional disease from its inception. With sufficient observation of cases, and careful examination of the clinical history, facts appear which, I think, will lead most observers to this conclusion. The importance of the subject will justify the following statement of some of these facts.

1. It is a law in pathology that those diseases which have or may have a long incubative period—say of a week or more—are constitutional.

2. Another fact, which indicates primary blood poisoning in diphtheria, is observed in certain cases, namely, the *occurrence of severe constitutional symptoms for a longer or shorter time, perhaps for half a day, before the appearance of the usual inflammation.* Thus a girl of five years, having malignant diphtheria, whom I saw in consultation, was carefully examined on the first day of her sickness by the attending physician, and, although he closely inspected the fauces, there was no appearance which indicated the nature of the malady till the subsequent day. In such cases, a sufficient number of which I have observed, there is apt to be complaint of soreness of the throat, or difficulty in swallowing, almost from the beginning of the general symptoms; but the pain and tenderness seem to be in the deeper tissues of the neck, and the fact that redness of the mucous surface does not appear till some hours subsequently, is evidence that the inflammation is developed from within, and not from the irritating effect of the poison upon the surface.

Again, treatment of the inflammations by the most reliable and efficient antiseptics and disinfectants which we possess, commenced at the earliest possible moment and repeated at short intervals, does not prevent the occurrence of indubitable symptoms of blood poisoning in cases of a severe type. Thus I have treated every portion of the inflamed surface, as far as it was accessible, every second or third hour, with carbolic acid and other disinfectants, almost from the very commencement of diphtheria, and so thoroughly that any vegetable or animal poison, with which the remedies had come in contact, would probably have been destroyed, or rendered inert, and yet, except in mild cases, symptoms of diphtheritic blood poisoning have occurred, and as early and uniformly as if less energetic local measures had been employed. While, therefore, I do not fail to recommend local treatment as calculated to diminish septic poisoning, and relieve the inflammations, I have lost confidence in it as a means of preventing the entrance of the diphtheritic poison into the blood. Its powerlessness to prevent contamination of the blood by the diphtheritic

virus is an additional evidence that this contamination occurs independently of the local disease, and probably precedes it.

3. *The quick succumbing of the system in certain malignant cases* is evidently due to diphtheritic toxæmia. We sometimes observe a fatal result on the second, third, or fourth day, without any dyspnœa, or sufficient laryngitis to compromise life. Cases of this kind, terminating fatally even in the first day, have been reported. The system is suddenly overpowered by the poison, struck down, as it were, by the profound blood change, while the inflammations are still in their incipiency.

4. Important evidence of the constitutional nature of diphtheria is afforded also by the *state of the kidneys*. No internal organs are so often affected in diphtheria as the kidneys, and on account of their location and anatomical relation, it is evident that the poison first passes through the system before it reaches them. Any clinical or anatomical fact, therefore, which indicates that the diphtheritic virus has reached and affected the kidneys, affords proof that it has penetrated the system, and poisoned the blood. Now the occurrence of albumen, with granular or hyaline casts, in the urine, in cases unattended by dyspnœa, affords proof of nephritis, caused by the action of the poison on the kidneys.

Sir John Rose Cormack, of Paris, in a series of interesting and useful papers relating to diphtheria, published in the *Edinburgh Medical Journal* during 1876, states that albuminuria, and of course the nephritis on which it depends, sometimes begin as early as the first day. My observations confirm this statement, as in the following cases :—

Case I.—L. McD., aged three years, was first visited by me on February 29, 1876. I learned from the parents that she had been feverish during the preceding forty-eight hours, and her urine very scanty. A moment's examination was sufficient to show that the case was one of malignant diphtheria, for the fauces were already nearly covered by the diphtheritic pellicle, the temperature was $103\frac{1}{4}^{\circ}$, and the pulse 140. The skin was hot and dry, and there was moderate swelling under the ears, and a muco-purulent discharge from the nostrils. On account of the scantiness of the urine, the amount not exceeding f ℥iv–v daily, it was impossible to obtain sufficient for examination till the following day. It was then found to have a specific gravity of 1032, to contain a deposit of urates and hyaline and granular casts, a diminished amount of urea, and a large quantity of albumen. It can hardly be doubted from the scantiness of the urine, and the large amount of albumen found when the urine was first examined, that albuminuria had been present on the first day.

Case II.—The following was a similar case: K., aged four years, living in West Thirty-sixth Street, was visited by me in consultation on Jan. 29, 1875. Her sickness had also continued forty-eight hours; her fauces were swollen, and covered with the diphtheritic pellicle, which was dark and offensive; respiration guttural; pulse 120; temp. 101°; she had a free discharge from each nostril; urine scanty, its specific gravity 1030; it contained a small amount of albumen, with casts, and a large amount of urates, with no apparent diminution of the urea. Death occurred on the fourth day.

In such severe cases, in which albumen and casts are found in the urine at the first visit of the physician, there can be little doubt that the nephritis begins nearly or quite as early as the pharyngitis, and therefore, since poisoning of the blood must antedate the renal disease, diphtheria is in these cases very early, probably from the occurrence of the first symptoms, a constitutional malady.

Again there are cases, though not frequent—three I can recall to mind during the last two years in my practice—in which the external manifestations of diphtheria are very mild, even insignificant, and quickly cured, but in which the kidneys are severely affected. The occurrence of such cases is best explained on the supposition that the first departure from the state of health is in the blood, and that the blood change gives rise to the inflammation of the mucous membrane externally, and of the kidneys internally, rather than upon the supposition that the transient and insignificant inflammation of the mucous membrane is the first event in the series of morbid changes, and that this inflammation leads to poisoning of the blood, and the establishment of a much more severe and protracted inflammation in the kidneys. The following are histories of the cases alluded to:—

The house 229 West Nineteenth Street, New York, is an old wooden structure, and the family, which has occupied it during the last five years, has been three times visited by diphtheria, the first case, that of the oldest child, proving fatal. In February, 1876, one of the children had diphtheria in a moderately severe form. He recovered, and, after my visits had been discontinued, his sister, aged six years, who had had scarlet fever when eighteen months old, became feverish, and complained of her throat. No rash appeared on her skin, and there was apparently no coryza. Inspection of the fauces by the parents revealed a small diphtheritic patch over each tonsil. Although diphtheria was so frightful a malady to this family from their past experience, the case seemed so mild that the parents treated it without medical attendance, by the remedies which had been employed for the boy. A mixture of carbolic acid, subsulphate of iron, and glycerine, was applied to the fauces every third hour, sufficiently often, apparently, to destroy all bacteria or other vegetable or animal organisms with which it might have come in contact, and within two or three days the inflammation of the throat seemed to the parents to be cured. Nevertheless, with this insignificant inflammation of the fauces, so quickly subdued, and with no other apparent inflammation of the mucous surfaces, there was severe internal disease going on as the result of the general infection. The child did not regain her former appetite; she had increasing pallor, although able to play about the house; and, finally, in the third week, when I was called to see her, slight œdema of the face and limbs was observed. Her urine, which was scanty, was found to contain pus and blood corpuscles, albumen, and granular casts, and nearly two months elapsed before, under treatment, it became normal, and her health was restored.

The second case occurred in January, 1878, in West Fifty-first Street. A boy, aged six years, in a family in which diphtheria was occurring, had slight sore-throat, which abated in two or three days. It was attended

by little or no exudation, and would not have been considered diphtheritic, except for the circumstances in which it occurred, and the subsequent history. Still, the boy remained ill, and fretful, and four days subsequently his urine was found to be very scanty and very albuminous; and three days later death occurred, preceded by total suppression of urine. The last urine passed, which was not more than a teaspoonful, became nearly semi-solid by heat. There had been no scarlet fever in the family.

The above facts indicate, in my opinion, the constitutional nature of diphtheria; but within the last few years the old doctrine that diphtheria is local in its commencement, and is, therefore, at least in many instances, amenable to local treatment early applied, has been so revived, and promoted by the advocates of the bacterian theory that it has had a marked influence upon the treatment. It does, indeed, sometimes seem as if mild cases, which may apparently fully recover in two or three days, with only local measures, could not be attended by systemic infection; but we observe the same mildness, though less frequently, in scarlet fever. And not infrequently, even in the mildest cases, the constitutional nature of diphtheria is shown by the return, and return more than once, of the pseudo-membrane after it has been fully removed by local treatment. The persistence of the inflammation, and of its peculiar exudative nature, corresponds more with the history of those phlegmasiæ which proceed from the state of the blood, than of those which are merely local.

Diphtheria, as experiments on animals and the histories of many reported cases show, is sometimes communicated by inoculation. Most frequently, however, the virus is received from an infected atmosphere. The anti-hygienic conditions in which it originates are well known. Many cases in New York are traced to sewer gases, which have escaped into houses through imperfect plumbing.

When diphtheria reappeared in New York in 1858, after an absence of more than fifty years, some of the first and most severe cases seen by myself occurred in the upper part of the city, along the old water-courses, where in consequence of street grading, water was stagnant and impregnated with decaying animal and vegetable matter. Though observing and treating diphtheria, both in its epidemic and sporadic form, during the last twenty years, I have not observed an instance in which it seemed to be communicated from house to house by the clothing, as we frequently observe in cases of scarlet fever, and sometimes of measles. When it spreads from house to house, or even from room to room, in the same house, I think that it is almost always by the visits of persons having diphtheritic inflammation. The area of contagiousness of diphtheria is therefore limited to the room in which the patient resides, or to his immediate vicinity.

But it is well known that the sputum of a diphtheritic patient and bits of diphtheritic pseudo-membrane may communicate diphtheria. The ex-

periments indeed show this, as do many observations published in the records of diphtheria. Therefore, caution is required that children be not needlessly exposed to the handkerchiefs or towels employed by a patient, nor to his breath, especially during the act of coughing. We may here repeat that in localities where diphtheria is endemic or epidemic, certain constitutional diseases sustain a causative relation to diphtheria. Thus scarlet fever furnishes the conditions in which diphtheria arises in a house whose sanitary state is apparently good, and when there has apparently been no exposure to a diphtheritic patient. And in three instances I have known diphtheria thus originating to become dissociated from scarlet fever, and spread as a primary and independent malady.

Anatomical Characters.—In the commencement of diphtheria we observe redness of some portion of the mucous surface. In most cases it is the faucial membrane which is first affected, and that part of it which covers the tonsils. If there is a pre-existing inflammation of one of the other mucous surfaces, or a portion of the cuticle denuded of its epidermis and inflamed, the specific inflammation is apt to appear primarily upon these parts, with or without its simultaneous appearance upon the faucial surface.

The inflammation varies greatly in severity and extent. In a mild attack it is often limited to a part of the fauces, and there are few exceptions to the rule that the tonsillar portion is affected, the redness gradually fading away in the healthy membrane beyond. In all except the mildest cases, the whole faucial surface is, in the course of a few hours, involved in the inflammatory process, its mucous membrane is thickened and softened, and its follicles tumefied, and actively secreting. In severe cases the uvula is elongated and enlarged from watery infiltration; the submucous connective tissue also becomes involved to a greater or less extent, and swells; and the submucous lymphatic glands, especially the tonsils, also swell, and are painful. The color of the inflamed surface is sometimes a deep, bright red, almost like arterial blood; in other cases it is a dusky red, which indicates a vitiated state of the blood. The dusky red hue is more common in secondary than in primary diphtheria; it is also common in the obstructive laryngitis of diphtheria, the color becoming more and more dusky as the obstruction increases.

Within a day, and usually within a few hours, from the commencement of the inflammation, a small slightly raised patch or spot is observed usually upon the tonsillar portion of the inflamed surface, of little importance, did the disease stop here, but very significant as a diagnostic sign, and as a forerunner of what is to happen. This patch, termed the pseudomembrane, gradually becomes firmer, and at the same time thicker and broader from fresh exudations underneath, and it has a grayish or grayish-white color. Sometimes different points or patches are observed, which extend and coalesce so that the fauces are almost entirely concealed from

view. The pseudo-membrane is closely attached to the mucous surface, which it penetrates, becoming firm, and not easily detached. Attempts to separate it often lacerate the engorged capillaries, producing a free flow of blood. It does not ordinarily attain a greater thickness than one-eighth to one-sixth of an inch. I have seen it, however, not far from one-third of an inch thick. By the microscope we observe numerous micrococci with a small number of rod-like bacteria in the meshes of the exudation. They can be traced through the subepithelial tissues, being adherent to and even incorporated in pus-cells, and entering into and blocking up the minute lymphatics and bloodvessels.

The same pseudo-membrane is often firmer in one part than another, the outer and central portions being more compact and tough for a time than that underneath, which is more recent, and in which there is less fibrillation. After a few days, however, decomposition commences, and then that which was first formed becomes softer than the more recent production. When this occurs, the color of the exudation changes from a whitish or a grayish-white to a dirty brown, and its exposed surface is uneven and jagged from the partial separation of shreds and fibres.

The escape of the liquor sanguinis from the engorged vessels diminishes somewhat the turgescence of the inflamed tissue. If this is considerable, the pseudo-membrane often sinks to the level of the surrounding surface, producing an appearance very much like that of an ulcer, or even of gangrene. Though there is no loss of substance in this stage of the pseudo-membrane, it does, however, often occur, being produced by the presence and contraction of the fibrin with which the mucous membrane is infiltrated. Sometimes the pseudo-membrane has a reddish tinge. This is due to rupture of the capillaries, and the escape of the blood-corpuscles. It occurs in those cases in which the inflammation is intense, and the capillaries are greatly engorged. Sometimes the lower part of the exudation is blood-stained, while the exposed surface has the usual grayish-white hue. For a very interesting and instructive description of the anatomical characters of the diphtheritic pseudo-membrane, the reader is referred to the treatise of Prof. Rindfleisch, of Bonn, relating to pathological histology. His description is as follows :—

"Genuine diphtheritis has no claim to be regarded as a specific process in the same measure as croup. That which microscopically characterizes it, and has become the occasion of placing it as a membranous inflammation is the formation of a whitish-gray, compact, felted membrane, which is elevated, perhaps, to the height of one-half line along the level of the mucous membrane, but penetrates just as deep into the substance of the mucous membrane, and is most intimately connected with the latter. This membrane is nothing that is superimposed, nothing secreted, but the mucosa itself, as far as it has been partly tumefied, partly rendered anæmic, even by the excessive infiltration with cells. This condition has not im-

properly been compared with a mortification by a chemical agent, with a corrosion, and the diphtheritic membrane has been designated as diphtheritic scab; in fact the diphtheritic membrane is a *caput mortuum*, it can undergo no other changes than those of putrefaction, of decomposition; and the question only is, how it is loosened and removed from the intimate organic connection in which it stands with the mucous membrane. A sharply defined boundary line separates, as we can convince ourselves with the naked eye, the living from the dead; but numerous connective-tissue fibres, bloodvessels, nerves, and elastic fibres, pass over from the living into the dead; they must all have separated ere the loosening can proceed. The means which are placed at the command of the organism are inflammation and suppuration. We call this inflammation 'reactive,' and unite with it the idea as though this were an answer to the irritation, which the diphtheritic scab exerts upon the surrounding mucous membrane; yet a portion of the hyperæmia also may be explained according to static principles as collateral fluxion. The pus collects between the scab and the healthy parts and always, accordingly as the fibrous bridges mentioned melt down and tear, the separation begins now at the edges, then at the centre. After it is completed an ulcer remains behind which is disposed to rapid cicatrization; not unfrequently, however, the process repeats itself again at the same place; we have a new scab, and with it anew the necessity of a purulent separation, after whose termination a very considerable loss of substance remains. The cicatrices finally resulting distinguish themselves by their capacity of vigorous retraction, so that the danger of subsequent contraction of mucous membrane canals, especially of the large intestine after dysentery, threatens so much the more, the more diffused the ulceration was." (*Text-book of Pathological Histology*, translated, page 354.)

Two of the microscopists of New York who, for years, have been engaged in microscopical and pathological studies, kindly consented to examine for me the anatomical characters in the following cases. The examinations in the first, second, and fourth cases were by Dr. Sutherthwaite; in the third by Dr. Heitzman, formerly clinical assistant to Prof. Rokitansky, in Vienna. The specimens were placed in a solution of bichromate of potassium immediately after their removal from the bodies:—

Case I.—H——, aged four years, and two brothers S., who lived directly opposite in the same street in New York, were daily playmates. On January 27, 1876, H—— became feverish and complained of sore throat, and four days subsequently died of malignant diphtheria. This case was carefully examined by me in consultation, and minute records of it preserved. Before it terminated, the two brothers S. became affected with diphtheritic laryngitis. The younger brother, aged three years, was for a time in a very critical state from the dyspnœa, but recovered in about one week. The older brother, aged six years, died, having the following history: On January 29, two days after the commencement of diphtheria

in his playmate, H——, he vomited and became feverish, and his voice hoarse. These symptoms continuing, I was asked to visit him on February 2. His respiration at this time was harsh, and audible in the adjoining room, and the cough croupy; pulse 96; temperature in axilla 100°; he takes considerable nutriment, and sits quietly, or walks about the room; fauces red, and slightly swollen, but without any diphtheritic exudation upon their surface; has slight glandular swelling underneath the ears; the urine contains no albumen, and the nitric acid test shows no excess of urea. The constant inhalation of the spray of lime-water is recommended, with the use of tonics. Feb. 4. Pulse 96, temperature 99°; breathes with much difficulty at times, but there is still no pseudo-membrane upon the fauces; has expectorated since the last record two thick pieces of pseudo-membrane, each about one inch in length, apparently from the larynx; specific gravity of urine 1022; it contains a deposit of urates, but no albumen; urea apparently somewhat in excess of the normal quantity. Feb. 5. Pulse 92; temperature 101¾°; has a small diphtheritic patch, not more than three lines in diameter, over the left tonsil. Feb. 6. The pellicle upon the tonsils has disappeared; the urine for the first time albuminous, thirty-six hours before death; its specific gravity 1024; temperature 103°; dyspnœa great; pulse about 120. Death occurred on Feb. 7.

Sectio Cadaveris, 19 hours after death; body spare, but not emaciated; rigor mortis present; has post-mortem extravasation of blood along the back, and a thin blood-stained fluid escapes from the mouth; two or three drachms of transparent liquid in the pericardial sac; a large yellowish-white clot fills the right ventricle, and is prolonged into the pulmonary artery; the right auricle also contains a large clot, soft and dark in its centre, but firmer and of a whiter color externally; left ventricle contains a few soft dark clots, with a little fluid blood; left auricle partly filled with blood of a tarry appearance; tonsils not enlarged, but soft, and a yellowish diffluent secretion lies in the depressions on their surface; subcutaneous glands of the neck slightly enlarged, one being somewhat larger than a filbert; under surface of epiglottis, and entire surface of larynx, covered by a firmly adherent pseudo-membrane which entirely conceals from view the vocal cords and the sinuses of Morgagni; the pseudo-membrane is continued over the surface of the trachea, being less adherent than in the larynx, and, near the bifurcation, it floats freely; it does not extend into the bronchus or bronchial tubes of the left lung, and this lung is normal. In the right lung the pseudo-membrane extends as far as the bronchial tubes of the third order; the upper lobe of the right lung is in the second stage of pneumonia, its cut surface being rough and granular, and liquid escaping from it on pressure; the right, middle, and lower lobes are congested, and in the lower lobe is a single hepatized nodule; those portions of the bronchial tubes which are not covered by the false membrane exhibit the appearance of catarrhal bronchitis. The liver is large, and not fatty; spleen small, moderately firm, and contracted (this is noteworthy, as the spleen has been found large and soft in diphtheria); kidneys congested and swollen, and a stellate appearance of the vessels under their capsules; surface of both small and large intestines congested.

Microscopic Examination.—Red corpuscles of the blood well-preserved, some of them round, others crenated, and all granular; large masses of transparent material, containing red corpuscles, floated in the blood. The rod and chain forms of bacteria were observed in the blood, but not in greater number than are often seen in other blood the same number of

hours after death. (A few grains of chloral had been added to this specimen of blood immediately after its removal.) Substance of heart apparently normal, showing no fatty degeneration, nor infiltration; no bacteria can be recognized in the substance of the heart. *Kidneys:* Right kidney examined; Malpighian bodies congested, and extravasations of blood throughout this organ; tubal epithelium granular; increase of connective tissue in points near periphery of kidney, showing insterstitial nephritis, but no increase observed in this tissue in other parts of the organ; no bacteria that could be certainly recognized as such in the kidney. *Spleen:* Multitudes of granules in scrapings from the cut surface of this organ, many of them so small as to be with difficulty recognized with a magnifying power of over 600 diameters; some of them gave the appearance of the usual forms of bacteria.

Larynx: Thickness of false membrane which covered the entire surface of this organ varied from $\frac{1}{1000}$ to $\frac{1}{25}$ of an inch; thickness of mucous membrane about $\frac{1}{500}$ of an inch; epithelial border of mucous membrane could be traced inwards $\frac{1}{2000}$ to $\frac{1}{1000}$ of an inch, where it became indistinct, merging into the other tissues which were more or less infiltrated with embryonic cells and blood. The false membrane consisted of a network of a homogeneous material, most of the meshes being empty, but those nearest the epithelial layer containing more or fewer epithelial cells. The boundary line between the false membrane and the mucous surface could not be distinguished by the microscope in many of the sections, the network of the pseudo-membrane extending into the mucous membrane. But in other places the line of separation could be distinguished, and here and there the pseudo-membrane and mucous surface were separated by collections of embryonic cells. The lymph follicles and racemose glands were apparently normal; mucous surface infiltrated with granular matter and red blood-corpuscles; cylindrical epithelial cells, some of them with cilia, were distinctly visible both along the free border, and in the under surface of the pseudo-membrane. *Trachea:* The false membrane measures from about $\frac{1}{1000}$ to $\frac{1}{300}$ of an inch in thickness; the mucous membrane $\frac{1}{500}$ of an inch, and its epithelial layer $\frac{1}{1200}$ of an inch; the epithelial cells are much more distinctly visible than in the larynx, and the line of separation of the adventitious layer and the mucous surface is everywhere distinctly seen under the microscope; the false membrane has the same general appearance as in the larynx; but the mucous membrane is in a better preserved state than that of the larynx; it is nevertheless infiltrated with granular matter, plastic matter, and red blood-corpuscles; lymph follicles and racemose glands apparently normal; in the trachea, as in the larynx, a large number of embryonic or lymphoid cells—most of them no doubt becoming pus cells—lay between the false membrane and the mucous surface.

Case II.—A second case, having the following history, occurred in the New York Foundling Asylum in New York. George, aged two years and seven months, was under treatment for a second attack of measles, the eruption appearing on March 23, 1876. On March 24, the pulse was 136 and temperature 104½°. The fauces presented a deep-red appearance, indicating severe pharyngitis, but without any membranous exudation. March 25. Pulse 140; temperature 103¼°; the rubeolar eruption is very thick over the entire surface. The Sister who has charge of the ward, noticing unusual offensiveness of the breath, has inspected the fauces and found on them the diphtheritic pellicle. March 26. Cough becoming

croupy, and voice hoarse; pulse 152, temperature 105¼°. From this date the dyspnœa progressively increased, and death occurred on March 30.

Sectio Cadaveris.—A considerable part of the interior of the larynx is coated with the diphtheritic pseudo-membrane, which is firmly attached to the mucous surface; it extends without interruption over the larynx, and perhaps over one-third to one-half of the tracheal surface. It is not attached to this surface, but hangs over it like a curtain, suspended from its attachment in the larynx. Further down in the air passages there is the usual catarrhal inflammation of the mucous surface.

Microscopic Examination.—Larynx: The false membrane is found to consist of a network, apparently fibrinous; in places, in the larynx, it is raised from the mucous membrane by an accumulation of embryonic or lymphoid cells underneath; in other places it is adherent to the mucous membrane, but with a line of attachment which can be distinctly made out with the microscope; while in other places still the network extends down into the mucous membrane, and no distinct line of separation can be seen. In the upper or exposed portion of the false membrane, no embryonic or lymphoid corpuscles are observed, but they are abundant in the deeper portion, and they infiltrate the whole mucous membrane extensively; upon the mucous surface, wherever the pseudo-membrane is detached, these corpuscles are abundant; in parts of the false membrane they fill so completely the interstices of the network that epithelial cells can scarcely be distinguished within them; in places, in the sections examined, the epithelium seemed to be wholly replaced by granular matter; in general, the border line between the diphtheritic membrane and the mucous surface is marked by a somewhat denser exudation of the albuminate—a fibrinous appearing material—than is seen in the false membrane generally; the bloodvessels in the mucous membrane of the larynx are numerous, and distended with blood. *Trachea:* The epithelium, consisting of from two to three layers, is seen to be intact wherever it is observed; the surface of the epithelium is covered with minute markings, probably the cilia in contraction; the pseudo-membrane is not seen to be reticulated as in the larynx, perhaps from the contractions which had occurred in it; it appeared granular and fibrous, and contained but few corpuscles. *Lungs:* A portion of one lung was found hepatized, and the alveoli of this portion contained pus cells, epithelial cells, blood, and a fibrinous appearing material (croupous pneumonia). *Kidneys:* The changes observed in these organs were those of tubal nephritis; the tubes were highly granular, both in the pyramids and cortex; no increase in the interstitial connective tissue was noticed; in places the tubes were not granular. The muscular tissue of the *heart* seemed normal.

Case III.—J——, aged four years, an inmate of the N. Y. Foundling Asylum, began to have sore-throat on March 4, 1876. The fauces were red and somewhat swollen, but without any membranous exudation, and the diphtheritic nature of the disease was not at first suspected. My attention was first called to this case on March 11, on account of almost total suppression of urine. The fauces were still injected, and somewhat swollen from catarrhal inflammation; there was a copious muco-purulent discharge from the nostrils; pulse 148. March 13. Pulse 144; temperature 101¼°; urine still nearly suppressed, though one drachm of infusion of digitalis is administered every fourth hour, and bromide of potassium, four grains, every second or third hour, for the restlessness. Dr. Reid, in using the catheter, observed a diphtheritic patch on the vulva; there is moderate

tumefaction under the ears; the patient vomits often during the last days; she has livid spots, from extravasation, under the skin; and vision is much impaired, if not lost; it is impossible to obtain any urine for examination. Death occurred without convulsions on March 15.

Microscopic Examination of the Kidneys.—The tubuli contorti of the first and second order of the cortical substance of the kidney almost all enlarged; their epithelium swollen in many places to such a degree that no calibre of the tubules can be seen; the epithelium richly provided with coarse granules, the enlarged living matter; the original cement substance missing; instead of this, new transparent lines formed within the protoplasm, indicating the earliest stage of catarrhal inflammation, with partition and new formation of epithelial elements; the same changes, though in a less marked degree, observable in the epithelium of the straight ducts of the pyramidal substance, while the flat epithelial bodies of the narrow ducts appear almost unchanged. The connective tissue between the ducts and the enlarged glomeruli is somewhat increased in size, and it contains newly-formed nuclei in moderate number, with enlarged bloodvessels, some of which are much distended with blood-corpuscles; no fatty degeneration in kidneys. In a few places, accumulations of dark granules occur within the ducts and their epithelium. These granules, not being united with each other by threads, nor staining with carmine, are considered to be micrococci, such as occur in any decomposing animal tissue. Whether they were present during the life of the patient, or were due to early cadaveric putrefaction (which is common after death from diphtheria), is uncertain. But since I have seen micrococci and bacteria in the fresh urine of children suffering from diphtheria, I would not deny the possibility of the occurrence of micrococci in the uriniferous tubules during life; nay, even, they may produce the inflammatory process in a way still unknown to us. In the case under consideration no trace of casts was found within the tubules, so that the inflammatory process doubtless was not a croupous one, but a relatively slight process, termed catarrhal or interstitial nephritis.

Case IV.—M., aged four years, inmate of the N. Y. Foundling Asylum, New York, began to be sick May 6, 1876; was languid and feverish, temperature 104°, had redness of fauces and an exudation over each tonsil, no coryza; evening temperature 103°. May 7. Pulse 120; temperature 100°. May 8. Pulse and temperature as yesterday; urine scanty; no albuminuria, and no discharge from nostrils: the membrane extends from the sides of the throat to the roof of the mouth; specific gravity of urine 1021, urine contains no albumen, no excess of urea, and no deposit of urates. May 10. Pulse 140; has considerable œdema of fauces, and breathing guttural in sleep; vomited once since yesterday; the urine contains for the first time a moderate amount of albumen, with hyaline casts; specific gravity 1018, acid; no urea deposited on adding nitric acid; that alarming symptom in diphtheria, epistaxis, has occurred to-day. The records which were written daily till death, which occurred on the 14th, show a gradual increase of albumen with hyaline casts in the urine, increasing scantiness of urine, so that on the 13th not more than half an ounce was passed in twelve hours; temperature not rising above $100\frac{1}{4}°$, nor pulse above 108; poor appetite, occasional vomiting, and epistaxis. Death occurred from feebleness and blood-poisoning, notwithstanding that, from the first day, three grains of salicylic acid were given the first hour, two grains of quinine the second hour, and tincture of iron and chlorate

of potassa the third hour, these doses having been continued night and day in alternation; with the application of carbolic acid and subsulphate of iron to the fauces, three times daily; with nutritious diet, and the moderate use of stimulants. There were no symptoms referable to the larynx, unless a slight cough.

Sectio Cadaveris.—Mucous membrane of larynx, trachea, and bronchial tubes intensely and uniformly injected, but without any membranous exudation; lungs fully inflated, as if from commencing vesicular emphysema, and pale in front; numerous extravasations of blood in the substance of the lungs and other organs; the hemorrhages in and under the mucous membrane of stomach so abundant that the gastric surface presented a mottled appearance like the skin in measles.

Microscopic Examination.—The mucous membrane of the larynx and trachea was hyperæmic, but was otherwise apparently normal; muscular tissue of heart normal; spleen soft, but not appreciably enlarged. The scrapings of the cut surface of this organ contained red blood-corpuscles; bodies from two to five times the size of the blood-corpuscles, holding in their interior oil-drops and fine granules, and having a yellowish-red color; granular lymphoid corpuscles, and granular débris. The walls of the stomach were congested, but without any noticeable exudation upon the surface; the extravasations of blood, described above, were found to be chiefly in the submucous tissue. In some places the gastric tubes were bare, but in other places covered with amorphous matter; but whether the covering substance was altered epithelium or diphtheritic exudation was not determined. The epithelium covering the more exposed portions of the tubes was in many places not distinct, while that covering the deeper portions of the tubes was clearly defined; at the pylorus, upon the valve, the mucous membrane was deficient; those portions of the true peptic glands lying below the tubes were normal. The mucous membrane in the lower part of the ileum was congested. Peyer's patches, and the solitary glands, both in the ileum and large intestines, were prominent, and surrounded by halos or rings of inflammation. Both the cortical and pyramidal tubes of the kidneys contained granular epithelium.

Briefly stated, therefore, the exudation of diphtheria is found to consist of fibrin forming a delicate interlacing network, epithelial cells more or less altered by the inflammatory process, leucocytes, nuclei, mucus, and amorphous matter. Upon the faucial, buccal, laryngeal, and perhaps also nasal surfaces, the pseudo-membrane penetrates the entire mucous membrane, so that no line of demarcation between them can be seen with the microscope. Below the larynx upon the surface of the trachea and bronchial tubes, a distinct line of demarcation exists, as in the croupous exudation, so that the tracheal and bronchial pseudo-membrane can be readily detached, without impairing the integrity of the underlying mucous surface.

The inflamed mucous membrane is not only hyperæmic and infiltrated with serum, but it contains numerous round white corpuscles (leucocytes) which may result in part from proliferation of connective tissue corpuscles, but are believed by most pathologists, since Cohnheim's well-known discovery, to be in great part wandering white corpuscles of the blood, which have escaped through the walls of the bloodvessels along with the fibrin.

In the commencement of the diphtheritic inflammation, before the pseudo-membrane forms, we often observe a grayish tinge of the mucous surface, which is due to the crowding of these cellular elements underneath and in the mucous membrane, for these newly-formed cells can be traced into the submucous connective tissue. Even where the inflammation remains catarrhal, as it does over certain areas in all cases of diphtheria, this infiltration of the mucous and submucous tissues with cells is common.

No certain and invariable chemical or microscopical difference has yet been established between the pseudo-membrane of croup as described in the appropriate chapter and that of diphtheria. The difference universally recognized is this, that while the croupous membrane in all situations lies upon the mucous membrane, and does not penetrate it, that of diphtheria, in the localities where it most commonly forms, namely upon the buccal, faucial, and laryngeal surfaces, penetrates and becomes blended with the mucous membrane, so that it cannot be detached by force without the risk of injuring this membrane, and lacerating its vessels; moreover, by its presence in the mucous layer, it is apt to obstruct circulation in it and cause ulceration, even in the submucous tissue.

During the height of the inflammation, it is astonishing often to see with what rapidity the pseudo-membrane returns, when removed by force. A few hours suffice to restore it as firm and extensive as before the interference. In favorable cases this adventitious layer is detached in a few days, and is either expectorated or swallowed with the ingesta. Its separation is promoted by the secretions underneath, especially by pus, which is formed in abundance between it and the surface on which, and in which it lies. In most cases it does not separate in mass, but disappears, by progressive liquefaction, a little less remaining at each visit till all is detached.

Such are the appearances, character, and history of the pseudo-membrane in this malady. Although its common seat is upon the fauces, and in mild cases it occurs only upon the fauces, nevertheless all the mucous surfaces are liable to be attacked by the inflammation, in consequence of infection of the blood, and therefore in severe cases, and even in cases of moderate severity, we often find the product elsewhere, as well as upon the fauces, and in localities where from its mechanical effect it greatly increases the danger and even compromises life. The mucous membrane of the nostrils, mouth, larynx, trachea, œsophagus, stomach, intestines, conjunctiva, vagina, and even the delicate lining of the middle ear, are at times the seat of diphtheritic inflammation, with the characteristic product. If the exudation occur in the larynx, or air-passages below the larynx, we have diphtheritic croup, more dangerous even than true croup; if upon a surface concerned in the digestive process, this function is more or less interfered with. In a case which occurred in the Nursery and Child's Hospital of New York, the surface of the stomach was almost completely lined with the diphtheritic formation, so that the function of this organ was ap-

parently nearly or quite abolished. The occurrence of the pseudo-membrane in the nares is common, and is attended by the discharge of thin mucus and pus, but though inconvenient to the patient, its mechanical effect is not dangerous, except in the nursing infant, in whom it interferes, more or less, with lactation. The thin irritating discharge produces excoriation around the nostrils, and upon the upper lip. I have met only one case of diphtheritic inflammation of the intestines, in which the diagnosis was certain. A physician, in whose family severe diphtheria had just occurred, took what was believed to be typhoid fever. After a long sickness he expelled, per rectum, about one foot of diphtheritic pseudo-membrane in a cylindrical form, evidently produced upon the intestinal walls. In the subsequent months the patient suffered from constipation, and severe abdominal pains, apparently due to contraction in the healing of a large diphtheritic intestinal ulcer. Death finally occurred from this state of the intestines. The occurrence of the diphtheritic pellicle upon the vulva and vaginal walls is occasionally observed, as in one of the cases related above. Its occurrence upon the uterine surface is very rare, except in the parturient woman, in whom it is said to occur by preference upon that part from which the placenta has been detached. I have met only one case of uterine diphtheritic inflammation, the disease having been contracted during or immediately after parturition, and ending fatally with all the symptoms of acute metritis within the first week.

In mild cases of diphtheria, in which the pseudo-membrane is small, and quite superficial, penetrating but little the mucous membrane, in which it is imbedded, there is little danger of septic poisoning. But in grave cases, in which the diphtheritic pellicle is extensive, and deeply imbedded, so that the lymphatic and blood vessels are in immediate relation with its under surface, the conditions in which septicæmia occurs are present, as soon as decomposition begins. Therefore septicæmia is properly regarded as a not infrequent and dangerous accident in severe diphtheria, but it is obviously very difficult to distinguish septic from diphtheritic blood poisoning, from the symptoms. Septicæmia is most apt to occur in those cases in which the pseudo-membrane has become dark gray, and friable, from decomposition, producing an ichorous discharge and offensive breath, and in cases in which blood escapes from the capillaries underneath.

Absorption of the poisonous substance produces inflammation of the lymphatic vessels, along which it passes, and of the lymphatic glands, which these vessels enter. The adenitis also gives rise to inflammation of the periglandular connective tissue, so that the neck is thickened, hard, and tender. If we examine a gland which is swollen and inflamed by the toxic absorption, we will find that its bloodvessels are congested, and its cells have undergone hyperplasia. The periglandular connective tissue is œdematous, and sometimes infiltrated with lymphoid cell-nuclei and pus-corpuscles. Capillary hemorrhages are also common in the connective

tissue, and micrococci are found in the lymphatic vessels, lymphatic glands, and in the connective tissue.

Bronchitis also occurs in certain cases. It is usually simple or catarrhal, but in some patients it is pseudo-membranous in some of the tubes, especially in the larger, or in those which are located in the posterior part of the chest, while in the other tubes it is catarrhal.

If death occur from obstruction in the air-passages, the lungs will be found much reduced in size, the anterior superior portions being pale from lack of blood, and perhaps emphysematous, while the posterior and inferior portions have a dark-red color, many of the lobules being collapsed, and others not only collapsed, but in the commencement of catarrhal pneumonia. This difference in the state of different parts of the lungs, in those who have died of suffocation in consequence of the presence of the false membrane in the air-passages, receives partial explanation from the seat of the exudation in the bronchial tubes, for in those who perish from this cause the exudation is found chiefly in such tubes as pass to the posterior and inferior parts of the organ, while such as pass to the superior and anterior lobules remain free from it. In some instances, in parts of the lungs fibrin can be traced along the minute bronchial tubes into the alveoli, where it forms a network containing in its interstices pus, and sometimes blood-corpuscles, and more or fewer micrococci. Pneumonia is also a common complication sometimes resulting from downward extension of the bronchitis, but in other instances occurring independently.

The muscular fibres of the heart in diphtheria, as in all acute infectious diseases, are liable to granulo-fatty degeneration, so that they become softer, have a color which French writers liken to that of new leather or coffee and milk. This degeneration has been observed only in a certain proportion of the more malignant cases, and is far from being uniform. Any portion of the heart may undergo this change. It may occur in the columnæ carneæ, or in the walls of the organ. White fibrinous clots are sometimes observed in the cavities of the heart after death from diphtheria, and it is the accepted belief, in consequence of the symptoms and mode of death, that in a certain proportion of such cases the clots are ante-mortem, having formed some hours before the agony. It is well known that similar clots, thought to be ante-mortem, are not infrequent in fatal scarlet fever.

The blood in cases of a severe type is usually darker than in health, and the clots soft. After death from diphtheritic laryngitis, it is also dark from excess of carbonic acid in it. The chemical changes which the blood undergoes in diphtheria are little known. MM. Andral and Gavarret found a notable diminution of fibrin in grave infectious diseases, as typhoid fever, puerperal fever, etc., and it is not improbable that the same is true of diphtheritic blood, although the exudation of fibrin is so abundant. Mr. Bouchet and others have found a notable excess of the white corpus-

cles in the blood in a considerable proportion of diphtheritic patients, so that, instead of three or four in the field of the microscope, as many as sixty have been counted. M. Sanné writes of diphtheria: "It is necessary to recognize in the dark-brown blood an abnormal accumulation of the débris of the red corpuscles, débris of little abundance in the normal state, augmented considerably under the noxious influence of the diphtheritic poison, which has rapidly produced destruction of a great number of globules" (*Traité de la Diphthérie*, page 107, Paris, 1877). Small extravasations of blood in various organs are among the most constant lesions. They have been most frequently observed in the brain and its meninges, the lungs, spleen, and kidneys. In one of the cases which I examined after death in the N. Y. Infant Asylum, as I have stated above, the extravasations in and under the gastric mucous membrane produced a mottling as great as that of the skin in measles.

No notable changes have thus far been observed in the nervous centres, with the exception of the apoplectic foci, and softening of adjacent brain substance, and the congestion present when death has resulted from diphtheritic croup. But certain degenerative changes have been observed in peripheral nerves, as well as in the muscles in parts affected with diphtheritic paralysis. Thus, in nerves from a paralyzed palate, certain nerve tubes have been observed nearly or quite destitute of medullary matter, though this is not common, but many tubes are found to contain fatty granules, the result of retrogressive metamorphosis (MM. Charcot and Vulpian).

The liver does not appear to be seriously engaged or its function compromised. In most acute infectious diseases which are fatal in consequence of blood poisoning, the spleen is apt to become softened and somewhat enlarged, but this does not always occur in diphtheria. It will be recollected from the cases related above that the spleen may not be perceptibly enlarged or softened.

The kidneys of all the internal organs are most frequently affected, as is shown by the common occurrence of albuminuria. Parenchymatous nephritis, with the characteristic hyperæmia and swelling, is the usual form of kidney disease which complicates diphtheria. In the albuminous urine are found hyaline and granular casts. This inflammation may begin early in grave cases, even as soon as the first or second day, but its commencement is ordinarily not till towards the close of the first week or in the second. It occurs in the majority of those severe cases which prove fatal from blood poisoning. Interstitial nephritis also occurs in certain cases, as in one of those related above, giving rise to an increase in the connective tissue.

Symptoms.—In general, in the commencement of an epidemic, diphtheria is more severe and fatal than when the epidemic influence is abating. The prominent symptoms, such as arrest the attention of the friends,

are often disproportionate to the gravity of the attack. Striking cases illustrative of this have occurred in my practice, the friends not supposing that there was any serious ailment, and not seeking medical advice till the fatal termination had nearly arrived. The initial symptoms are sometimes mild, such as chilliness or rigors, often slight, and succeeded by moderate febrile reaction, languor, and perhaps more or less headache, pain in the limbs or back, and impaired appetite. Still the patient may continue to walk about as if affected with slight and temporary ailment. Such cases in New York city frequently attend the schools, and do immense harm in propagating the disease. The symptoms in these mild cases are often like those from a cold, for which light attacks of diphtheria are apt to be mistaken by the friends. With some, in mild as well as severe diphtheria, one of the first symptoms is slight tenderness or a sensation of fulness in the fauces. A distinguished clergyman of the Pacific coast, who fell a victim to this disease, dreamed, a few nights before he complained of illness, that his throat was cut. Doubtless the diphtheritic inflammation had already commenced, so that what seemed a forewarning had a natural explanation. So insidious was the commencement in this case that the disease had advanced beyond all hope of relief when medical advice was first sought. But in most cases, other than those of a very mild type, the commencement is more severe, being attended by a temperature of 102° or 103°, or even 104°, with corresponding heat of surface, thirst, languor, loss or impairment of appetite, tenderness of throat, etc. Delirium as well as eclampsia may occur, but both are rare. The febrile reaction ordinarily abates considerably by the close of the second or on the third day, as I have noticed in many observations.

The symptoms of invasion have less prognostic value in diphtheria than in most other infectious maladies. We meet cases with a severe beginning, attended by delirium, which terminate in apparently complete restoration to health in less than a week, the presence of the characteristic pellicle upon the fauces and the occurrence of diphtheria in other members of the family rendering the diagnosis certain. On the other hand, a mild commencement sometimes ushers in a fatal form of the disease. This is notably true of those cases in which laryngitis supervenes, as it not infrequently does in cases which begin very mildly.

The fever which ushers in diphtheria abates, as stated above, after the second or third day, and subsequently, in grave as well as in benign cases, there may be but little or even no elevation of temperature. The diphtheritic poison does not therefore, like that of scarlet fever, exhibit any marked tendency to increase the animal heat. Even in profound and fatal blood poisoning in this disease, the thermometer shows the normal, or scarcely more than normal, temperature, so that the inexperienced practitioner is apt to be deceived in his prognosis. On the other hand, a con-

tinued elevation of temperature with only moderate angina should lead the physician to examine for some complication, perhaps a nephritis.

The tongue is usually moist, and slightly furred. The patient often vomits in the commencement, and, if this ceases or is seldom repeated, it is not a grave sign; but vomiting occurring often, so that the food is rejected, and due often no doubt to uræmia, is not infrequent in severe cases. The appetite varies. Repugnance to food characterizes many of the gravest cases, and, if the child is compelled to take it, it is often rejected by vomiting. There are no notable symptoms referable to the state of the intestines. The stools usually appear normal, except as they are changed by medicines.

The respiratory apparatus is not involved in the benign cases in which only the fauces are inflamed. But next to the fauces and posterior buccal surface, the Schneiderian membrane is most frequently involved of all the surfaces, and when the nares are inflamed, and are covered to a greater or less extent by the pseudo-membrane, there is more or less discharge, which may excoriate the upper lip, and cause incrustation around the entrance of the nostrils. This often renders respiration through the nostrils difficult. In cases having this severity there is usually at the same time considerable faucial swelling, so as to cause guttural respiration, which is most marked in sleep. But the most important symptoms pertaining to the respiratory apparatus, occur when the inflammation attacks the laryngeal surface, or this surface and those contiguous to and below it in the respiratory tract. Diphtheritic croup may be primary or secondary. In New York the secondary form most frequently occurs as a complication of measles, and as the rubeolar inflammation extends not only over the larynx and trachea, but bronchial tubes, the diphtheritic pseudo-membrane is apt to extend further downward than when the inflammation is primary.

Diphtheritic croup often occurs at the commencement of diphtheria, so as to be and continue to be the predominant inflammation, but in other cases it supervenes after diphtheria has continued a few days. There are many mild cases, which give no anxiety as long as the inflammation remains faucial, but in which the whole aspect is within a day changed by the occurrence of croup, and the condition becomes one of imminent danger. Usually when diphtheritic croup occurs, there is a simultaneous if not pre-existing exudation upon the fauces. Occasionally in undoubted diphtheria the diphtheritic pellicle forms only upon the surface of the air-passages below the epiglottis, while the fauces present merely an inflammatory reddening, and the surface of the nares is either free from disease or only reddened. Thus, in January, 1875, I attended a child, aged two years and ten months, who died from a gradually increasing dyspnœa after a sickness of four days, having during his sickness moderate swelling of the tonsils, and general redness of the faucial surface, but without membranous exudation upon it. The symptoms and history of the case were

precisely those of true croup, but the diphtheritic nature of the malady was clearly shown by the occurrence very soon after the death of the patient of diphtheritic pharyngitis, with the characteristic exudation upon the fauces, of the two young women who nursed him.

In New York, as will be seen by the table below, the predominant inflammation in about one-fourth of the cases of diphtheria is the laryngitis.

In addition to the accelerated pulse during the febrile stage and the slow and compressible pulse during the stage of profound blood poisoning, the chief symptoms, pertaining to the circulatory system, relate to the state of the heart, and the altered state of the blood which gives rise to hemorrhages. The ante-mortem heart-clots, the weakened action of the heart from degenerated muscular fibres, the hemorrhages from the altered state of the blood, indicate a very dangerous condition of the circulatory apparatus.

Very little attention had been bestowed upon the state of the kidneys, and the character of the urine in diphtheria, till Mr. Wade, of Birmingham, discovered albuminuria, since which many observations in different epidemics, and localities, have established the fact that albuminuria occurs in a majority of cases of a severe type, and in many cases of diphtheritic laryngitis in which the type is not severe. Two conditions of the kidneys give rise to albuminous urine, namely, nephritis, which is the most common, and venous congestion, which occurs in cases of embarrassed circulation, as in certain cases of diphtheritic laryngitis, and in obstruction from heart clots. The latter is comparatively infrequent.

During the latter part of 1875, and in 1876, prior to August 1, I endeavored to obtain and examine the urine in every case of idiopathic diphtheria, having a clear diagnosis, which came under my notice, both in family practice and in the institutions with which I have an official connection. Ordinarily, during the first week of a case, I found that the urine deposited urates on cooling, and that the nitric acid test showed a large relative quantity of urea, but I suspect that this was due to a somewhat diminished quantity of urine. But the occurrence of albumen was of chief interest, and the results of the examinations as regards the presence or absence of this, are recorded in the accompanying table. In most of the cases the urine was examined several times in the course of the disease, and, if albumen were present, a microscopic examination was also made. In nearly all the specimens which contained albumen—all but three or four—casts, usually granular, but now and then hyaline, and sometimes both kinds in the same specimens, were observed. In those cases of albuminuria which recovered, there were comparatively few casts, or none. If the albumen were abundant, and casts plentiful, the case was usually fatal, though not perhaps till after the lapse of three or four weeks, when death occurred with symptoms of exhaustion, paralysis, or feeble heart-action, sometimes with œdema of lungs supervening sud-

denly, and, probably, formation of heart clots. The albuminuria, unlike that of scarlet fever, seldom occurred except in the grave cases; and in the majority of instances it did not appear till near the close of the first week, or in the second, and, in a few instances, not till a later period. Although the albuminuria of diphtheria is much more grave than that of scarlet fever, it has in my practice been attended by much less serous effusion or dropsy, often by none which was appreciable. The urine, although containing a large quantity of albumen, ordinarily had nearly the normal appearance, instead of the smoky or hazy color so common in the albuminous urine of scarlet fever.

I. *Cases attended with the usual membranous exudation upon the fauces, with or without coryza, and without laryngitis or with only catarrhal laryngitis; fifty-eight cases.*

	Died.	Recovered.	Result not stated.	Total.
With albuminuria . .	13	5	1	19
Without albuminuria .	4	27	1	32
State of urine not recorded	3	4	..	7

II. *Cases attended with membranous laryngitis as the predominant inflammation; nineteen cases.*

	Died.	Recovered.		Total.
With albuminuria . .	4	1	..	5
Without albuminuria .	2	4	..	6
State of urine not recorded	7	1	..	8

The mortality of the cases embraced in the above table was probably larger than the average in New York practice, for several of them were seen in consultation, and their type was severe. Those in which the state of the urine could not be ascertained, were usually in children so young or so near death that it was impossible to obtain sufficient urine for examination.

It is seen that in New York, where diphtheria is endemic, of 62 cases occurring in the course of about ten months, 24 were attended by albuminuria, and 38 were exempt. In a larger number of cases, of which I have preserved the records since 1876, I think that the proportion of albuminous cases has been about the same, but obviously during epidemics of a severe type, the proportion is larger than when the type is mild.

An efflorescence is sometimes observed upon the skin during the time in which the temperature is exalted. It is the erythema fugax of dermatologists, suddenly appearing and disappearing. This eruption, which is so common in the febrile and inflammatory affections of childhood, does not seem to present any peculiar characters in children. But there is another eruption, which I have several times observed, and of which I have preserved a drawing as it appeared in one case, which I have no

doubt is due to diphtheritic toxæmia, or to septicæmia occurring in diphtheria. It appears after the sixth or seventh day, in the form of red points or spots, not more than a line in diameter, and interspersed with patches of larger size, and irregular margins, one to two inches in diameter. This roseolar eruption is slightly raised, like that of measles; it disappears on pressure, and so far as I recollect it has, in my practice, appeared only in fatal cases. Occasionally extravasations of blood occur in and under the skin, like those occurring in the internal organs. The pallor of the skin, which diphtheritic toxæmia produces in the second and third weeks, is known to all who have had experience with this disease.

Diphtheritic *paralysis* is described by some writers as a symptom and by others as a sequel. It usually begins during convalescence in the second or third week after the abatement of the inflammatory symptoms, but sometimes not till considerably later. It may on the other hand appear considerably earlier, during the stage of the development of the inflammations, as early as the fifth or sixth day, or even as the second or third day from the beginning of the diphtheria (Sanné). When the paralysis begins at an early period it may cease, and reappear later, and in other parts. Its commencement may not be announced by any symptoms apart from the loss of muscular power, but in other cases there is febrile movement with albuminuria. The muscles most frequently affected are those of the pharynx, and upper part of the larynx. The muscles of deglutition are sometimes so involved, that the food and drinks are not swallowed till after several successive efforts, and a part may be returned through the nostrils. A portion of the food sometimes enters the larynx, so as to produce violent coughing. As we observe the dysphagia, it seems as if there must be pharyngitis, which renders deglutition difficult, but on inspecting the fauces we find no evidence of inflammation. The mucous membrane has recovered its normal appearance, and the nerves only are affected. The velum palati hangs flaccid and motionless like a curtain; and the relaxed state of the muscles at the entrance of the larynx causes guttural respiration, or snoring in certain cases, which is especially marked during sleep. In severe cases the difficulty of swallowing may endanger suffocation from the lodgment of food in the larynx, and inspire dread of taking food on the part of the child. Tickling, and even pricking the velum fails to induce motion. In some there is only faucial paralysis, but in many the loss of muscular power occurs in other parts also. Whenever it occurs elsewhere, the pharyngeal muscles are nearly always involved at the same time. Diphtheritic paralysis may affect the motor muscles of the eye, causing strabismus; the muscles of one side, causing hemiplegia; of the legs, causing paraplegia; or of an arm on one side and leg on the opposite. It does not commence simultaneously in the various muscles which are affected, but in succession, those first affected being for the most part the muscles of the pharynx. In some patients the muscles of the bladder

are paralyzed, leading to retention of urine or difficulty in passing it. Paralysis in the limbs is frequently preceded by tingling or a sensation of formication. There is often not a total loss of sensation or of motion in the paralyzed part, but more or less numbness with difficulty rather than impossibility of motion. A few cases have been reported in which the paralysis was almost general, and some believe that they have met cases in which the heart was paralyzed, death occurring suddenly and unexpectedly. Dr. J. B. Reynolds relates a case in the *New York Journal of Medicine*, May, 1860, in which there were not only strabismus, partial paralysis of the limbs, and paralysis of the muscles of the pharynx, so that food was regurgitated, but the head dropped forward so that the chin rested on the sternum.

A majority of those affected with paralysis recover, although few regain the complete use of their muscles in less than one month, and many do not till between two and four months.

Defect of vision is an occasional result of diphtheria; some have presbyopia; others myopia; some see double; some are amaurotic; while in others one pupil is more dilated than the other, or both pupils are dilated, and feebly sensitive to light. This impairment or perversion of vision gradually disappears as the vigor of system returns.

Various theories have been advanced in explanation of the occurrence of the paralysis, as that of reflex irritation advocated by Brown-Séquard, that of anæmia, etc. A careful examination of the nervous centres, made in certain fatal cases, has revealed nothing which throws light on its etiology. That the diphtheritic virus causes paralysis by some special action is evident, for there is no other infectious disease which is attended and followed by paralysis so often as diphtheria. The most plausible theory is that recently brought to light by histological examinations, which have shown that the peripheral nerves in paralyzed parts have undergone degenerative changes, as mentioned above, so that under the neurilemma, we observe more or less granular matter, in place of the normal nerve tissue, or lying in this tissue. Among the many anatomical changes which the specific principle produces, those in the peripheral nerves must therefore be regarded as important, since pathological changes in the nerves which supply paralyzed muscles sanction the belief that they sustain a causative relation to the paralysis.

Diagnosis.—In most instances the diagnosis of diphtheria is readily made when the case has continued a few hours, for the characteristic false membrane is observed on inspection of the fauces. I have usually at my first visit been able to state the nature of the pharyngitis from its appearance. But there are cases which vary from the typical form in which the diagnosis is more or less difficult. The confervoid growth of sprue, when occurring upon the fauces, is sometimes mistaken for the false membrane of diphtheria, but the error of mistaking one for the other in cases which

I have met, has been due to hasty and careless examination rather than to any real difficulty in the discrimination. The peculiar product of sprue has but little depth and coherence, and is readily detached without injury to the mucous membrane or its vessels. If there is any doubt, the differential diagnosis can be readily made by the microscope.

Follicular pharyngitis, like diphtheria, commences with sharp fever, which, however, is ephemeral, and is attended with the formation of round white masses in the site of the follicles, usually over the tonsils only. These masses do not occur in patches, like those of diphtheria, except when two or three are in close proximity and unite, but at the same time a sufficient number are discrete to establish the diagnosis. Follicular pharyngitis often occurs in several members of a family at the same time, involves no danger, and is quickly cured.

The diagnosis of diphtheritic from membranous laryngitis is often difficult. Diphtheritic laryngitis is usually accompanied by more tumefaction of the lymphatic glands of the neck, and more discharge from the nostrils. Moreover the laryngitis is often secondary in point of time to the pharyngitis, so that in the first day of the former we observe so much faucial inflammation, that it is evident that the latter predominates; whereas in true croup the laryngitis precedes and predominates.

Often the diagnosis is made clear by the history. Thus a boy, aged two years and ten months, died of acute laryngo-tracheitis, lasting about four days. He lived in the suburbs of the city, where the houses were scattered, and where there had been no recent diphtheria. The case commenced with hoarseness, which gradually increased to a fatal obstruction in the air-passages, without any pseudo-membrane upon the fauces or upon any other visible part. This case seemed to be identical with the true croup with which we were familiar before the occurrence of diphtheria in New York; and yet it was diphtheritic, for two or three days after the death of the child, the two young women who nursed him were affected with severe diphtheritic pharyngitis with the characteristic pseudo-membrane.

Sometimes the occurrence of albumen in the urine, with or without fibrinous casts, aids in establishing the diagnosis, for it is more common in diphtheria than in croup. It is evident, from the above facts, that the diagnosis of diphtheritic from membranous croup, though easy in typical cases, is difficult if not impossible at the bedside in certain cases, especially when there is little or no exudation upon the fauces.

Prognosis.—No infectious disease presents greater differences in type or severity. In mild epidemics, with moderate fever, slight faucial swelling, and little extent of the pseudo-membrane, a large majority recover, and would recover even without treatment. Uncertainty of prognosis, of which even physicians of ample experience complain, is largely due to the fact that diphtheria terminates fatally in several distinct ways. Hence,

while the patient may be secure as regards the more manifest and common conditions of danger, so as to justify a favorable prognosis in the opinion of the physician who attends him, the fatal result may suddenly occur from some unseen and unsuspected cause.

Death in diphtheria may result from—

1st. Diphtheritic blood-poisoning.

2d. Probably, also, from septic blood-poisoning produced by absorption from the under surface of the decomposing pseudo-membrane. But it is difficult to distinguish the constitutional effects of sepsis from those produced by the diphtheritic poison. Septic poisoning is obviously most apt to occur in those cases in which the pseudo-membrane is extensive, and deeply imbedded, and its decomposition attended by an offensive effluvium. Cervical cellulitis, and adenitis, which, when severe, cause very considerable swelling of the neck, appear to be often, if not usually, due to septic absorption from the faucial surface, the inflammation extending from the absorbents to the glands and connective tissue. Considerable tumefaction of the neck, therefore, seldom occurs in diphtheria or scarlet fever, without manifest symptoms of toxæmia, and is to be regarded as a sign of its presence.

3d. Obstructive laryngitis.

4th. Uræmia.

5th. Sudden failure of the heart's action, either from the anæmia, and general feebleness, from granulo-fatty degeneration of the muscular fibres of the heart, which is liable to occur in all infectious diseases of a malignant type, or from ante-mortem heart clots.

6th. Suddenly developed passive congestion and œdema of the lungs, probably due to feebleness of the heart's action, or to paralysis of the respiratory muscles. I have known death to occur apparently from this cause during the period of supposed convalescence, and when the visits of the physician had been discontinued. Thus in a case in my practice, symptoms of œdema pulmonum (moist rales in both sides of the chest, and embarrassed breathing) suddenly occurred nearly one month after the disappearance of the faucial pseudo-membrane and inflammation. The urine, which had contained considerable albumen during the active period of the malady, had for some time shown no trace, or but slight trace of this principle by the proper tests. By active stimulation these symptoms entirely disappeared in a few hours, and the heart's action seemed normal, unless a little weakened. On the following day the same symptoms reappeared, and death occurred before I was able to reach the house.

That physician obviously is least apt to err in prognosis, who recognizes the fact that patients are liable to perish in any of these different ways, and carefully examines in reference to all the conditions which involve danger. Many physicians, as I have had the opportunity to observe, are remiss in not examining more frequently the urine of diphtheritic patients,

for there is often a large amount of albumen in the urine in diphtheria, indicating a poisonous quantity of urea in the blood, and yet the appearance of the urine to the naked eye is probably normal.

Among the symptoms which render the prognosis unfavorable are, repugnance to food, vomiting, pallor of countenance, with progressive weakness and emaciation from the blood-poisoning; a large amount of albumen with casts in the urine, showing uræmia, to which the vomiting is sometimes, but not always, attributable; a free discharge from the nostrils, or occlusion of them by inflammatory thickening, and exudation, showing that a considerable portion of the Scheiderian membrane is involved, hemorrhage from the nostrils or fauces, and obstructed respiration. In diphtheritic laryngitis, attended by obstructed respiration, a large majority have thus far died, whether treated by the most approved inhalations or by tracheotomy. One, at least, of the above symptoms has been present in most of the fatal cases which I have observed.

Treatment.—It is remarkable that there is so little agreement in the profession in regard to the medicinal treatment of diphtheria, since this disease has now been under almost constant observation during the last twenty years in the principal cities of this country, and many epidemics have been closely observed and reported by intelligent physicians in the rural districts. The wide discrepancy, which exists in reference to the proper therapeutic measures, receives partial explanation from the fact of a wide difference of opinion as to the nature of diphtheria and its mode of commencement, but is more due to the fact that statistics of its treatment afford very unreliable, and often conflicting data by which to determine the proper medicinal agents. For scarcely any other disease presents such a diversity in type as diphtheria, from cases so mild, that nearly all recover, whatever the measures employed, to those so severe, that a large proportion die under the best possible treatment. And this difference in type may be observed in cases occurring at the same time in a great city like New York, or even in the cases, which two physicians, practising near each other, may be called upon to treat. Hence, one physician recommends with confidence a medicine or mode of treatment, as eminently successful in his hands, which another physician of equal experience speaks disparagingly of. The theory relating to diphtheria which, in my opinion, has of late years done the most harm, is that which attributes it to low vegetable organisms, visible under the microscope, which alight upon one of the exposed surfaces, usually the fauces, where they excite local inflammatory action, and if not promptly destroyed, are apt to penetrate the tissues, enter the blood, and establish a constitutional disease. Acceptance of this theory evidently leads to the employment of parasiticide medicines, the so-called antiseptics, or anti-ferments, externally and internally, to arrest and destroy the vegetable growth, their local use sufficing, according to the theory, in the early stage, when these organisms have passed no

further than the surface, but their internal use being required in addition, if the malady have continued longer, and the disease have become general. Hence, in proportion as this doctrine came in vogue, carbolic acid, chlorine preparations, bromine, the sulphites, phenic acid, and, as the best representative of this class of medicines, and most powerful antiseptic, salicylic acid, attained at once prominence as the agents which would be most likely to cure diphtheria, by destroying the cause. A solution of bromine and bromide of potassium, having been used, with apparent good results, in the antiseptic surgery of the army during the late war, has obtained under the influence of this theory some reputation in New York as a remedy for diphtheria employed externally and internally, and without the aid of other therapeutic agents. A certain number of drops are administered internally every hour, or second hour, properly diluted, and the same medicine undiluted, or with less dilution, is applied to the fauces with a brush at regular intervals.

But experience, if sufficiently extensive, is the safe guide in therapeutics, and, according to my observations, internal antiseptic measures have not seemed to exert any marked controlling effect on the course of diphtheria.

Thus in Case IV. related above, a child of four years took, almost from the beginning of the sickness, a mixture of potassa and iron on the first hour, two grains of quinine on the second hour, and three grains of salicylic acid on the third hour, and this treatment was continued night and day ; and yet this child, having from the first taken sixteen grains of quinine, twenty-four of salicylic acid, besides the potash and iron daily, died after eight days with profound blood poisoning, having had many extravasations of blood.

This case, which presented the ordinary history of fatal diphtheria, did not seem to be materially modified by the internal antiseptic treatment. It would apparently have done as well without it. It is but one case, though an average example, and I have not observed any other in which the internal use of antiseptics seemed to produce a curative effect. My knowledge, however, of the bromine treatment is limited to the four children of one family, and to the effects of its use, which have been reported to me by others.

The theory that micrococci, or vegetable monads, are the specific principle of diphtheria, which suggests and justifies the antiseptic treatment, was promulgated to the profession by those who had seen less of diphtheria than many others, but had zealously used the microscope. Their opinion, based on microscopic examinations and experiments, plausible, because having the appearance of scientific exactness, was widely received. And since, according to this theory, diphtheria is at first localized at the point upon the surface where the micrococci are received, this opinion, so far as it was accepted, evidently led to the early energetic treatment of

the local ailment, and indifference as regards constitutional measures. It is interesting to observe how the profession have been led by theories to regard the local treatment of diphtheria as of prime importance, especially during the first stage of the malady. Twenty to thirty years ago, when Trousseau was making his observations on diphtheria, and his views had great weight with the profession in both continents, it was believed that those blood diseases, which were communicated by inoculation, were at first local, even after the specific inflammation had appeared at the point of inoculation. Syphilis, for example, could be cured, it was thought, by proper applications to the specific eruption, if made within a certain number of days, and before the poison had entered the blood. In the same way it was believed that diphtheria is commonly received by inoculation, as it confessedly sometimes is, and could be cured by early applied local measures. Hence Trousseau recommended to attack the pseudo-membrane, with what he designates "savage energy." After a time it began to be believed that the acute infectious diseases are already constitutional, although contracted by inoculation, when the specific eruption or lesion has appeared upon the surface, and that therefore no local treatment can prevent blood contamination, since it is already present. Now, when this opinion was received generally by the profession, and diphtheria began to be regarded as a constitutional malady, in its inception, as much as scarlet fever or measles, the promulgation of the bacterian theory exerted a retrograde influence, so that it seemed for a time, as if the old mode of treatment of the age of Bretonneau, and Trousseau, would be restored. At this time there appeared in our language the exhaustive volumes of Ziemssen's Encyclopedia, containing the cream of German medical literature, and as German physicists are most patient and exhaustive investigators, these volumes occupied the centres of our private libraries, and were pointed out as the means, which would be likely to elevate the profession of this country to a higher standard of medical knowledge. The treatise on diphtheria contained in this encyclopedia, the most minute of any on this subject in the English language, was eagerly sought for and read, and an immense amount of harm done. The writer of this treatise is fully committed to the bacterian theory, and the section relating to treatment begins thus: "In diphtheria we have to deal at first with an infection, which is localized, and afterwards with a general disease resulting from this, out of which may ultimately be developed still a later affection of various organs," and he discusses first the local treatment, as of paramount importance, and secondly, the general treatment. It was a great misfortune, that a treatise like that by Sanné had not appeared in place of the one published. But the mischief was done, the brush and inhalations were made the potent instrument of cure, and constitutional remedies held the second place, and were believed to be unnecessary, except when local treatment had failed to destroy the micrococci, and the second stage, or that of general infec-

tion had arrived. For a time this theory has had its influence on practice, but unpleasant experiences have taught, and are teaching physicians, that local measures, however early and perseveringly employed, do not protect the system from the diphtheritic poison, do not prevent the occurrence of unmistakable symptoms of general infection in all cases of a grave type. Whatever the theory, experience gradually establishes the fact, in the minds of all observing physicians, that constitutional treatment is of paramount importance in diphtheria, as it is in that other malady, which, in my opinion, is most nearly akin to it, namely, scarlet fever, except when the danger is located in the larynx.

Since December, 1875, I have examined minutely, and preserved records of, 104 cases of primary diphtheria, occurring either in my private practice, or seen by me in consultation, besides observing cases, and witnessing autopsies in the New York Foundling Asylum, where diphtheria was endemic nearly two years. From these observations, as well as from what I have been able to learn from other physicians, I am persuaded that, in order to secure the best treatment, constitutional and local, of diphtheria, it is necessary that the physician should accept the following propositions :—

1st. The specific principle of diphtheria, in all probability, enters the blood, in ordinary cases, through the lungs ; and after an incubative period, which varies from a few hours to seven or eight days, produces the symptoms which characterize the disease.

2d. Facts do not justify the belief that the system can be protected by antiseptic or preservative medicines administered internally. A quantity of this kind of medicine, introduced into the system, sufficient to preserve the blood and tissues from the action of the diphtheritic virus, would, there is every reason to think, be so large as to arrest molecular action, and therefore the functions of organs, and occasion death.

3d. There is no known antidote for diphtheria, in the sense in which quinia is an antidote for malarial diseases, and no more probability that such an antidote will be discovered than for scarlet fever or typhoid fever.

4th. Diphtheria, like erysipelas, has no fixed duration. It may cease in two or three days, or continue as many weeks ; but the specific poison acts with more intensity in the commencement than subsequently, and its energy gradually abates. Hence, diphtheritic inflammation, which arises in the beginning of diphtheria, as laryngitis, is more severe and dangerous than when the malady has continued a few days.

5th. The indication of treatment is to sustain the patient by the most nutritious diet, by tonics, and stimulants ; and to employ other measures, general and local, as adjuvants, to meet special indications which may arise. The rules of treatment appropriate for scarlet fever, apply for the most part to diphtheria. Local treatment of the inflammations should be unirritating, and designed to prevent putrefactive changes, and septic

poisoning. Irritating applications which produce pain lasting more than a few minutes, or which increase the area or degree of redness, are apt to do harm, and increase the extent and thickness of the pseudo-membrane.

General Treatment.—This may be conveniently considered under the three heads, food, stimulants, and tonics. All physicians of experience recognize the importance of the use of the most nutritious and easily digested food, and the preservation of the appetite—for the safety of the patient requires that he should retain, as far as possible, his flesh and strength. The more nutritious and easily digested the food, given in sufficient quantity, with the appetite preserved, the less, obviously, the danger of the fatal prostration, which so frequently occurs suddenly and unexpectedly in grave cases. Beef-tea, or the expressed juice of meat, milk with farinaceous food, etc., should be administered every two or three hours, or to the full extent, without overtaxing digestion. Failure of the appetite, and refusal to take food, are justly regarded as very unfavorable signs. One objection to the use of the brush, instead of spraying the fauces, with the atomizer, is that it is more apt to provoke vomiting, by which nutriment, that is so much required, is lost. In malignant cases of diphtheria, as in scarlet fever of a similar type, patients are sometimes allowed to slumber too long without nutriment. It is the slumber of toxæmia, and should be interrupted at stated times, in order to give the food.

Stimulants.—M. Sanné, in his elaborate treatise on diphtheria, says: "De tous les antiseptiques donnes à l'interieur, l'alcool est de beaucoup le plus sûr. Plus l'infection est prononcé, plus il faut insister sur les composés alcooliques." He states that Bricheteau reports the history of a patient, who took daily, during the diphtheria, a bottle and a half of the wine of Bordeaux, without the least symptom of intoxication or headache. A somewhat similar case was reported to me, in which nearly a bottle of brandy was given in less than twenty-four hours, without any ill effect, and an apparent good result on the general course of the disease. The same rule holds true in diphtheria as in other acute infectious maladies, that while mild cases do well without alcoholic stimulants, they are required in cases of a severe type, and should be administered in large and frequent doses, whenever pallor and loss of appetite, or of strength and flesh, indicate danger from the diphtheritic or septic infection. It matters little how the stimulant is administered, whether milk-punch or wine-whey, provided that the proper quantity is employed.[1]

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[1] Dr. E. N. Chapman, of Brooklyn, a physician of large experience, considers alcohol almost a specific for diphtheria. I believe, from my observations, that, if given early and frequently in grave cases, as, for example one teaspoonful every half hour of brandy or Bourbon whiskey, it does have a tendency to render the disease more tractable, and that it therefore affords important aid in saving the patient's life, and I am willing to allow that it is as nearly a specific as any other agent. But to be instrumental in saving life in malignant cases, it must be given

Of the vegetable tonics, cinchona, or its important alkaloid principle, quinia, is more commonly employed than any other medicine, and there is probably none which answers the purpose better. The compound tincture of cinchona, and the fluid extract, have been used and recommended by physicians of experience; but quinia is more conveniently employed, and is regarded by a large proportion of physicians as the most useful of all therapeutic agents in the treatment of this malady. But there is great difference of opinion in regard to the quantity which is required each day, and the size and frequency of the doses. It is sometimes administered in small doses, as one grain every three or four hours, for its supposed tonic effect; and again in doses sufficiently large to produce an antipyretic effect, as from twenty to forty grains per day. It is prescibed by some physicians in two or three large doses per diem, as ten- or fifteen-grain, and by others in small and frequent doses. That quinia does not exert any special or peculiar action in diphtheria, and is beneficial in the same way, and no further than in other acute infectious diseases, is, I think, generally admitted by the profession; for large doses do not exert that controlling effect, which we would expect from a specific, as is shown by cases like the following, which are not infrequent, during severe epidemics:—

C., aged four years, male, was examined by me in consultation, on February 10th, 1876. I learned that he had apparently contracted diphtheria from the escape of sewer-gas through a defective trap in the little room where he slept, and that the disease began after midday on February 6th, with fever. At 10 P. M. of the same day, when visited by the family physician, the temperature was 103°, and the fauces were red, but without any pseudo-membrane. Four grains of quinia were ordered to be given every two hours, and ten drops of the tincture of the chloride of iron, with two grains of the chlorate of potassa, to be give three times hourly. On the 7th the exudation covered both tonsils and the half arches; temperature 102½°; evening, temperature 100°; pulse 128. 8th. Is playful; pulse 100; has slight swelling of the cervical glands; evening, some extension upward of the pseudo-membrane; has vomiting. 9th. Pulse 144; vomits often. 10th. At 3 P. M. began to grow worse; pharynx and nostrils covered with the exudation.

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boldly from the start. If there is marked diphtheritic toxæmia, when its use is commenced it will not save life, but it may prolong it. Although an advocate of the liberal use of alcohol I cannot regard this agent as a specific. When I commenced serving in the N. Y. Foundling Asylum in May, 1878, the quarantine wards contained four children, between the ages of three and five years, who had been sick a few days with severe diphtheria, and it was evident at a glance that they must soon perish with the ordinary mild sustaining treatment. Quinine, iron, the most nutritious food, and a moderate amount of alcoholic stimulants were being given, and we determined to increase the Bourbon whiskey to one teaspoonful every twenty to thirty minutes, day and night. Nevertheless, whatever the result might have been with the earlier commencement of this treatment, the blood poisoning was now too profound, and one after the other died.

It was impossible, at the time of my visit, to obtain any of the patient's urine for examination, and death occurred a few hours afterwards from the toxæmia. Forty-eight grains of quinia daily, administered from the first day, had no appreciable effect in staying the fatal progress of the malady, had no such effect as would be likely to follow, were its action specific or antidotal. But there are two advantages from the quinia treatment, which explain the confidence reposed in it by the profession: 1st. It has an antipyretic effect in doses of from three to five, or more, grains. 2d. In moderate doses it is one of the most reliable tonics. But high febrile movement, requiring an antipyretic, I have seldom observed in diphtheria, except in the first forty-eight hours; and if, during this time, the febrile movement be such that an antipyretic is required, quinia in the larger doses is preferable, in my opinion, to any other remedy. In its subsequent use, namely, as a tonic, two grains may be administered every two to four hours. But other bitter mixtures, which have been found to be the most useful tonics in general practice, perhaps would meet the indication nearly or quite as well.

There is the same difference of opinion in regard to the use of iron, as to the use of quinia. Some prescribe the tincture of the chloride of iron, as the sole remedy in large and frequent doses, and others in smaller doses, as an adjuvant to the vegetable tonic.

The internal treatment which I have found most satisfactory for a child of five years is the following:—

℞. Quiniæ. sulphat. ʒss;
Elix. adjuvantis (Caswell and Hazard's),
Vel elix. tarax. comp., ℥ij. Misce.

Give one teaspoonful every two to four hours; and hourly, between, one teaspoonful of the following:—

℞. Tinc. ferri chloridi, ʒij;
Potas. chlorat., ʒij;
Syr. simplic., ℥iv. Misce.

The tonic effect of the iron is not impaired by the chlorate of potassa, the latter being added to the mixture, on account of its local action on the inflamed surface.

The citrate of iron and ammonia alone, or in combination with carbonate of ammonia, may be given in two-grain doses, dissolved in simple syrup, in place of the above mixture, when the inflammation of the fauces has considerably abated or is moderate. If the patient improve, and the disease begins to decline, the intervals between the doses may be lengthened, but the tonic should not be entirely discontinued, until the patient is far advanced in recovery, on account of the dangerous sequelæ, which take their origin in an impoverished state of the blood.

Local Treatment.—It is important to keep in mind the purpose for which local measures should be employed, as stated above. It is to reduce

the inflammation of the mucous surfaces, and destroy the diphtheritic poison, and contagious properties in the pseudo-membrane, and to destroy the septic poison, and prevent its absorption, if any forms. Forcible removal of the pseudo-membrane, irritating applications, the use of a sponge or other rough instrument, for making the applications, should be avoided as likely to do harm. The applications should be made either with a large camel's-hair pencil, or, better for most of the mixtures employed, with the atomizer. The hand atomizer, like Richardson's hard rubber, which is of simple construction, while it carries a heavy spray from the curved tube, which is introduced over the tongue, is very useful, but the use of the steam atomizer is more convenient, and is preferable in severe cases.

The following mixtures I am in the habit of using with the atomizer:—

1. ℞. Acid. salicylic., ʒss;
   Glycerinæ, ℥ij;
   Aq. calcis, ℥viij. Misce.
2. ℞. Acid. carbolic., gtt. xxxij;
   Glycerinæ, ℥ij;
   Aq. calcis, ℥vj. Misce.
3. ℞. Acid. carbolic., gtt. xxxij;
   Potas. chlorat., ʒiij;
   Glycerinæ, ℥iij;
   Aquæ, ℥v. Misce.

Half a dozen to a dozen compressions of the bulb of the hand atomizer cover the surface of the throat more effectually with the liquid than can be done by several applications of the brush, and it is usually not dreaded by the patient. Diminution of size of the pseudo-membrane under the use of the spray is a favorable sign, but if it do not diminish, its presence can do little harm, provided that it is properly disinfected.

In most cases of diphtheritic inflammation of the fauces the spray suffices for local treatment, but the following mixture, applied by a large camel's-hair pencil, is also very effectual, immediately converting the pseudo-membrane into an inert mass, and putting a stop to all movements of the bacteria which swarm in it, as I have observed under the microscope:—

℞. Acid. carbolic., gtt. viij;
Liq. ferri subsulphat., ʒij–iij;
Glycerinæ, ℥j. Misce.

This may be used two or three times daily, between the spraying, or oftener without the spraying. It is not irritating (such an effect would condemn it), but it is dreaded by most children, on account, of the unpleasant "puckering," which it produces.

That form of diphtheritic inflammation which most imperatively requires local treatment, and in which local measures are of more importance than the constitutional, is obviously the laryngitis. Catarrhal laryngitis sometimes occurs in diphtheria, as I have occasionally observed in the

dead-house, without producing any marked symptoms, but the pseudo-membranous laryngitis of diphtheria is also common, and, as all know, is one of the most dangerous forms of disease.

Diphtheritic Croup.

Of the 104 cases of primary diphtheria, which I have alluded to above, as having been seen by me in family practice, since December 1, 1875, and notes of which I have preserved, in twenty-five the predominant inflammation was pseudo-membranous laryngitis. Cases in which there was some huskiness or hoarseness of voice, but no obstruction in the respiration, were not included in this number. Of these twenty-five cases, in which there seemed to be no reasonable doubt of the presence of a laryngeal pseudo-membrane, nine recovered, two by tracheotomy, and seven by the inhalation of the spray. Of the sixteen who died, upon two tracheotomy was performed, while the others were treated by the spray. It will be admitted, I think, that recovery of nine in twenty-five cases was an exceptionally good result, and was probably in part due to mildness in the type of diphtheria, during a portion of the time, in which these cases occurred, for if the type is severe the exudation is more abundant, and the exudative process continues longer. But those who observe carefully the effects of the spray (lime-water being used in the atomizer, as the most powerful solvent which can be safely employed), must admit that it is the most effectual agent at our command, for treating this very fatal affection. The following cases may be cited as examples, showing what may be accomplished by the spray:—

L., æt. 9 months, began to have croupy cough on February 16th, 1877, but it was slight at first, so as to attract little attention. Gradually this symptom became worse, and on the 19th I was asked to see her. At this time both inspiration and expiration were noisy, the cough frequent and croupy, the temperature 101°, and the fauces red, but without any pseudo-membrane upon them. In addition to the internal treatment, the above No. 2 mixture was ordered to be used every half hour to every hour. On the 22d small patches of pseudo-membrane were observed upon the fauces, the noisy respiration and croupy cough remained with little change, and the same treatment was continued.

24th. Symptoms worse; temperature 103°; respiration still more embarrassed, and the sternum is depressed in each respiration. Evening, temperature 101°; respiration 40; pulse 136; urine scanty, none of which can be collected for examination. The steam atomizer is to-day substituted for the hand atomizer, and its constant use directed.

25th. No lividity of fingers or lips, but very great dyspnœa; struggles for breath at times, with a wild expression of the eyes; respiration 40; pulse 164; temperature 103°. On the evening of this day, it did seem that the child would die before morning, and I greatly regretted that tracheotomy had not been performed, and would then have prepared for it, except for the opposition of the family. The No. 1 mixture was now substituted for the No. 2, and used without intermission.

26*th*. Respiration 48, its character as before, but the mother states that the cough is somewhat looser; temperature 103½°. The membranous exudation has disappeared from the fauces. From this time there was gradual improvement, and in a few days the child was out of danger.

In the same month in which the above case occurred, diphtheritic laryngitis appeared in two other families in my practice, and the following histories of them will also show the probable good effects of the atomizer:—

B., æt. 13 months, began to be croupy on February 14. On the 16th, when visited by me, there were small isolated patches of pseudo-membrane upon the fauces, and the uvula was completely covered by this exudation. The cough was croupy, but the respiration was much easier than in the above case, and there was much less hoarseness of voice. The No. 2 mixture was used every half hour with Delano's hand atomizer, and the symptoms, which never showed any immediate danger, gradually abated.

B., a girl, æt. 4 years, living in the east side of the city, began to be hoarse on February 14, and on the 15th the dyspnœa became so urgent, that the attending physician performed tracheotomy. A cast two inches in length, circular, and evidently extending nearly to the bifurcation, was expectorated from the opening, after which the respiration was easier. Her temperature was constantly under 100°. A few days after the operation, symptoms of profound blood poisoning occurred. The urine was very albuminous, and it contained casts. The edges of the opening into the trachea became covered with the diphtheritic pellicle, and the characteristic offensive odor was observed. Her death occurred on February 22.

The second child, æt. 20 months, began to be hoarse on February 15, and was visited by myself with the attending physician on the 17th. Her temperature was 101°; her fauces were red, but with only small patches of exudation, and her respiration was embarrassed and noisy, so as to be heard in the adjoining room. We prescribed, in addition to sustaining remedies, the constant use of the No. 1 mixture through the steam atomizer. Some of the time two steam atomizers threw the spray upon the face of the child. It was obvious within a day or two, that the obstruction within the larynx had not increased, and with the constant use of the instruments night and day the inflammation gradually abated, and the life of the child was saved.

These cases indicate, in my opinion, the proper course of treatment in diphtheritic laryngitis, but while we accord to local measures the first place in the role of therapeutic agents for this form of inflammation, internal treatment should not, as a rule, be suspended. Even mild cases of diphtheritic laryngitis may end fatally by systemic infection after the obstruction in the larynx is removed as in the above case, in which tracheotomy was performed, although the temperature during the period of the dyspnœa had been constantly under 100°.

In diphtheritic croup the steam atomizer, which produces a constant application of the spray, should be used. If the inflammation do not begin to yield, and death seems imminent, tracheotomy should be considered. During an epidemic of severe type it will not, with an occasional exception, save life, but when the type is mild a considerable proportion recover after the operation with judicious subsequent treatment. When the type

was severe in New York, and blood poisoning a prominent feature, one of our surgeons operated about forty times with only two recoveries, and the experience of others was about the same, but during the last two years, with a milder type, the result has been much more favorable. Tracheotomy should therefore be performed as a last resort in certain cases.

Unless in comparatively rare instances, there is only one other diphtheritic inflammation which requires special treatment, namely, that affecting the Schneiderian membrane. This membrane, in sensitiveness and liability to irritation, is intermediate between the conjunctiva and buccal or faucial membrane, and, therefore, when inflamed it requires milder applications than such as are appropriate for the fauces. Applications suitable for the fauces, would, if thrown into the nostrils, be too painful, and might increase the inflammation. I know no better treatment of the nostrils, than to inject with a small syringe one to two teaspoonfuls of the following mixture every third or fourth hour. It should be used at the temperature of the body, with the head thrown back and the eyes covered with a cloth. I have sometimes employed it with the atomizer:—

℞. Acid. carbolic., gtt. xxiv;
Glycerinæ, ℥ij;
Aquæ, ℥vj.

Diphtheritic paralysis requires the use of strychnine with tonics. I ordinarily employ the elix. phosphat. ferri, qui, et strychniæ of the shops. Each drachm of this contains gr. $\frac{1}{60}$ of strychnia, and by dilution with water the proper dose can be administered to a child of any age. Thus, recently, a child aged six years, having paralysis of the muscles of the pharynx, recovered in about one week, by the use of one drachm of this medicine daily, given in four or five doses. I have not found it necessary, in any case which I have observed, to employ electricity, but it is no doubt useful in expediting recovery, especially if the paralysis is in the limbs. The anæmic state which succeeds diphtheria requires the use of iron for several weeks.

Preventive Measures.—The occurrence of diphtheria in a family necessitates the prompt removal of other children of the family either out of the house or to a distant part of it, and the disinfection of the room, and the handkerchiefs, and other linen, and spittoons employed. The diphtheritic like the scarlatinous virus may remain for weeks or months in a locality or apartment. In East Fifty-fifth Street two families resided in a brown-stone house, the sanitary condition of which was apparently good. In December, 1874, diphtheria occurred in one of these families, who occupied the lower floor and the basement, causing the death of two of the children. The other family, in order to escape the danger, immediately removed to another part of the city, where they remained two months, returning home on March 6th. On March 14th and 15th, eight and nine days after the return, their two children, aged $2\frac{1}{2}$ and $4\frac{1}{2}$ years,

who had been allowed free access to the room in which the fatal cases had occurred, also took severe diphtheria, one of them dying.

In another family, living in the suburbs of New York, the mother contracted diphtheria from her brother's child, who died of the malady a few blocks distant. Returning home, she occupied a small room, remaining constantly in it, and by prompt local treatment was soon convalescent. Her only child, a boy of six years, was excluded from her companionship about one month, after which he was allowed to enter the room, and slept in it. Within a few days, namely, thirty-five days after it commenced in the mother, the diphtheritic patch appeared upon his fauces. In one of the asylums of this city, diphtheria has been prevailing more than a year, the cases occurring mainly in one of the buildings, and with so little break or intermission that it appears that the diphtheritic virus has not been eradicated from one or more of the wards since the first case occurred. Such instances show the danger of admitting children into rooms where diphtheria has occurred, until a considerable period has elapsed, and thorough disinfection has been employed.

When diphtheria is prevalent, indisposition on the part of a child, and especially febrile symptoms, or defluxion from the nostrils, should at once arrest attention. Although there is no complaint of soreness of the throat, the fauces should be carefully inspected, and if they seem too red, they should be sprayed with one of the mixtures recommended above.

Pertussis.

Pertussis is an infectious disease attended and manifested by a catarrh of the air passages. This catarrh gives rise to a cough which does not differ, during the inception and in the declining period, from that in an ordinary catarrh, but during the middle period of the malady is spasmodic. Exceptionally the system is so mildly affected that the spasmodic element of the cough is lacking through the whole course of the malady, or is confined to a brief period. This distinctive symptom, namely, the peculiar cough, has been attributed to the irritating and disturbing action of the specific principle on the nerves, which control the muscles of respiration. Some attribute it to the impression produced upon the filaments of the pneumogastric, especially upon those of the internal branch of the superior laryngeal nerve, by the mucus which collects in the larynx and trachea, and which is known to contain the contagious principle in abundance. This cough consists in a series of forcible and loud expirations, followed by a noisy and difficult inspiration. Its special character is due to spasmodic contraction of the muscles of expiration, and notably of the small muscles of the larynx so as to produce narrowing or even closure of the aperture of the glottis. Each paroxysm of the cough usually ends, not always, in the expectoration of viscid mucus. With rare exceptions per-

tussis affects the same individual but once. Rilliet and Barthez report a case of its second occurrence, and West another case. I have attended two adult patients, both women of intelligence, who stated that they had had previous attacks in early life. Pertussis usually prevails as an epidemic, but is occasionally sporadic, at which time its type is mild. It is highly contagious through the breath of the patient, or from exhalations from his surface.

Age.—Most cases of pertussis occur between the ages of one year and eight years, but it occasionally occurs in adult and even old people who have not been attacked previously. It is rare under the age of three months, but through the kindness of Dr. Ewing, of New York, I was enabled to see a new-born infant with pertussis, whose mother had had the disease during the two months preceding her confinement. This infant when fifteen minutes old, and during the washing, had the first convulsive seizure, which appeared to consist chiefly of a spasm of the laryngeal muscles, with temporary suspension of the respiration, and attended by deep lividity of the features, with some frothing of the mouth. These attacks occurred nearly every hour, with intervals of complete cessation of symptoms. The mucus between the lips finally became stained with blood, and death occurred on the third day. The mother, the intelligent wife of a clergyman, believes that the infant had similar attacks before its birth. A parallel case is related by Rilliet and Barthez.

Causes.—Climate, race, and nationality do not seem to exert any decided influence on the spread of pertussis. Females are somewhat more liable to be attacked than males, and, as we have seen, a large majority of the cases occur between the ages of one and ten years. The nature of the contagious principle of this disease has, in my opinion, thus far eluded detection, and is likely to, for some time to come, on account of its subtlety. The last ten years have been characterized by very active search, chiefly with the microscope, for the *contagia* of the infectious diseases. Many suppose that it had been discovered, as regards diphtheria, in the countless bacteria which swarm in the pseudo-membrane, and even in the tissues and excretions during the course of this dreadful disease, mistaking an effect for a cause. And Letzerich, about the year 1870, supposed he had discovered the cause of pertussis in a fungus, which received upon the surface of the air passages in inspiration, increase rapidly and produce the spasmodic cough by their irritating effect, or the irritating property which they impart to the mucus. In the first stage of pertussis he found only the spores of the fungus, and at a more advanced stage in addition to the spores he discovered the irregularly ramifying branches of the thallus. He introduced the mucus upon the fauces of the rabbit, and witnessed the production of pertussis in this animal. But a moment's thought shows us that this theory fails to explain the history and phenomena of this disease, for, unless the cause were something more subtle than the spores and

branches of a fungus, we do not see how it is possible that the mother, contracting pertussis during the last weeks of her pregnancy, should infect her fœtus, whose circulation is entirely distinct; nor does this theory comport with the fact that pertussis passes through regular stages and declines, without any measures which are calculated to destroy the fungus. Besides, it is stated by Steffen, in *Ziemssen's Encyclopædia*, that other microscopists have failed to verify the theory of Letzerich.

Lesions have been discovered in certain fatal cases which have been supposed to throw light on the etiology of pertussis, but which are now known to have been merely coincidences or results of the disease. Such are congestion of the spinal cord and its meninges, hyperæmia of the pneumogastrics, and tumefaction of the tracheo-bronchial glands, which it was claimed produced the spasmodic cough by compressing the recurrent laryngeal nerve.

Pathological Anatomy.—Catarrhal inflammation of the air passages is uniformly present. It occasionally occurs on the mucous surface of the nostrils and pharynx, but is often absent from these parts. In the majority of cases the inflammation affects the surface of the glottis and that below the glottis. However, in not a few cases the surface of the larynx and trachea is pale and not swollen, or the inflammatory appearance is limited to a small part, as the ventricles of the larynx, while the mucous coat of the bronchi and their branches is swollen and red, and covered with tenacious mucus. Sometimes certain alveoli are found distended by a thick muco-pus, producing an appearance like minute tubercles.

A common lesion found in the lungs of those who have perished with this malady is emphysema, affecting chiefly the peripheral portions of the upper lobes. It is commonly vesicular emphysema occurring from over-distension of the air cells, but in some instances the air has escaped into the connective tissue, causing interstitial emphysema. According to my recollection of fatal cases, which have occurred from time to time in the institutions of New York, and of which I have made post-mortem examinations, the upper lobes were exsanguine and inflated to nearly the fullest extent possible within the thorax, while other portions of the lungs presented areas of pneumonic, or more or less complete atelectatic solidification. Pneumonia, atelectasis, and small extravasations of blood in the lungs, are, indeed, common lesions. Hyperplasia of the bronchial glands is also common, and hyperplasia has also been occasionally observed of other lymphatic glands, as the mesenteric. An ulcer under the tongue which observers have frequently noticed is now attributed to pressure of the tongue on the lower incisors during the cough.

In fatal cases small extravasations of blood in or upon the brain are common, as is also passive congestion of the sinuses, veins, and capillaries, meningeal and cerebral, attended with more or less transudation of serum within the ventricles of the brain, and between the meninges. Large dark

and soft clots, and occasionally some that are white or yellow, are common in the intra-cranial sinuses, especially if, as often happens, death has occurred in convulsions, which supervened upon the severe spasmodic cough.

Symptoms.—Pertussis consists of three stages: first, that of catarrh of the air passages; secondly, the stage of spasmodic cough, or for brevity the spasmodic stage; thirdly, the stage of decline.

The first period is characterized by the symptoms of coryza and bronchitis, which present nothing peculiar, or different from ordinary catarrhs of the same parts, unless occasionally the cough is more frequent and teasing. Trousseau has known it to be repeated forty or fifty times per minute. The eyes present a moderately suffused appearance, and there is sneezing, with defluxion from the nostrils, but less than in the commencement of measles. The cough, which commences as soon as the catarrh affects the larynx is accompanied by little or no expectoration. The pulse and respiration are moderately accelerated, and such other symptoms, as commonly accompany catarrh of a mild grade are present, namely, increased heat of surface, thirst, and impaired appetite.

The duration of the first stage varies in different cases. In severe hooping-cough it may last only two or three days, and in mild cases, be protracted to five or six weeks. It may be absent especially in very young infants. We have alluded above to the new-born infant, in whom there was no first stage, a glottic spasm occurring soon after birth. The first stage commonly ends in from eight to fifteen days. In fifty-five cases observed by Dr. West its average duration was twelve days and seven-tenths of a day. It is stated above that the first stage in rare instances continues during the entire course of pertussis; at least no spasmodic cough occurs. In two such cases which I now recall to mind, both girls, the inflammatory symptoms abated somewhat after the first few days, and there remained an occasional easy cough like that of simple bronchitis, which continued during a period corresponding with the ordinary duration of pertussis. The diagnosis would have been doubtful, except for the occurrence of pertussis with its regular stages, in other children of the same families.

Second Period.—This may commence quite abruptly, but ordinarily its beginning is gradual. While the cough commonly has the character present in the first stage, it is now and then observed to be more severe and spasmodic, especially at night, and when the patient is in any way excited. The spasmodic element increases, so that in the course of a week all doubt as to the nature of the disease is removed.

The severity of the cough in the second stage varies considerably in different cases. It sometimes commences quite abruptly, with little warning, but commonly there is premonition of it, and the child endeavors to repress it. He experiences a tickling sensation in the throat, or median line of the chest, or a feeling of constriction. He leaves his playthings, and rests his head on his mother's lap, or takes hold of some firm object for support; his face has a grave or even anxious appearance, while the

pulse and respiration are somewhat accelerated. Immediately the cough begins. It consists in a series of short and hurried expirations, which expel a large part of the air contained in the lungs, followed by a hurried inspiration, which is difficult and noisy on account of the spasmodic contraction of the laryngeal muscles, and narrowing of the glottic aperture. The sound which accompanies the inspiration, and which is often absent especially in infants, is designated the hoop. The forcible expirations, and difficulty experienced in expelling the air from the lungs on account of the constriction of the glottis afford explanation of the emphysematous distension of the air cells in the upper lobes, which we have seen is so common in severe pertussis.

There may be a single series of expirations terminating in the manner stated, but often there are several such series embraced in a paroxysm. The cough commonly ends in the expulsion of frothy mucus from the bronchial tubes, and sometimes in vomiting. During the cough there is temporary arrest of blood in the lungs, leading to congestion in the right cavities of the heart, and throughout the systemic circulation; therefore the face is flushed and swollen, and occasionally hemorrhage occurs under the conjunctiva, or from one of the mucous surfaces. The most frequent hemorrhage is epistaxis. When the cough ceases, and normal respiration is restored, the fulness of the vessels immediately abates; but often puffiness of the features is observed, due to serous infiltration of the subcutaneous connective tissue, and continuing for days or weeks during the period when the cough is most severe. The paroxysm lasts from a quarter to a half or even a whole minute, and in that time, in cases of ordinary severity, there are often as many as fifteen to twenty series of expirations.

At the close of the paroxysm, if there is no complication, the symptoms soon abate; the temperature, pulse, and respiration become normal, and there is no evidence of disease. The cough in the second stage is much more frequent in one case than another. At the height of this stage it is generally more severe if it occurs at long intervals than when frequent. During the weeks in which pertussis is most severe, there is, in the average, about one paroxysm of coughing in each hour.

The cough increases in severity till the third week of the second stage, or the thirtieth to thirty-fifth day of the disease, after which it remains stationary for a certain time. It is apt to be more frequent in the night than daytime. Sometimes it occurs while the child is quiet; it may even awaken him from sleep, but it is often also produced by mental excitement or by physical exertion. Anger or fright gives rise to it, and therefore the child is apt to cough when being examined by the physician, or when his wishes are not complied with. The ordinary duration of the second stage is from thirty to sixty days. It may, however, be considerably longer or shorter than this.

The *third stage*, which commences at the time when the spasmodic cough begins to abate, is short, not continuing longer than two or three weeks.

A protracted stage of decline indicates some complication. While the sputum in the second stage is mucous and frothy, that in the third stage is more opaque and puriform.

In the third as in the second stage, if there is no complication, the pulse and respiration in the intervals of the paroxysms are nearly or quite natural. Febrile excitement may, however, now and then occur from trifling causes, or, indeed, without any apparent cause. The digestion and the general health in uncomplicated pertusses remain unimpaired, with the exception of more or less emaciation, which is apt to occur in all but the mildest cases, in consequence of the frequent vomiting. After complete recovery, it is not unusual for the spasmodic cough to reappear, at times, for one or even two years. The cough of ordinary simple laryngitis, or bronchitis, assumes this character.

Complications.—These, like the symptoms, are chiefly of a twofold character, namely, inflammatory and neuropathic. From the nature of the cough in pertussis, it would naturally be supposed that that spasmodic affection, which is now designated internal convulsions, and which is characterized by spasm of certain muscles of respiration, would be a frequent complication. It does sometimes occur in young children, but it is not common. Clonic convulsions affecting the external muscles are, on the other hand, not infrequent. They occur chiefly in the second stage, when the cough is most severe, and in infancy much more frequently than in childhood. They are apt to be general and severe, or, if not of this character at first, to become such. The convulsions commence, in most instances, in or directly after the paroxysm of coughing; but they sometimes occur in the interval when the child is quiet.

Rilliet and Barthez remark: "Almost all infants succumb to this complication, ordinarily in the twenty-four hours which follow the first attack; nevertheless, life may be prolonged during two or three days." (Article *Coqueluche.*) In my own practice, this complication usually ended fatally before bromide of potassium and chloral were employed, but with the proper use of these agents can often be arrested. In the month of June, 1867, I was attending a little girl two years and four months old, who had reached the fifth week of pertussis, when she was seized with general clonic convulsions. The mother, who was requested to keep a record of the number of convulsions, stated that there were twenty in all, occurring within forty-eight hours. They affected both sides, the shortest lasting only three or four minutes, the longest seventy-five minutes. The treatment in this case, which eventuated favorably, will be noticed hereafter.

In those who die of convulsions occurring in hooping-cough, the most constant lesion is congestion of the cerebral veins and sinuses, often with transudation of serum. This congestion is due in part to the cough which precedes the convulsions and in part to the convulsions themselves. At

the autopsies which I have made of two infants, who died in hospital practice from hooping-cough, accompanied by convulsions, all the cerebral sinuses were filled with clots, which were generally soft and dark; but in the lateral sinuses clots were found which were light-colored. The light color of a clot, either in a vein or sinus, indicates its ante-mortem formation.

The gravity of the convulsive attack can be ascertained by observing whether the patient readily recovers consciousness. Its return indicates that there is no serious congestion. On the other hand, great drowsiness remaining, or a semi-comatose state, indicates persistent congestion and, perhaps, even the formation of clots in the sinuses of the brain. Death from convulsions is usually preceded by coma. Occasionally meningeal apoplexy supervenes upon the congestion, and death is immediate.

The most frequent inflammatory complications are bronchitis and pneumonitis. Inflammation of the bronchial tubes of a mild grade we have seen, is a common accompaniment of pertussis, but when it extends to the minuter tubes, or becomes so severe as to cause acceleration of respiration, it is, properly, a complication. Both bronchitis and pneumonitis, occurring as complications, are developed, with few exceptions, in the second stage. Bronchitis is accompanied by accelerated respiration and pulse, and increased temperature. The danger is proportionate to the amount of dyspnœa.

Pneumonitis is a less common complication than bronchitis, but it occurs more frequently in pertussis than in any other constitutional affection of early life, excepting measles. The congestion, which occurs and remains in the lung when the cough is frequent and severe, favors the development of pneumonia. The symptoms and physical signs which accompany this inflammation and serve for its diagnosis are the same as in the primary form of the disease, and are described elsewhere. Bronchitis or pneumonia usually moderates the severity of the spasmodic cough, for when the inflammatory element in pertussis increases, the spasmodic abates. On the abatement of the inflammation, however, the cough usually regains its former convulsive character. The fact may be stated in this connection, that any complication or intercurrent disease, which is attended by decided febrile reaction, ordinarily renders the cough for the time less spasmodic.

The occurrence of bronchitis or pneumonia is shown by the elevated temperature, acceleration of pulse and respiration, short and frequent cough. These symptoms do not cease as long as the inflammation continues, whereas in uncomplicated pertussis the patient seems nearly or quite well between the coughs. In pneumonia the respiration is accompanied by the expiratory moan, and in both bronchitis and pneumonia there is more or less depression of the infra-mammary region during inspiration. These symptoms, in connection with the physical signs, render diagnosis in most instances easy. Although the general character of the

cough is changed, a cough now and then occurs, even when the inflammation is pretty severe, sufficiently spasmodic to indicate the nature of the primary affection. Capillary bronchitis and pneumonia are always serious complications.

Not only is more or less emphysema a common complication of severe pertussis, but bronchiectasis also occurs in certain cases, due to the same conditions. Emphysema is a common lesion in young and feeble infants, even when there is no history of any previous severe disease of the respiratory organs. I have found it one of the most common lesions in infants of feeble constitutions, who die in the hospitals and asylums of New York, but it is apt to be interstitial and confined to a small part of the upper lobes. It is not accompanied by that general distension of the alveoli and consequent enlargement of the lobes, which occur in the emphysema of pertussis. Its chief cause in these feeble and wasted infants appears to be impaired nutrition and change in the molecular condition of the pulmonary tissue. The same condition often occurs in severe and protracted pertussis, and therefore serves as an additional and efficient cause of the emphysema.

The following was a not unusual case of this disease as it occurs in the tenement houses and asylums of New York. At the meeting of the New York Pathological Society, October 14th, 1868, I exhibited emphysematous lungs, removed from an infant who died at the age of nineteen months, at the commencement of the fourth week of pertussis. Death occurred from thrombosis in the lateral sinuses of the cranium, resulting from the severe spasmodic cough, eclampsia, and feebleness of the circulation, as the infant was previously in a reduced state from chronic enterocolitis. At the autopsy the superior lobes of both lungs were found exsanguine, doughy to the feel, and enlarged so as to rise above the level of the other lobes. The resiliency and elasticity of the lung tissue in these lobes were evidently greatly impaired, and their air cells in a state of over-distension. The other lobes were healthy except that one of them was the seat of catarrhal pneumonia. In this case there had been no disease affecting the respiratory apparatus previously to the pertussis, so that the incipient vesicular emphysema was referable to the severe cough and impaired nutrition of the lungs.

Occasionally we meet cases of severe pertussis in which, while there is over-distension of the alveoli of the upper lobes, collapse occurs over a greater or less extent of the lower lobes. Collapse like emphysema may continue for weeks or months subsequently to pertussis, and then gradually disappear, but in the following rare case in my experience, it was permanent. John O'Neil, aged 5½ years, was brought to the Bureau for the Relief of the Out-door Poor in New York, in December, 1876. He lived in the under-ground basement of a tenement house, and was supported by charity, except, at intervals, when his father, who was dissipated,

could obtain work. At the age of fifteen months he had a glandular swelling on the right side of the neck, which suppurated, and three months later one on the opposite side, which also suppurated. At the age of 2½ years he had bronchitis, the cough of which did not abate till two months subsequently. When near the age of three years he had measles, and the cough from this disease lasted three or four months. In the summer of 1875, or about one year subsequently to the measles, he contracted pertussis, which was severe, but was allowed to run its course without treatment. It lasted four months, never, however, confining him to bed or materially impairing his appetite; and one morning about the close of the second month of the malady, the parents first observed depression of the right side of the thorax. This gradually increased for a few weeks and has been permanent. The parents stated that he had never been confined to the house or without appetite except during the week of measles.

Since his recovery from pertussis he has had his usual appetite and general health, but crying or excitement commonly brings on a pretty severe cough. The depression of the thorax examined in front, begins quite abruptly in the line of the left costo-chondral articulations. Circumferential measurement of the left side from the middle of the sternum to the spine, the tape lying a little below the nipple gives eleven and a half inches, while corresponding measurement of the right side, gives seven and a half inches; pulse 136, sounds of the heart normal; respiration 44. On auscultation over the right side of the chest we observed bronchial respiration, and a feeble bronchophony, with perhaps slight vocal fremitus. The accompanying figure is from a photograph by Mr. Mason, photographer to Bellevue Hospital. My first impression on observing this case was that it was one of unexpanded lung, which had been compressed by a pleuritic effusion, but it is seen that the history points clearly to pertussis as the cause of the deformity. The depression occurred somewhat suddenly when the cough was most severe, and when there was no fever, loss of appetite, or other symptoms of pleuritis. The patient had not presented any marked evidence of rachitis, but was decidedly strumous.

Fig. 14.

Pertussis is sometimes complicated by the eruptive fevers. There does indeed seem to be some affinity between it and measles, so that many epidemics of the two have been observed at about the same time. During my term of ser-

vice in the New York Foundling Asylum, in May, 1878, measles and pertussis prevailed in the wards at the same time. Eighteen of the children, who were having pertussis, contracted measles, and the Sisters, who were very intelligent and faithful observers, and were requested by me to notice the effect of the complication, stated that with few exceptions the severity of the hooping-cough was increased during the continuance of the exanthem. This is contrary to the statement of some authors.

Diagnosis.—During the period of invasion it is impossible to diagnosticate pertussis. Its nature can only be conjectured from a known exposure, or from the epidemic occurrence of the disease. In the second stage, which is characterized by the spasmodic cough, diagnosis is ordinarily easy, and often the parents are able to announce the nature of the disease when the physician is called. Still, a mistake is sometimes made: a spasmodic cough very similar to that of pertussis occasionally occurs in other maladies. Young infants with bronchitis frequently experience great difficulty in the expectoration of mucus, which collects in the air-passages and provokes a suffocative cough. The following facts will aid in making the diagnosis. Bronchitis, accompanied by a suffocative cough, is an acute disease, and the cough occurs at an early period, usually in the first week. It lacks the inspiratory sound or the hoop, and is associated with constantly accelerated respiration and well-marked febrile symptoms, dependent on the inflammation. Moreover, the cough is only occasionally suffocative, according to the amount of mucus in the tubes. The spasmodic cough of pertussis, on the other hand, is preceded by the stage of invasion, and this cough occurs only in the second stage, when the febrile symptoms have abated. Again, the suffocative cough of bronchitis rarely ends in vomiting, which has been seen to be so common in the cough of pertussis.

The only other disease with which there is much likelihood of confounding pertussis is bronchial phthisis. The points of differential diagnosis are the following: the one epidemic, and spreading by contagion; the other non-contagious and isolated: the one embraced in three distinct stages, and much shorter; the other chronic, and presenting no stages, but commencing with mild non-febrile symptoms, and progressively becoming more severe: in the one an absence of symptoms in the intervals of the cough, provided there is no complication; in the other constant symptoms, such as are common in tubercular disease. The previous health, and the presence or absence of a tubercular cachexia, should be considered in determining the nature of the disease, and usually, in bronchial phthisis, the lungs are also affected, so that auscultation and percussion may furnish positive proof of the nature of the cough.

The attacks of suffocative cough, which are produced by the lodgment of a foreign body in the larynx, or lower down in the air passages, bear a close resemblance to those of pertussis. The diagnosis can be made by

the history, for in the one case there is a preliminary catarrhal stage, and in the other the cough begins abruptly, and usually after the known swallowing of the offending substance, which produces dyspnœa and a spasmodic cough as soon as it enters the larynx. The presence of the body can also be determined in a large proportion of cases by the laryngoscope and auscultation.

Prognosis.—A larger proportion doubtless recover under the better therapeutics of the present time than in former years. According to Hirsch (II., p. 105) 72,000 persons perished from this disease in England and Wales between 1848 and 1855, or one in every forty who died; and Wilde's reports show that it stands fifth as regards mortality among the epidemic diseases of Ireland. In New York city during the half century ending with 1853, 4840 died of pertussis, or one died from this disease in every 76 of deaths from all causes.

As a rule, the older the child the better the prognosis. Young infants may die of suffocation due to the glottic spasm. Eclampsia with extreme passive congestion of the encephalon is a not infrequent complication in children under the age of five years, and it is apt to terminate fatally. It may, however, in my opinion, be averted in most cases by proper treatment. In rare instances death may occur in or immediately after a paroxysm of coughing, in consequence of the rupture of cerebral or meningeal capillaries, and the effusion of blood, or from stasis and coagulation of blood in the venous system, especially if convulsions have supervened upon frequent and protracted paroxysms of coughing. Other complications, which are likely to arise under conditions which favor their development, and which greatly increase the danger and render the prognosis unfavorable, are capillary bronchitis, pneumonia, diphtheria, and in the summer season intestinal catarrh. In New York I have noticed that pertussis occurring in the summer is much more fatal if it becomes complicated with the intestinal catarrh which is an epidemic among infants during that season.

Feebleness of system and antecedent and accompanying chronic disease increase the danger. Pertussis sometimes produces so much emaciation and loss of strength, in consequence of the severity and frequency of the cough, and the repeated vomiting, that intercurrent diseases which in favorable states of the system would probably end in recovery, are very apt to prove fatal.

I usually inform the family that the patient is doing well, if he seem entirely well between the paroxysms, but if he appear ill, whether with somnolence, fretfulness, fever, loss of appetite, accelerated breathing, or diarrhœa, he is not doing well, and probably has some complication, which requires immediate attention. Sudden deaths occur in the second stage; but deaths from causes or conditions which operate in a gradual and protracted manner, may occur in the second or third stage.

TREATMENT.—In the catarrhal stage the treatment should be the same as in mild idiopathic catarrh. Demulcent and gentle expectorant measures are required. Care should be taken to employ nothing which reduces the strength or impairs the general health. If there is much bronchitis with accelerated breathing and frequent cough, mild counter-irritation to the chest, and the use of the oil silk jacket are proper.

Therapeutic measures are chiefly indicated in the second stage, or that of convulsive cough. Proper treatment may control the severity of the cough, and abridge the duration of the second stage, and prevent or control complications. As with most other diseases whose cause and nature are obscure, and which under ordinary circumstances terminate favorably, pertussis has received a great variety of treatment. The enumeration of the medicines, and modes of treatment which have had their season of repute, and been employed by intelligent physicians, would occupy too much time. The treatment should vary in some respects according to the case, but a small number of medicines suffices, even in the most severe and obstinate forms of the malady. Those which I have found most useful for internal treatment, and which are employed more than any others in the institutions of New York, are belladonna, quinine, the bromides, and hydrate of chloral. They are now largely used in the treatment of pertussis in this city, and I can bear witness that a larger number of cases treated by them escape complications and recover, than under other modes of treatment which were formerly employed.

When the second stage commences, belladonna should be given in ordinary cases in morning and evening doses. Children require a larger proportionate dose than adults, and it can with few exceptions be safely administered even to the youngest infant in a quantity gradually increased till the cough is moderated or physiological effects are produced. The physiological effects are more readily produced in some than in others. Thus recently I gradually increased the doses of the tincture of belladonna to twelve drops for a child aged three and a half years, who had severe pertussis, without producing the characteristic efflorescence, while smaller doses from the same bottle produced this effect in older children. Probably the action of the drug is on the respiratory centres in the medulla, and not directly on the muscles, as once held. Rarely I have discontinued the belladonna on account of diminished flow of urine, which this agent may or may not have produced, and very rarely on account of suddenly developed muscular weakness, which I had reason to think the belladonna caused. This occurred in the case alluded to above, in which twelve drops of the tincture were given, so that the muscles seemed flabby, and the trunk and head were supported with difficulty.

Trousseau sometimes employed atropia in place of belladonna, since the medicinal property of the plant resides in this alkaloid, which being crystalline has uniform strength. He gave the neutral sulphate of atropia

in doses of about $\frac{1}{174}$ part of a grain, dissolved in distilled water, to infants or young children. He gave the medicine twice each day, and for older children ordered a proportionately larger dose. Brown-Séquard, in remarks made before the United States Medical Association in May, 1866, maintained that the duration of pertussis, so far as its neuropathic element is concerned, might be abridged to a few days, by doses of atropia, sufficiently large to produce toxical effects. He recommended a dose which will cause, and repeated will maintain delirium for three days, after which he stated that the cough is no longer spasmodic. But a more moderate dose, even with a longer time to effect a cure, seems preferable. The tincture of belladonna is most convenient for use, and most of that kept in the shops is active and reliable. The doses which I have ordinarily found to be sufficient, and which also produced efflorescence, were as follows: to a child of two years three drops, and to one of six or eight years, eight or ten drops, morning and evening. I always, however, commence with a smaller number, and continue to administer the dose which produces the local effects alluded to, unless the cough is moderated with smaller doses. In the majority of cases I have noticed no decided effect till the rash was produced, when the symptoms improved, the cough becoming less frequent or less severe. By the belladonna treatment the spasmodic stage may not only be rendered mild, but abridged to two or three weeks. In some cases the severe cough begins to yield almost immediately under full doses of this agent, but in other cases its continuance for some days is necessary, with other remedies as adjuvants, before there is any appreciable benefit from its use.

The use of quinine as a remedy for pertussis was first strongly recommended by Binz, who embraced the theory of Letzerich, that this disease is produced by a fungus, upon which the quinine acts injuriously. I have not observed that improvement from the use of this agent, when employed alone—and it has been largely prescribed in the institutions of New York—which I have observed in cases treated at the same time, with morning and evening doses of belladonna. Its good effects upon the spasmodic cough are probably due to the fact that it diminishes reflex irritability (Schlakow and Eulenberg). At the same time it acts as a tonic, and improves the appetite, and tends to prevent any depressing effect which might occur from the belladonna. It is beyond question the proper remedy in those frequent cases, in which febrile symptoms arise, whether from some complication as bronchitis, pneumonia, or other causes. In ordinary cases a child of five years should take about two grains four times daily, in the elixir adjuvans or other convenient vehicle. As an antipyretic a larger dose may sometimes be needed.

As the paroxysms are apt to be more severe at night, and the patient consequently be deprived of the required sleep, a medicine is indicated, which will procure some hours of rest, and thereby diminish the number

of paroxysms. For this purpose the hydrate of chloral is especially useful given in doses of two to five grains according to the age, and perhaps repeated. It does not seem to me that chloral exerts any marked influence upon the cough ; it seems to be useful chiefly in the manner stated, namely, by procuring prolonged sleep.

One of the chief dangers from pertussis we have seen to be the occurrence of great passive congestion of organs, especially of the brain, with the liability to hemorrhages, serous effusion, and eclampsia. This is in great part prevented by the action of the medicines mentioned above, which diminish the severity of the cough, or its frequency. But when there are great and frequent congestions of the nervous centres, producing eclampsia or premonitions of eclampsia, the use of one of the bromine compounds is indicated for its prompt and decided action in averting the danger. Even if the symptoms are not urgent, its tranquillizing effect, and especially its prompt action in diminishing reflex irritability, render it one of the most useful agents in pertussis. If there is sudden twitching of the muscles, marked stupor, headache, or fretfulness, or adduction of the thumbs across the palms of the hands during the cough, I never fail to give the bromide of potassium in sufficiently large and frequent doses, and now eclampsia occurs much more rarely in a case which I treat from the commencement, than in former years.

Inhalations have been much employed, and from the nature of pertussis we would suppose that proper substances used in this way would materially aid in the treatment. The inhalation of the fumes from the purifying of gas has been employed for several years as one of the methods for alleviating the cough, and there is sufficient statistical evidence of its utility. But since the atomizer has come into general use this instrument renders other and more inconvenient methods of employing vapors unnecessary, carbolic acid produces an anæsthetic effect on the mucous surfaces, and its vapor has been used by Dr. Burchardt of Berlin, and others, in the treatment of hooping-cough with apparently good results. Opium and glycerine inhalations appear also to be useful. If therefore the internal remedies recommended above do not sufficiently relieve the cough some such mixture as the following should be employed every two to six hours either with the hand or steam atomizer. If the hand atomizer is employed the bulb should not be compressed more than six to twelve times at each using.

℞. Acid carbolic., gtt. xxiv ;
Aq. extract. opii, gr. v ;
Glycerinæ, ℥iij ;
Aquæ, ℥v. Misce.

The complications of pertussis require prompt treatment. Whenever the child feels ill between the paroxyms, he should be carefully examined, and some complication will probably be found which requires treatment. If the bronchitis have increased so as to become a complication, or pneumonia have arisen, the whole chest should be covered with a light flaxseed poul-

tice containing one-sixteenth part of mustard, while quinine and ammonia with alcoholic stimulants are given at regular intervals. Cerebral accidents are best arrested by the warm foot bath, cold to the head, and by the bromide and chloral.

Diphtheria not infrequently supervenes as a complication in a locality where it is endemic or epidemic, and if mild is apt to be overlooked. Recently I have seen a case in which diphtheria complicating pertussis had continued four days, without being recognized by the attending physician, the symptoms being attributed to other causes. The diphtheritic patch in these cases is apt to appear upon the well-known sore under the tongue, in addition to its occurrence upon other parts. This secondary form of diphtheria requires the same treatment as the primary form.

Hauke, in 1862, published experiments which showed that both carbonic acid and ammoniacal vapors when inhaled increase the cough, while the inhalation of oxygen produced no cough and was agreeable to the patient. Hence children in close and crowded apartments suffer most severely from pertussis, and those who are taken to parks, or the country, where vegetation absorbs the carbonic acid, not only obtain benefit from the general invigorating influence, but also as regards the cough. The fact that fresh and pure air benefits the cough has indeed long been known, and has influenced practice, for patients are almost universally allowed to be much of the time in the open air, and are taken to the parks and upon excursions. Nevertheless caution in this regard is required, for exposure in wet weather or to sudden changes of temperature is very apt to develop bronchitis or pneumonia.

Prophylaxis.—Pertussis is very contagious, and it appears to be, in nearly all instances, if not in all, contracted by inhaling the breath of the patient. I have never observed a case in which it seemed to be communicated through a third person, and it is not, I think, usually contracted by children living in the same house, if there is no personal contact. There is not, therefore, that urgent need of disinfection, and of caution on the part of physician and nurse in their subsequent intercourse with healthy children, as in case of the eruptive fevers.

CHAPTER II.

PAROTIDITIS.

Ordinarily, parotiditis, or parotitis, or mumps, has no premonitory stage; but in exceptional cases languor with fever precedes the disease for a few hours. Mumps commences with tenderness in the parotid region, followed soon after by tumefaction. The swelling gradually increases; it

fills the depression under the ear, extends forward and upward upon the cheek, and downward to a greater or less extent upon the neck. It has been demonstrated in case of symptomatic parotiditis, and the same is probably true of the idiopathic disease, or mumps (Virchow), that the swelling is due to inflammation of the gland-ducts and consequent œdema of the interstitial tissue. The inflammation is specific, due to a materies morbi in the blood, and hence its decline after a fixed period. It reaches its maximum from the third to the sixth day. The most prominent point at this time is immediately underneath the lobule of the ear. The tumor, which is firm but slightly elastic, presses outward the lobule. In most cases the skin preserves its normal appearance over the swelling, but occasionally it presents a faint blush. The pressure which movements of the jaw produce on the gland renders mastication and even talking painful. Febrile movement more or less intense occurs, lasting, in ordinary cases, not more than forty-eight hours, but occasionally it is more protracted. Vomiting and epistaxis are sometimes present. The swelling having attained its maximum size, remains stationary a short time, when it begins to decline, and by the sixth to tenth day it has entirely subsided.

In most cases parotiditis is double; it commences on one side, more frequently the left than right, and in from one to four days the opposite gland is involved. In those exceptional cases in which only one parotid is affected, the opposite gland may be the seat of the disease at some subsequent period. It has been estimated that the proportion of unilateral to double mumps is as one to ten.

The total duration of this disease is usually from eight to ten days; in the mildest cases it may not be more than five days. The submaxillary glands are often involved in connection with the parotids, and sometimes also the sublingual, although, from their small size and concealed position, their tumefaction escapes notice. Rarely the tonsils are also tumefied. Sometimes free perspiration occurs at the commencement of convalescence.

The swelling of the parotids sometimes abates suddenly, and in the male the testicle, epididymis, and tunica vaginalis become inflamed; while in the female the mammary glands, ovaries, or the labia majora, are the seat of the so-called metastasis. Occasionally these inflammations, which are less frequent in young children than those near the age of puberty, when the sexual organs are becoming more developed, occur without subsidence of the parotid swelling. They cause considerable increase in the fever and constitutional disturbance, but with proper treatment decline in six to eight days, pursuing the same course as the parotid inflammation.

Nature.—Parotiditis is contagious. It is rare in infancy and after the middle period of life, occurring chiefly in childhood, youth, and early manhood. An incubative period of about twelve days was ascertained by me in cases occurring in the Protestant Episcopal Orphan Asylum of this

city. The observations of others give a similar result. Parotiditis is a blood disease, having the local manifestation described above, and which is our only means of diagnosis.

Diagnosis.—If the physician has seen but few cases of mumps there is danger that he may mistake the swelling for an inflamed cervical gland, or *vice versa*, but an inflamed cervical gland presents to the finger a hardness almost like that of cartilage, and it is circumscribed or round, and does not invest the ear. These characteristics contrast with the elasticity, seat, and shape of the parotid swelling, which extends forward on the cheek and surrounds and elevates the lobule of the ear. Tumefaction resulting from diphtheritic or any other form of faucial inflammation, or from periostitis affecting the root of the posterior molar, may be detected by examining the fauces and interior of the mouth.

Treatment.—This is very simple. Oakum or carded wool may be bound over the swelling, and the surface occasionally rubbed with sweet oil. Mild laxative and diaphoretic drinks, such as bitartrate of potash or lemonade, are useful. If metastasis occur, the new local affection should receive chief attention. It should be treated in the same manner as if it occurred independently of the mumps, while emollient poultices or fomentations should be applied over the parotids. The ill effects of repellant applications in mumps are shown by the following case:—

On March 19, 1877, I was requested to see a young gentleman of eighteen years. He had been well till March 14th, when he complained of pain below his ears, and his mother applied a towel, wrung out of cold water, around his neck. On the following day slight swelling was observed under the angle of the lower jaw, on the right side (submaxillary gland), and the cold application was continued. On the 17th the swelling had disappeared, but the fever and headache had greatly increased, so that he was compelled to lie in bed. On the 19th, at my first visit, he had such violent headache, and was so intolerant of light and noise, that I greatly feared that he had acute encephalitis. All swelling under the ears was gone; the left testicle was tender, and beginning to swell; axillary temperature 102°. The cold cloths were removed from the neck and applied to the head, and potass. bromid. gr. xxv administered every third hour. 20*th*. Axillary temperature 104°; symptoms unabated and alarming. Ordered six leeches to be applied upon the temples and left groin, and a purgative, and two drops of the tincture of aconite to be given with each dose of the bromide. 21*st*. Temperature 103°. States that numbness and a pricking sensation which he had felt in both legs during the last forty-eight hours had ceased (possibly from the aconite). 23*d*. Is convalescent. Has no return of the swelling under the ears, and the orchitis has abated.

SECTION IV.

OTHER GENERAL DISEASES.

CHAPTER I.

INTERMITTENT FEVER.

This is a constitutional malady produced by a miasm which emanates from the soil. I have notes of 36 cases of this disease occurring under the age of $3\frac{1}{2}$ years. Several of the cases were treated in private practice, and the rest in the institutions with which I have been connected. In children above the age of $3\frac{1}{2}$ years intermittent fever differs but little from that of the adult, while in those under this age it presents certain peculiarities. Of the 36 cases which I have observed, 19 had the quotidian form, 10 the tertian, 2 the tertian becoming afterwards quotidian, 1 the quotidian becoming afterwards tertian, while in the remaining 4 cases the form of the disease is not stated. In quotidian ague the malaria has been supposed to act more powerfully on the system, or the system is more susceptible to its influence than in the tertian form, and hence the fact that the quotidian is the prevailing type of ague in tropical regions, where vegetation is luxuriant, marshes extensive, and the heat intense. According to this theory, the feeble resisting power in the system of the infant explains the fact that it has quotidian more frequently than tertian intermittent, although the latter is much more common in the adult in this climate.

Facts demonstrate that infants sometimes receive intermittent fever from their mothers. If mothers during gestation have malarious cachexia, their infants, whether born at full time, or, as often happens, prematurely, are apt to be small, thin, and feeble, and occasionally they have soon after birth distinct paroxysms of the ague. Dr. Stokes related the case of a pregnant woman with ague, who believed that she noticed periodical tremors of her fœtus, but I suspect that she was mistaken, as regards the cause, for the paroxysm of intermittent in young children is not ordinarily accompanied by tremors.

The youngest infant in my practice who apparently derived the ague from its mother, and probably through the fœtal circulation, had the following history: Its mother had occasional attacks of tertian intermittent during the two years preceding her confinement, and her baby when one

week old was observed to have the same disease, occurring also each second day, the coldness and blueness in the first stage of the paroxysm lasting from half an hour to one hour.

It is not fully ascertained whether a nursing infant may contract intermittent fever by lactation, but if it is admitted that it is sometimes communicated to the fœtus through the maternal circulation, it does not seem improbable that the specific principle occasionally enter the milk as well as other secretions. I have frequently remarked the presence of the disease in nursing infants whose mothers were affected, and in one instance an infant at the breast, whose mother had the ague, having contracted it in a suburban village, but was since living in a non-malarious part of the city, presented evident symptoms of the disease. Similar observations by Frank, Burdel, and others, do not indeed fully prove the communicability of intermittent fever by lactation, but render it highly probable.

The period of incubation in the infant varies greatly, as in the adult. When the malaria is concentrated and unusually active, or the condition of system is favorable for its reception, the disease may commence soon after exposure. Thus, in tropical regions, travellers exposed for a single night have been known to sicken within twenty-four hours; but in our cooler latitude, a longer incubative period is the rule. In the infant, however, in our climate, intermittent fever often begins in a very short time after exposure, though there may be an incubative period of some weeks. The following have been my observations relating to this point: A. M., female, 8 months old, remained two days on Long Island, in October, 1870, and three days after her return to the city, a quotidian commenced. P. S., male, 11 months old, remained three days on Long Island, and a quotidian commenced four days after his return. K., 9 months old, remained on Staten Island one week, and eleven days after his return, a tertian commenced. G. K., aged 3 years, remained a day and a night on Staten Island in 1870; three weeks afterwards intermittent fever commenced, preceded by a week of languor. A. U., female, aged 2 years and 2 months, had the first paroxysm of a tertian, two and a half weeks after returning from a visit of one week in Hoboken. As there was no malaria in the portions of the city where these infants resided, the incubative periods are nearly ascertained.

Whatever may be the nature of the malarial poison, whether a vegetable cell, as Prof. Salisbury believes, or something else, it often clings tenaciously to the system, and is probably reproduced in it, even under circumstances favorable for its elimination. Thus, at one of my cliniques at Bellevue Hospital Medical College in 1871, a child, 10 years old, was presented, who had had every year for seven years attacks of intermittent fever. The disease was contracted at the age of three years in Harlem, and the subsequent residence of the family had been in a part of the city where there was no malaria.

Symptoms.—In infancy, and especially prior to the age of eighteen months, the symptoms differ in certain respects from those which characterize the malady in the adult, and are universally known. In childhood the symptoms are similar to those in the adult, and need not, therefore, be described in this connection.

In the infant the type as we have seen is quotidian, with now and then a tertain. Advancing beyond the age of eighteen months, we meet more and more cases of the tertian type, and in childhood it is the common form. I have known the quotidian in the infant, when cured, to reappear a few weeks after as a tertian; but ordinarily it remains quotidian, unless the patient has reached the age at which the tertian type predominates.

The paroxysm in the young infant presents three stages, as in the adult, but while the second, or febrile, is well marked, the first and third are much less pronounced. The patient does not shake (exceptionably, one does even within the first year) in the first stage, but a slight tremor may or may not be observed. The countenance presents a sunken appearance; the lips and fingers are livid, while portions of the surface not livid are pallid, with the goose-flesh appearance, which is, however, less marked than in children of a more advanced age. The blood leaves the surface, which consequently shrinks, while it accumulates in the veins and internal organs; the pulse is feeble, and readily compressed; the surface grows cool from the diminished supply of blood, but the breath is warm, and the internal temperature, so far from being reduced, is elevated two or three degrees. The parents may be alarmed at the sudden sinking of the vital powers, and seek medical advice, but in other instances the first stage is so slight that it passes unperceived till they have been taught to watch for it, and the second stage first attracts attention.

In the second or febrile stage, which immediately succeeds, the pulse becomes full and rapid, 120 to 130 or 140 beats per minute, and the external as well as internal temperature is elevated as in few other diseases (104°–108°). The face is flushed, surface dry, and head painful, as evinced by the features. This stage lasts about two or three to six or eight hours. The third stage, or that of perspiration, succeeds, which terminates the suffering of the patient till the following paroxysm. In infancy the perspiration is not abundant, and in the first half of this period is nearly absent. In the interval of the paroxysms the patient appears well, except a degree of languor.

In twenty-four of the cases of infantile intermittent which I have treated, my notes describe the character of the paroxysms. In sixteen of these there was no chill or trembling in the first stage, but blueness and coolness of the extremities and features, and sudden prostration. This stage lasted from ten minutes to one hour. In the eight remaining cases the infants were observed to tremble or shake as in adult cases. The perspira-

tion of the third stage was in nearly all cases slight and of short duration, and in some was not observed.

During the cold stage, passive congestion of the internal organs occurs to a greater or less extent, but the circulation is equalized during the reaction of the second stage. The spleen, whose capsule is distensible, soon enlarges in many patients, in consequence of the frequent and great congestions, constituting the "ague cake." This enlargement is more common in children than adults. Since my attention has been particularly directed to this subject, I have been able to feel the enlarged spleen, by examination through the abdominal walls, in probably one-third of the cases under the age of ten years. This organ returns to the normal size after the ague is cured. From the intimate relation of the spleen to the composition of the blood, it is evident that the character of this fluid must be affected if intermittent fever be protracted. The blood becomes more and more impoverished, and a state of decided hydræmia supervenes. A few weeks' continuance of the ague suffices to produce decided pallor of the features, and surface generally, and as all watery blood is prone to transudation, such patients not infrequently present more or less œdema of the face, ankles, and other parts. Sometimes, also, especially under unfavorable hygienic circumstances, purpuric spots (purpura hemorrhagica) appear under the skin, affording additional proof of the change which the blood has undergone.

In long-continued cases of malarial disease in the adult waxy degeneration of organs is apt to occur, as well as melanæmia. Pigment cells, flakes, and particles appear in the blood, the coats of the minute arteries, and in various organs, as the spleen, liver, etc. In the child these results are more rare.

Intermittent fever in children, if proper remedial measures are employed at an early period, is ordinarily not dangerous, and is quite amenable to treatment; but that comparatively infrequent and fatal form of it, designated the pernicious, occurs more frequently in children than adults. In New York city, where the type of malarial diseases is mild, I have never met a case of pernicious intermittent in the adult, but I can recall to mind such cases in children, two of them fatal. This form of the fever occurs in a smaller proportionate number of cases in infancy than in childhood, probably because the cold stage is less pronounced. In the pernicious ague the system is overpowered—it does not react in a degree commensurate with the intensity of the disease. The patient enters the cold stage, becomes stupid, and, if not relieved by prompt and efficient measures, passes into fatal coma. A type of the disease, therefore, which would not be pernicious in a robust individual, may be such in one of a broken-down constitution and feeble reactive power. In most cases occurring in children the coma is preceded by eclampsia, which is apt to be general and protracted.

Eclampsia increases the passive congestion of the cerebro-spinal axis already present in this stage, and if not speedily relieved may end in transudation of serum over the surface of the brain, and perhaps meningeal apoplexy, causing fatal coma. This has occurred twice in my practice.

Sometimes in young children the diagnosis of intermittent fever is doubtful, either because the disease has not continued sufficiently long, or there has not been the characteristic paroxysm. The patient may be feverish, and fretful, with anorexia, and evidences of headache, but without the usual distinctive symptoms. I have sometimes in such cases been able to establish the diagnosis by detecting enlargement of the spleen. In examining for the "ague cake," the child must lie quietly on its back, and the fingers, placed midway between the epigastrium and umbilicus, be carried gently but with firm pressure outward in the direction of the spleen, when the anterior edge of this organ will be felt, if it be enlarged. It is impossible to make the examination when the child cries, on account of the contraction of the abdominal muscles.

Treatment.—It is evident that no time should be lost in applying appropriate remedies in a case of infantile ague; for, although the first paroxysm may be mild, the next may be more severe, and attended by danger. Moreover, the sooner the disease is cured the less liable it seems to be to return. Therefore we prescribe at once the sulphate of quinia or cinchonia, one and a half grains of the latter producing the effect of about one grain of the former. Our experience in the children's class in the Outdoor Department has been chiefly with the sulphate of cinchonia, on account of its cheapness, and there has yet been no case of ague which it has failed to control. A recent writer has published statistics showing his success in curing intermittent fever by this agent, but nothing in therapeutics is more easy than to cure this disease in our climate by either of the sulphates mentioned. The chief difficulty consists in preventing a return. To an infant of two years I prescribe one grain of sulphate of quinia, or the equivalent of sulphate of cinchonia, three times daily, till all symptoms of the ague have disappeared; then twice a day during the subsequent week, and afterward once a day for some days; and finally twice or thrice a week. It is only by the protracted use of the drug in occasional doses that the return of the intermittent can be prevented.

It is important in administering these sulphates to infants to employ a vehicle which will, so far as possible, disguise the bitterness. The vehicle which I prefer for their administration is the elixir adjuvans or elixir tarax. co. The following formula is for a child of three years:—

℞. Qui. sulphat., gr. xij;
Elixir adjuvantis ℥jss. Misce.

One teaspoonful three times daily. The first dose should be adminis-

tered immediately after the fever abates. In this climate two or three days suffice to cure the disease, after which by daily but gradually diminished use of the medicine in the manner stated above, the return of the malady is prevented. Protracted cases attended by anæmia require the use of iron in addition to the remedy which is designed to control the disease.

CHAPTER II.

REMITTENT FEVER.

If a physician were to consult the standard treatises on diseases of children, in order to ascertain the nature of remittent fever, he would rise from the perusal with no clear idea of it. One tells us that the remittent fever of children is identical with typhoid fever of adults; another, that it is a gastro-intestinal inflammation; and, finally, Hillier believes that there is properly no such disease, and that the term should be dropped from the nosology of children. There is, however, a remittent fever of children as well as adults, and much of the confusion which exists in reference to it arises from the fact that writers have not kept in view what constitutes a fever.

Febrile action which has a local cause is not an essential fever, and should not be described as such. It happens that in children a symptomatic remittent fever arises from a variety of local causes, as dentition, intestinal worms, subacute gastro-intestinal inflammation, etc. But all such cases should be excluded from our consideration of remittent fever, as clearly as we distinguish the continued fever of pneumonia or bronchitis from that of typhus or typhoid.

There is an essential remittent fever of children due to malaria. The same conditions which produce intermittent fever do, in a certain proportion of cases, produce a fever which does not intermit, but continues with more or less pronounced exacerbations a certain number of days, when it ceases or becomes intermittent. Those who practise in malarious localities notice a larger proportion of cases of remittent fever among children than adults, because their constitutions are less able to resist the malarial poison, so that an exposure which in an adult would produce milder disease, namely, a tertain ague, is apt to cause a quotidian or remittent in the child. In young and feeble infants the proportionate number who have remittent fever is large. Cases, too, are not infrequent in localities not malarious, of a remittent fever, occurring more frequently in the spring and autumn than in other seasons. Some of these cases are perhaps a mild type of typhus, but in most instances the conditions do not

appear to be present which ordinarily give rise to typhus, and they do not occur in connection with cases of typhus in adults. The cause, though obscure, is apparently atmospheric.

The SYMPTOMS of remittent fever vary in different cases. The exacerbations and remissions are more pronounced in some than others. Even in those cases in which the fever is due to paludal emanations, and occurs in connection with cases of the intermittent, the febrile movement may be almost uniform, slight exacerbations occurring in the latter part of the day. In other cases the exacerbations and remissions are pronounced, the febrile excitement abating in a perspiration. Occasionally the fever is higher on each second day. Cephalalgia is common, and in severe cases delirium and stupor are not infrequent. There may be distinct remissions in the beginning, and afterwards, for a few days, the fever be pretty uniform, when it again remits or ceases. The tongue is covered with a light fur. Thirst, loss of appetite, a tendency to constipation, scanty and high-colored urine, containing perhaps urates, and a cough due to mild bronchitis, are common symptoms.

When remittent fever is due to marsh emanations, the same anatomical characters are doubtless present as in the adult, namely, blood containing more or less pigmentary matter, enlargement of the spleen, bronzing of the spleen, and, in severe cases, of the liver, and sometimes of the brain.

The DIAGNOSIS is not always easy. On the one hand, local diseases with symptomatic remittent fever are to be excluded, and, on the other, typhus and typhoid. The discrimination of it from typhus and typhoid fevers is practically of little moment, but it is a matter of vital importance to make a differential diagnosis between it and the local diseases. I have known one of the acutest diagnosticians and most eminent physicians of New York mistake incipient meningitis for it, a mistake indeed not uncommon. The points involved in a differential diagnosis will be considered in our descriptions of the local diseases.

TREATMENT.—If we have ascertained by a careful examination that the fever is remittent, and not symptomatic but essential, there is one remedy which is required in nearly all cases, namely, quinia, or its equivalent, cinchonia. Mild febrifuge medicines, with light diet, may be first employed in sthenic cases, in which the pulse is full and strong, and the quinia given when the fever has somewhat abated. The diet should be bland, but nutritious, and the bowels be kept regularly open by citrate of magnesia or other mild aperient. Bromide of potassium or hydrate of chloral may be occasionally employed as recommended in the treatment of typhoid fever, to produce quietude or sleep, in cases attended by delirium or insomnia A warm mustard foot-bath and cool applications to the head are useful in such cases.

CHAPTER III.

TYPHOID FEVER.

Typhus and typhoid fevers occur in children, but the former is mild and infrequent, rarely occurring except when adults of the same household are affected. It requires little treatment, except good nursing. Typhoid fever, on the other hand, is not infrequent in children, and, as it presents certain peculiarities prior to the age of puberty, it is proper to describe it in this connection. This disease is much less frequent in infancy than in childhood, and in the first half of infancy is believed to be rare. Still, there can be no doubt that many cases in the first years of life are not diagnosticated, being mistaken for subacute and protracted entero-colitis. It may, therefore, be more common in the infant than is commonly supposed. Its period of greatest frequency in children is between the ages of six and twelve years.

Causes.—It is now generally admitted that typhoid fever is mildly contagious, and that its specific principle abounds largely in the dejections and excretions of the patient. It is uncertain whether it is communicable by the breath of the patient, or exhalations from his surface. If it is, it is slightly so, while numerous observations demonstrate its communicability through the use of night-stools or privies which contain the evacuations.

There is little doubt also that typhoid fever originates *de novo*, caused by the miasm produced by decaying animal or vegetable matter. Numerous cases have been observed in which it originated from defective sewerage, or decaying vegetables in cellars, in localities in which no case had previously been observed. The germs of the disease may not only be received into the system by inspiration, but also through the stomach, for the use of well-water which contains the drainage of sewers has repeatedly been known to cause it. Boys are more frequently attacked than girls; according to some statistics in the proportion of three to one. Deterioration of the health from general causes increases the liability to be attacked. On the other hand, those having tuberculosis, carcinoma, heart disease, and probably certain other visceral lesions, are more apt to escape than those in health.

Anatomical Characters.—As typhoid fever is a constitutional disease, we would expect to find early and important changes in the blood. No alteration, however, has been discovered in this fluid peculiar to typhoid fever. The amount of fibrin is diminished as in most of the essential fevers,

and its coagulation is feeble, forming, when the blood stands, soft, small and dark clots. When the fever has continued for some time, a state of anæmia more or less decided supervenes, in which the amount of albumen and blood-corpuscles is diminished. Although there are often decided symptoms referable to the nervous system, no constant changes have been discovered in the brain or spinal cord. The changes observed in them when death has occurred in the course of typhoid fever have been for the most part due to other causes. It is different with the respiratory system. After the first week of typhoid fever bronchitis is almost as constant as inflammation of the fauces in scarlet fever, and accordingly we find in fatal cases redness and thickening of the bronchial mucous membrane, which is covered with a viscid and ordinarily scanty secretion. Hypostatic congestion of the lungs, with more or less œdema, and in severe and enfeebled cases hypostatic pneumonia, are not uncommon. In the bronchitis and state of feebleness we have the causes of pulmonary collapse, and this lesion is not infrequent over limited portions of the lungs, especially if the bronchitis affects the smaller tubes.

The lesions occurring in the digestive system are important. The mucous membrane of the small intestine is more or less injected, and at an early period, even by the second or third day, the patches of Peyer, solitary glands, and at the same time the mesenteric, begin to enlarge. It has been stated by high authorities that the enlargement is due to infiltration with a peculiar substance, which has been termed the typhous material. I have made microscopic examination of these glands in typhoid fever of the adult, and have found a notable increase of the small round granular cells of which these glands are composed. I do not, therefore, doubt that the enlargement is due mainly to hyperplasia of the cellular elements of the glands, though there is probably infiltration to a certain extent of inflammatory products between the cells. The mucous membrane over the glands undergoes inflammatory thickening and softening. In the adult, sloughing of this membrane is frequent, with the disintegration of the glands and their elimination into the intestines, producing ulcers, small and circular, corresponding with the site of the solitary glands, large and oval or irregular, corresponding with the site of the agminate. Disintegration of these glands and the formation of ulcers are less frequent in children than in adults. In the adult, who recovers, the mesenteric glands, and those of the solitary and agminate which are not destroyed, return to their normal state by fatty degeneration, liquefaction and absorption of the redundant cells. In the child this is the common result, instead of sloughing and disintegration, as regards both the solitary and agminate glands, and uniform result as regards the mesenteric, and I may add bronchial glands, which are also in a state of hyperplasia. The absence of ulceration or its slight extent affords explanation of the fact that intestinal perforation is very rare in children.

The spleen gradually enlarges, often to twice the normal size, has a dark-red color, and is softened. Enlargement of the spleen possesses great diagnostic value in those cases in which the diagnosis is obscure. For while very similar intestinal lesions may occur in chronic entero-colitis, the coexistence of these lesions with the splenic enlargement and softening shows the constitutional nature of the affection.

In cases which are severe, and which present a decidedly adynamic type, the muscles become soft and flabby, the action of the heart is feeble, and more or less passive congestion of the viscera results. In such cases congestion of the kidneys and albuminuria are not infrequent.

Symptoms.—Typhoid fever has a prodromic stage of a few days, sometimes of a week or more, in which the child appears languid, indisposed to play, and has little appetite, but complains of no pain unless occasional slight headache, and has no symptom which would lead the friends or even physicians to suspect the grave nature of the disease which impended. By and by a slight fever occurs.

The febrile movement, which gradually becomes more pronounced, remits, but does not cease in the morning, and has evening exacerbations. After the first week of fever the remissions are less marked, but the fever is not uniform at any period in its course. Hence some of our ablest writers on diseases of children continue to designate typhoid fever of children remittent fever, fully aware of its identity with typhoid fever of the adult. As the case advances, the appetite fails, all solid food being refused, and liquid food being taken more from thirst than hunger. The tongue in the first week, and in some patients throughout the course of the disease, is covered with a light moist fur, while in others having a graver type of the fever the tongue after the first week is dry and brown. During the prodromic period, and in the first week, the bowels act regularly, or are slightly relaxed, and they are readily affected by purgative medicines. After the first week there is in most children a tendency to diarrhœa, which requires now and then the use of astringents, the stools being watery and brown, or dark yellow. The abdominal walls are seldom retracted, but prominent, especially after the first week, in consequence of meteorism which is present in children as well as adults. Sometimes there is apparent tenderness, when pressure is made over the right iliac region, but this must not be confounded with hyperæsthesia, which is common in the commencement of febrile diseases in children, and which is observed especially upon the abdomen, chest, and inner part of the thighs.

The respiration in the first week is slightly accelerated, as it is in all febrile diseases. In the second week, and subsequently when bronchitis is developed, the respiration is ordinarily more accelerated, though not in a marked degree, unless in those exceptional instances in which there is an abundant collection of mucus in the smaller bronchial tubes. A cough is often present, dependent on the bronchitis, and varying in character ac-

cording to the degree and stage of the inflammation. In the first days of the fever it is infrequent, and hacking; at a later stage it is more frequent, and not so dry, though in cases of ordinary severity the amount of expectoration is inconsiderable. Hypostatic congestion, œdema, hypostatic pneumonia, splenization, or thickening of the alveolar walls, and collapse, which may and some of which not infrequently do occur in the advanced disease, increase more or less the frequency of the respiration and the cough, and modify the physical signs.

The pulse in the first week, in ordinary cases, is from 100 to 110 or 115. It gradually becomes more accelerated, numbering in the second week 123 or more; in grave cases even 160. The more frequent the pulse, the greater the danger and more unfavorable the prognosis. During the exacerbations the number of pulsations per minute is 15 or 20 more than in the remissions. The change in temperature corresponds with that of the pulse, being from 1° to 2° higher in the exacerbation than remission. The extremes of temperature in cases of ordinary severity are about 101° and 104°. A temperature above 105° shows a grave, probably, a malignant, type of the disease, or else a serious complication.

There is great variation as regards the symptoms referable to the nervous system. Headache is common in the prodromic and initial stages, after which it ceases. A few are delirious even from an early period, screaming loudly, or muttering incoherently, but the majority are quiet, having, indeed, a degree of mental dulness, but being able to appreciate questions when aroused, and answering correctly. Subsultus tendinum and carphologia, which some exhibit, show that there is profound disturbance of the nervous system. Epistaxis occurs occasionally in the first week as in the adult, but is not abundant.

The rose-colored eruption appears in children as well as adults between the sixth and twelfth days, but is more frequently absent in the former than latter; sometimes the number of spots is less than half a dozen. Sudamina are common in the second and third weeks, and perspirations may occur at any time in the course of the fever, but without amelioration of symptoms. More or less deafness is common, being in most instances a purely nervous symptom, without, therefore, any structural change in the ear, but it is possible, as has been suggested by certain writers, that it sometimes results from inflammatory thickening of the Eustachian tube or external meatus, or to a weakened and flabby state of the muscles of the ear.

The duration of typhoid fever is not uniform; while mild cases may end in two weeks, those of a severer type continue three or even four. The patient becomes progressively more emaciated and feeble. In protracted and severe cases his condition seems very unpromising to one not familiar with the clinical history of the fever. Pale, emaciated, and feeble, probably passing his evacuations in bed, taking little notice of objects around

him, he presents, at the close of the third week, an appearance of helplessness, notwithstanding the best of nursing, and the constant employment of sustaining measures, which is truly discouraging.

Complications.—The chief complications of typhoid fever are bronchopneumonia, already sufficiently described, enteritis, intestinal hemorrhage, peritonitis, otitis, parotiditis, and muguet. In one instance I lost a patient about ten years old, in whom the fever had nearly terminated, by the sudden accession of croup. There is, as we have seen, in ordinary cases, more or less inflammation of the mucous membrane of the air-passages, and of the intestines especially in the vicinity of the patches of Peyer. It is easy to understand how, under circumstances which may arise in the fever favorable to the development of mucous inflammations, the bronchitis and enteritis may so increase as to constitute complications. They are the most frequent of the serious complications.

Intestinal hemorrhage is an occasional accident. Hillier met four cases in thirty of the fever. It indicates the presence of ulcers upon the surface of the intestines. The younger the child, the less the liability to it. Some, in whom it has occurred, recover, but others die. Otitis, commencing with pain, and producing a discharge which may continue for weeks, is not rare, though less frequent than in scarlet fever. The otitis is commonly external, but it may, in scrofulous subjects, extend to the middle ear.

Intestinal perforation is more rare in children than in adults, as might be inferred from the statement already made, that intestinal ulceration is less frequent and extensive in them. Statistics show that perforation occurs only once in 232 cases. Therefore, as perforation is the common cause of peritonitis in this disease, this inflammation is a rare complication. Peritonitis may, however, occur in typhoid fever without perforation. In one such case (an adult) in the fever wards attached to Charity Hospital local peritonitis with fibrinous exudation occurred opposite two ulcerated paches of Peyer, the ulcers extending nearly to the peritoneum, but not perforating. The lesions observed in this case throw light on those cases of peritonitis complicating typhoid fever which recover, the cause of which has received a different explanation.

In advanced and greatly debilitated cases, thrush sometimes appears in the interior of the mouth, and upon the fauces. It is always an unfavorable prognostic symptom in children suffering from chronic or protracted disease. Parotiditis is also a rare complication.

Diagnosis.—This is more difficult in children than in adults, and the younger the child the greater the difficulty. In infants protracted enterocolitis, with febrile action and dry furred tongue, cannot in certain cases be positively diagnosticated from typhoid fever by the symptoms and clinical history. Typhoid fever is believed, however, to be rare at this age. When, however, as now and then happens, a young child presents

the symptoms characteristic of protracted subacute entero-colitis, or typhoid fever, and older members of the household have the fever, it is highly probable that the case is one of the latter disease, and it should be treated accordingly.

Even in older children typhoid fever is apt to be mistaken for simple subacute enteritis, or entero-colitis, or *vice versâ*. The following facts aid in the differential diagnosis. In typhoid fever there is total loss of appetite, while in the subacute intestinal inflammation food is not entirely refused. Diarrhœa commences early in the inflammation, while in the fever it is not ordinarily till after the lapse of a few days. Abdominal tenderness in the fever is not appreciable, or is located in the right iliac region; in the other disease it is general over the abdomen, or located in the umbilical region. In typhoid fever there is bronchitis with a cough which is absent in the inflammation. In typhoid fever there are certain other symptoms, more or fewer of which are present in most cases, and which do not occur in the intestinal diseases, except as a coincidence; for example, headache, epistaxis, stupor, delirium, and perhaps the rose-colored spots.

Typhoid fever may be mistaken for meningitis, during the first week, but in meningitis there is more constipation, irritability of stomach, and less elevation of temperature. Moreover, in meningitis, at a comparatively early stage, we are able to detect patches of congestion of the features coming and disappearing suddenly; and slight inequality of the pupils, or their oscillation when the light is uniform; signs which are lacking in typhoid fever. In a doubtful case the ophthalmoscope might be employed, which in meningitis discloses congestion of the vessels of the retina, œdema, etc., anatomical changes which do not pertain to typhoid fever.

The differential diagnosis of typhoid fever and acute tuberculosis may be made by attention to the following points. In tuberculosis there is cough, with some acceleration of respiration from the first, without epistaxis, stupor, or other nervous symptoms, and without the abdominal symptoms which are so prominent in the fever.

Duration.—The duration of typhoid fever varies from two to about four weeks, but complications which may arise may protract the febrile movement. Recovery from a severe and protracted attack is slow, several weeks or even months elapsing before complete restoration to health. A tendency to diarrhœa often continues several weeks after the fever proper ceases, necessitating a rigid oversight of the diet, and the occasional employment of astringents.

Prognosis.—A much larger percentage of children recover than of adults. Although there is great emaciation with loss of strength, recovery may be confidently predicted, provided that no serious complication occurs. In fatal cases which I have met, the unfavorable result occurred

as a rule from the complications, rather than directly from the malady. The condition in which severe typhoid fever leaves a patient is favorable to the development of tubercles, and now and then they occur, disappointing our expectations and prediction of recovery.

Treatment.—As typhoid fever is self-limited, the treatment required in ordinary cases is simple. It should be of a sustaining nature, both as regards diet and medicinal agents, and any untoward symptoms should be promptly met by appropriate measures. The food should be in liquid form; solid food is, indeed, in most cases, refused. Beef-tea, milk, rice or barley-water with milk, may be allowed from the first. Mild cases require no stimulants, still the moderate use of wine is not contraindicated in such cases, and may be allowed at an early period. In grave cases, characterized by a dry and furred tongue, and quick and compressible pulse, milk-punch or wine-whey should be employed in suitable quantity at regular intervals.

When the fever is mild and pursuing its normal course, one of the mineral acids, as the dilute muriatic, or even a simple febrifuge may be employed, as spts. ætheris nitrosi, with syrup of ipecacuanha.

℞. Spts. æther. nit., ℥ij;
Syr. ipecac., ℥iij;
Syr. simplic., ℥jss. Misce.
Dose, one teaspoonful every three hours to a child of six years.

If the febrile movement is considerable, or if it has distinct evening exacerbations, quinine is indicated, and in asthenic cases it may be employed in smaller doses as a tonic. In such conditions it will be found useful. In cases attended with great restlessness or delirium, an appropriate dose of bromide of potassium or hydrate of chloral at night will procure rest, and be followed by no unfavorable result. I prefer the hydrate of chloral given in a small dose. A single dose of two or three grains of this agent will generally be sufficient. For the diarrhœa, I ordinarily prescribe paregoric, or some other opiate, with subnitrate of bismuth, in chalk mixture. The state of anæmia which is present in the advanced disease and in convalescence requires the employment of iron. The citrate of iron and quinine will, under such circumstances, be found useful.

CHAPTER IV.

CEREBRO-SPINAL FEVER.

Cerebro-spinal fever, designated also spotted fever, tetanoid fever, and cerebro-spinal meningitis, is an epidemic constitutional disease, manifesting itself by lesions and symptoms which pertain chiefly to the nervous system. Descriptions of occasional epidemics, which appear to have been of this malady, have been left us by writers as far back as the fifteenth century, but it was not clearly distinguished from typhus on the one hand, and local inflammatory affections of the cerebro-spinal axis on the other, till after the present century commenced.

Few diseases more urgently demand elucidation than this, for while it is very fatal, there is discrepancy in the views of physicians in regard to its cause, nature, and proper treatment. As cerebro-spinal fever results from some pervading cause, probably as we will see atmospheric, we would expect to observe effects of this cause, in some other way, in addition to the disease of which we are treating. Accordingly, the histories of at least a portion of the epidemics of cerebro-spinal fever show an unusual prevalence of pneumonias of an ataxic type, and sometimes also of pharyngitis, in addition to the cerebro-spinal disease, and this disease is sometimes complicated by congestion, and less frequently by inflammation of the lungs. The prevalence of typhoid pneumonias during cerebro-spinal fever was long ago observed. Thus, in Bascome's history of epidemics, it is stated that "epidemic encephalitis and malignant pneumonias prevailed in Germany (Webber) in the sixteenth century." In this country, in the epidemics of cerebro-spinal fever from 1811 to 1815, pharyngeal and pneumonic inflammations were unusually frequent. In more recent epidemics observers have not so often, but have occasionally, recorded the prevalence of pneumonias in connection with cases of the cerebro-spinal disease. Accordingly, Webber, who has examined the histories of the various epidemics, describes in his prize essay a second variety of cerebro-spinal fever, which he designates pneumonic, in which the cerebro-spinal axis is involved but slightly, or not at all, and the brunt of the disease falls upon the respiratory organs. In certain epidemics, according to him, the pneumonic form is common, while in others it is infrequent.

During the time when the recent epidemic in New York city was at its maximum, an unusually large number of cases of pleuro-pneumonia of an asthenic type, and I may add, I think, of pharyngitis, occurred; and

while cerebro-spinal fever rarely affected those above the age of fifty years, many of those with pneumonia were old people. According to the statistics of the New York Health Board, there were 1707 deaths from diseases of the respiratory organs, exclusive of phthisis, during the four months from February 1st to June 1st, 1872, when the epidemic of cerebro-spinal fever was at its height, while during the remaining eight months of the year there were only 1336 deaths from the same diseases; and I need not add that deaths from affections of the respiratory apparatus are largely from pneumonia. Moreover, I am of opinion, from my own observations, that many of the cases of pneumonia, during that period, presented symptoms of greater gravity than usually accompany this form of inflammation of the same extent. The patients were greatly prostrated from the first, and in some of them febrile movement, muscular pains, restlessness, or delirium preceded for hours or even days the pneumonic symptoms, affording evidence that the lung disease, if not due entirely to the same atmospheric conditions which give rise to cerebro-spinal fever, was at least under their influence. Although it is probable that pneumonia occurring during an epidemic of cerebro-spinal fever is in most instances a strictly local malady, as it is at ordinary times more or less modified perhaps by the epidemic influence, there can be little doubt that Webber's view is correct, that there are occasional cases of true cerebro-spinal fever, in which the local manifestations are chiefly in the lungs; cases in which the cerebro-spinal affection is of less importance apparently than the pulmonic. I might relate striking examples, observed in the New York epidemic of 1872.

In one case three prominent physicians, one of them known throughout the country as an excellent diagnostician, pronounced the disease cerebro-spinal meningitis, but on the sixth day, the cerebro-spinal symptoms having considerably abated, pneumonia occurred, and afterwards the pulmonary symptoms predominated.

Cause.—*Does the cause of cerebro-spinal fever emanate from the soil?* Facts show that it does not. Most of the epidemics commence in winter when the ground is frozen; the disease occurs in valleys, and on hilltops, and upon all varieties of soil; it invades one district, passes over another adjoining, and affects, perhaps, a third beyond, although the geological formation of all is the same.

Does the cause exist in the diet, as some competent observers have supposed? The following facts, I believe, are sufficient to justify a negative answer: Of two adjacent localities, in which the nature of the diet of the inhabitants is the same, one escapes and the other is visited by the epidemic; an epidemic sometimes prevails here and there over an area of many thousand miles, as recently in North America. It is hardly reasonable to suppose that any deleterious property would occur in the food over so wide a territory. An epidemic ceases, although the food of the people

continues the same. Infants at the breast, having only the mother's milk, are sometimes affected, and likewise certain animals, whose food is very different from that of man, and finally the most careful examinations have hitherto failed to discover any change in the cereals, or other food, or noxious principle sufficient to explain the occurrence of the disease over a wide extent of territory.

There can, therefore, be little doubt that the cause exists in the atmosphere, though so subtle that we may never be able to detect it. Cerebro-spinal fever is, indeed, one of many examples in corroboration of the statement made by Humboldt, that there is no subject of scientific inquiry more obscure than the laws which control epidemics. Among the meteorological conditions which favor the occurrence of this disease, cool weather has already been alluded to. Statistics collected in France and the United States show that, while 166 epidemics occurred in the six months commencing with December, only 50 occurred in the remaining six months of the year. According to Professor Hirsch, whose statistics were obtained largely from central Europe, there were 57 epidemics in winter or winter and spring, 11 in spring, 5 between spring and autumn, 4 commencing in autumn and extending into winter or winter and spring, and 6 lasting through the entire year.

All observers have remarked the fact that anti-hygienic conditions, though obviously subordinate to the unknown atmospheric cause, nevertheless strongly predispose to this disease. Hence, soldiers in barracks and the poor in tenement houses suffer most severely. During the epidemic of 1872, in New York, unusually severe or multiple cases occurred for the most part where there were obvious anti-hygienic conditions, as in apartments which were unusually crowded and filthy, or in tenements around which refuse had collected or which had defective drainage. The interesting chart, prepared under the direction of Dr. Moreau Morris for the Health Board, shows that comparatively few cases occurred in those portions of the city where the sanitary conditions were good. I cannot, however, agree with Professor Hirsch that the greater crowding, domiciliary and personal uncleanlinesss, and imperfect ventilation in the cool than in the warm months, explain the fact that epidemics occur chiefly in winter and early spring; for in clean and well-ventilated apartments, in sparsely settled and salubrious localities, epidemics occur for the most part in these seasons. Anti-hygienic conditions probably predispose to this disease in the same way, and no more than to any other grave epidemic which happens to be prevailing, as, for example, to Asiatic cholera, whose ravages are largely in the crowded and uncleanly quarters of the poor.

Is cerebro-spinal fever propagated by contagion?—It is the almost unanimous opinion of those who are most competent to judge from their observations, that it is either not contagious or is so only in a very slight degree. It is certain that the vast majority of cases occur without the

possibility of personal communication. Thus, in the commencement of an epidemic, the first patients are affected here and there at a distance from each other, often miles apart, and throughout an epidemic usually only one is seized in a family. Children may be around the bedside of the patient, passing in and out of the room without restriction, and yet we can confidently predict that none of them will contract the disease if there are proper ventilation and cleanliness. And when two or more cases occur in a family, it commences at such irregular intervals in the different patients that the presumption is strong that they receive it from the same extraneous source, and not one from the other, for contagious diseases usually have a pretty uniform incubative period. Thus, in the Brown family, treated by the late Dr. Sewall (*N. Y. Med. Rec.*, July, 1872), the first child sickened January 30th, and the remaining five children at intervals respectively of 5, 7, 11, 25, and 45 days. The following have been my observations relating to this point:—

Single cases, No. 39 (4 adults).

Two in a family, No. 16 (8 families).

Three in a family, No. 3 (1 family).

In most of the 39 families in which single cases occurred, there were children who were allowed free intercourse with the patients. Is there any other malady of childhood known to be infectious, which affords such a record of non-contagion? In those instances in which two in a family took the fever, those who were last attacked did not seem to receive it from those who were first affected, for the reason already stated, namely, the very variable intervals between the two cases in the different families. The facts, in the family in which three cases occurred, did seem to lend support to the doctrine of contagion. A boy, twelve years of age, died of cerebro-spinal fever, and was buried on Saturday or Sunday. On the following Monday the mother washed the linen of the boy, which had accumulated, and within two days was herself affected with the disease. She and her infant, who was also seized with it, died. Were such cases frequent or not infrequent, the argument in favor of contagion would certainly be strong; but as they are infrequent, it is proper to accept any other reasonable explanation instead. The state of the bedding and apartments, as observed by me, was such as to render the atmosphere in which this family lived noxious in a high degree, and therefore such as to attract the prevailing epidemic. Moreover, the mother, exhausted by her long watching, and deprived of needed sleep (for the boy was several days sick), instead of obtaining the required rest, rendered her system more liable to the fever by her self-imposed duties on the day following the burial. These manifest anti-hygienic conditions appeared quite sufficient, without the aid of any contagious principle, to explain the occurrence of the cases in this severely visited family. My statistics, therefore, harmonize with the doctrine of non-contagiousness, but it is obviously very

difficult to determine from clinical experience whether an epidemic constitutional disease is absolutely non-contagious, or contagious in a very low degree. Experience shows that the attendants upon a case of cerebro-spinal fever have immunity, unless the hygienic conditions are very bad.

Allusion has been made to the fact that this malady sometimes occurs among the lower animals. In the epidemic of 1811, in Vermont, Dr. Gallop remarks that even the foxes seemed to be affected, so that they were killed in numbers near the dwellings of the inhabitants. The recent epidemic of New York, it is well known, prevailed among horses several months before it occurred among the people. It was common and fatal in the large stables of the city car and stage lines in 1871, while among the people the epidemic did not properly commence, although there were previously isolated cases, till January, 1872. It has been asked whether in epidemics like this, in which the lower animals are first affected, the disease may not be communicated from them to man? This obviously brings up the question of contagiousness. From my own observations I should certainly answer in the negative, for I have not been able to ascertain that those who had charge of the affected horses in the recent epidemic, as the veterinary surgeons or stablemen, were any more liable to the fever than others who were not so exposed. They apparently were not, and we must, therefore, believe that this disease is not propagated from one species of animals to another, certainly no more than from one animal to another in the same species, and the fact that different animals are affected by the epidemic is due to the potent and pervading nature of the cause. Cerebro-spinal fever is indeed, so to speak, pandemic in a double sense; on the one hand affecting both sexes, different ages, and all conditions of people over a wide extent of territory, and on the other hand different species of animals, but with little or no contagiousness.

Not infrequently we are able to discover some exciting cause of the fever, usually an exhausting or perturbating influence of some sort. An individual whose system is affected by the epidemic influence, and is therefore predisposed to the disease, may, perhaps, escape by a quiet and regular mode of life; but if there is an exciting cause of the nature alluded to, the fever may be developed. Among these exciting causes may be mentioned overwork, fatigue, mental excitement, prolonged abstinence from food, followed by over-eating, and the use of indigestible and improper food. Thus in one instance in my practice, a delicate young woman at the head of one of the departments in a well-known Broadway store, was anxious and excited and her energies overtaxed at the annual reopening. Within a day or two subsequently the disease commenced. Another patient, a boy, was seized after a day of unusual excitement and exposure, having in the mean time bathed in the Hudson when the weather was quite cool. During the recent epidemic in New York those children seemed to me especially liable to be attacked who were subjected to the

severe discipline of the public schools, returning home fatigued and hungry, and eating heartily at a late hour. In one instance which I observed, a school girl of ten years returned from school excited and crying, because she had failed in her examination and was not promoted. In the evening, after she had closely studied her lessons, the fever commenced with violent headache. Dr. Frothingham (*Am. Med. Times*, April 30, 1864) writes as follows of the brigade in which cerebro-spinal fever occurred in the Army of the Potomac: "Under Gen. Butterfield, a stern disciplinarian . . . . the men were drilled to the full extent of their powers—often to exhaustion. I did not at the time recognize this as the cause of the disease in question, but I learned that in the present epidemic in Pennsylvania the attack generally follows unusual exertion and exposure to cold." Observers have long recognized the fact of such exciting causes. Dr. Gallop, in his history of the epidemic of Vermont, in 1811, directs attention to the severity of the disease among the troops under General Dearborn, who were fatigued by marches, and greatly dispirited by a repulse which they had sustained from the British.

Sex.—It is stated by writers that more males are affected than females. Hospital and military statistics show this; but in family practice, in which a large proportion of the patients are children, the number of males and females is about equal. Thus in 75 cases occurring in the 20th and 22d wards, mainly in the practice of two other physicians and myself, I find that there were 39 males and 36 females. Sixty-four of these were children. From January 1st to November 1st, 1872, 905 cases in which the sex was stated were reported to the Health Board. Of these 484 were males, and 421 females. Dr. Sanderson's statistics of the epidemic in the provinces around the Vistula, the cases being chiefly children, give also but a slight excess of males. Probably, therefore, the sex under the age of puberty makes no difference in the liability to this disease, and the same may be said of all other constitutional affections. Men are more liable than women, only when they lead a more irregular life, and are subject to more privations and exposures.

Age.—Children, as already stated, are much more liable to cerebro-spinal fever than adults. The following are the statistics of the Health Board relating to this point, the cases occurring in 1872:—

Under 1 year,	125
From 1 to 5 years,	336
" 5 " 10 "	204
" 10 " 15 "	106
" 15 " 20 "	54
" 20 " 30 "	79
Over 30 years,	71
Total,	975

In the statistics which I have obtained of 81 cases occurring in the 20th and 22d wards, the ages were as follows :—

Under 1 year,	8
From 1 to 3 years,	18
" 3 " 5 "	20
" 5 " 10 "	17
" 10 " 15 "	7
Over 14 years,	11
Total,	81

It is seen that nearly three-fourths of the whole number of cases in the recent epidemic in New York city were under the age of ten years. The statistics of other epidemics occurring in civil practice are similar. Thus Dr. Sanderson, in examining the mortuary statistics of the epidemic in Germany, ascertained that there had been 218 deaths under the age of fourteen years, and only 17 above that age, and although this does not show the exact ratio of children to adults, in the entire number of cases it is apparent that children greatly preponderated.

The more advanced the age after childhood, the less the liability to this malady ; so that after the middle period of life few cases occur, and after the age of fifty years there is nearly an immunity. The oldest two in the recent epidemic, of whose cases I have the records, had attained the ages respectively of 47 and 63 years.

Symptoms.—During epidemics of cerebro-spinal fever, we are now and then called to patients who present certain of the characteristic symptoms, but in so transient and mild a form that they are soon restored to health. The fever is said to have aborted. I have met the following cases :—

A boy of eight years, previously well, was taken with headache, vomiting, and moderate febrile movement on April 2, 1872. The evacuations were regular, and no local cause of the attack could be discovered. On the following day the symptoms continued, except the vomiting, but he seemed somewhat better. On April 4th the febrile movement was more pronounced, and in the afternoon he was drowsy and had a slight convulsion. The forward movement of his head was apparently somewhat restrained. On the 6th the symptoms had begun to abate, and in about one week from the commencement of the attack his health was fully restored.

A boy aged six years was well till the second week in May, 1872, when he became feverish, and complained of headache. At my first visit, May 14th, he still had headache, with a pulse of 112. The pupils were sensitive to light, but the right pupil was larger than the left. The bromide and iodide of potassium were prescribed with moderate counter-irritation behind the ears. The headache and febrile movement in a few days abated, the equality of the pupils was restored, and within a little more than a week from the first symptoms he fully recovered.

Obviously the diagnosis, when symptoms are so mild, must sometimes be doubtful ; but as observers in different epidemics report such cases, it

seems proper to regard them with perhaps occasional exceptions as genuine, but aborted cases. The epidemic influence acts so feebly on these patients, or their ability to resist it is so great, that they escape with a short and trivial ailment.

Occasionally, also, during the progress of an epidemic, we meet patients who present more or fewer of the characteristic symptoms, but in so mild a form that they are never seriously sick, and never entirely lose the appetite, but the disease, instead of aborting, continues about the usual time.

Thus, on the 4th of January, 1873, I was called to a girl of thirteen years, who had been seized with vomiting followed by headache in the last week in December. During a period of six to eight weeks, or till nearly the 1st of March, she presented the following symptoms: Daily paroxysmal headache, often more severe in the forenoon; neuralgic pain in the left hypochondrium, and sometimes in the epigastric region; pulse and temperature sometimes nearly normal, and at other times accelerated and elevated, both with daily variations; inequality of the pupils, the right being larger than the left during a portion of the sickness. This patient was never so ill as to keep the bed, usually sitting quietly during the day in a chair, or reclining on a lounge, and she never fully lost her appetite. Quinia had no appreciable effect on the paroxysms of pain or fever.

There can, in my opinion, be little doubt that this girl was affected by the epidemic, but so mildly that there was, for a considerable time, much uncertainty in the diagnosis. Cases like this, in which the disease is so feebly developed, and those in which it aborts, though they deserve recognition, evidently should not be employed in the statistics.

Mode of Commencement.—In all the cases which I have observed, cerebro-spinal fever commenced between 12 M. and 6 A.M., and in the records of cases published by others the time of commencement, so far as I have observed, was between the same hours. The fact that this disease does not commence after the repose of night till several hours of the day have passed, shows the propriety, as we shall see hereafter, of enjoining a quiet and regular mode of life, free from excitement, and with sufficient hours of sleep during the time that the epidemic is prevailing.

Cerebro-spinal fever usually has no premonitory stage, or it is so slight as to escape notice. Exceptionally there are certain premonitions for a few hours or days, such as languor, chilliness, etc. Premonitions occur more frequently in mild than in severe forms of the fever. The ordinary mode of commencement in a typical or somewhat severe case is as follows: The patient has a rigor or chill, or rarely two or three of them at irregular intervals of some hours. One patient, an adult female, had three or four pretty severe chills, the last occurring, from recollection, as late as the fourth day. Children often have clonic convulsions in place of the chill, or immediately after it, partial or general, slight or severe. Apathy, more or less profound stupor, or less frequently delirium succeeds. In the gravest cases semi-coma occurs, from which the patient is with difficulty aroused,

or profound coma, which, in spite of prompt and appropriate treatment, may prove speedily fatal. If aroused to consciousness, he now complains of violent headache, with or without, or alternating with equally severe neuralgic pains in the neck, some part of the trunk, or in one of the extremities. The pupils are dilated, or less frequently contracted, and they respond feebly, or not at all, to light. Often they oscillate, and occasionally one is larger than the other.

Vomiting, with little apparent nausea, is also an early and prominent symptom, evidently having a cerebral origin. It occurred as an initial symptom in 51 of 56 cases observed by Dr. Sanderson. Of 61 cases observed by Dr. Sewall and myself, neither its presence nor absence was recorded in 13 cases, its absence in only 1, and its presence as an early symptom in 48 cases.

Unlike typhus and typhoid fevers, the temperature on the first day is usually as elevated as, and sometimes more so than subsequently. Indeed, the highest temperature which I have observed in any case was only two or three hours after the commencement of the attack in a child of three years, namely, an axillary temperature of $107\frac{2}{5}^{\circ}$.

Exceptionally the initial symptoms occur in a more gradual manner, becoming by degrees more severe, so that a few days elapse before they are so pronounced that a clear diagnosis is possible. The febrile movement, headache, neuralgic pains, lassitude, vomiting, and fretfulness, though pretty uniformly present in the commencement, are not in these cases so severe at this period as to excite any apprehension.

Symptoms pertaining to the Nervous System.—Pain, already described as an initial symptom, continues during the acute period of the malady. It is ordinarily severe, eliciting moans from the sufferer, but its intensity varies in different patients. Its most frequent seat is the head, where it may be frontal or occipital. It is described as sharp, lancinating, or boring. It is also common in the neck, especially the nucha, the epigastrium, umbilical and lumbar regions, in one or more of the limbs, and along the spine (rachialgia). It shifts from place to place, but it is commonly more persistent in the head and along the spine than elsewhere. The patient, if old enough to speak, and not delirious or too stupid, often exclaims, "Oh, my head!" from the intensity of his suffering, but after some moments complains equally of pain in some other part, while perhaps the headache has ceased, or is milder. In a few instances the headache is absent, or is slight and transient, while the pain is intense elsewhere. After some days the pain begins to abate, and by the close of the second week is much less pronounced than previously. Vertigo occurs with the headache, so that the patient reels in attempting to stand or walk. Contributing to the unsteadiness of the muscular movements is a notable loss of strength, which occurs early and increases.

The state of the patient's mind is interesting. It is well expressed in

ordinary cases by the term apathy or indifference, and between this and coma on the one hand, and acute delirium on the other, there is every grade of mental disturbance. Sometimes patients seem totally unconscious of the words or presence of those around them, when it appears subsequently that they understood what was said or done. Delirium is not infrequent, especially in the older children and adults. Its form is various, most frequently quiet or passive, but occasionally maniacal, so that forcible restraint is required. It sometimes resembles intoxication, or hysteria, or it may appear as a simpie delusion in regard to certain subjects. Thus one of my patients, a boy of five years, appeared for the most part rational, protruding his tongue when requested, and ordinarily answering questions correctly, but he constantly mistook his mother, who was always at his bedside, for another person. Severe active delirium is commonly preceded by intense headache. In favorable cases the delirium is usually short, but in the unfavorable it is apt to continue with little abatement till coma supervenes.

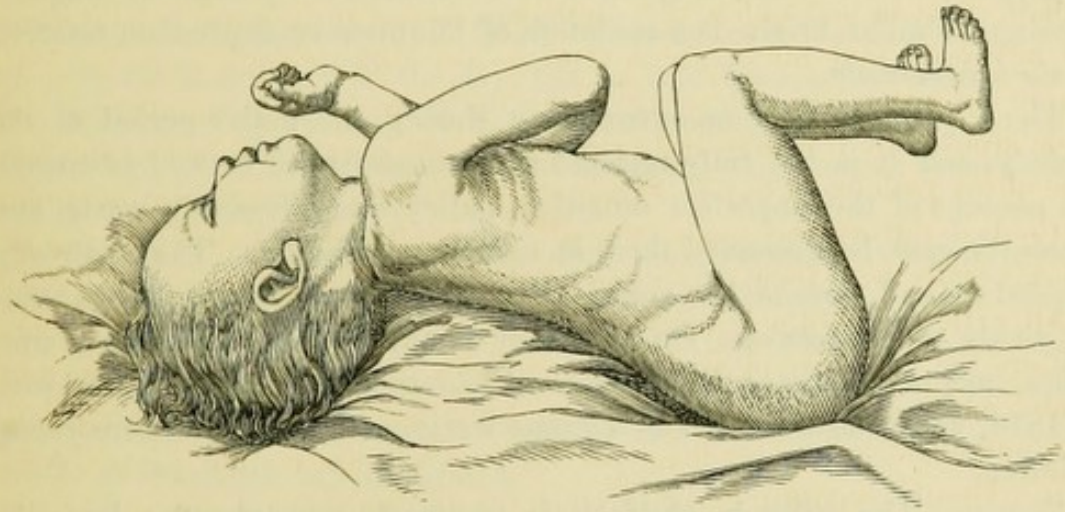
On account of the pain and disordered state of mind, patients seldom remain quiet in bed, unless they are comatose, or the disease is mild, or so far advanced that muscular movements are difficult from weakness. In severe cases they are ordinarily quiet a few moments as if slumbering, and then, aroused by the pain, roll or toss from one part of the bed to another. One of my patients, a boy of five years, repeatedly made the entire circuit of the bed during the spells of restlessness. In mild cases patients lie quiet, usually with their eyes closed, except when disturbed.

All writers record a general hyperæsthesia of the skin. Few patients that are not in a state of profound coma are free from it during the first weeks, and it increases materially the suffering. Frictions upon the surface, and even slight pressure with the fingers upon certain parts, extort cries. Gently separating the eyelids for the purpose of inspecting the eyes, and moving the limbs, or changing the position of the head, evidently increase the suffering, and are resisted. I have sometimes observed such outcries from slowly introducing the thermometer into the rectum, that I was forced to believe that the anal, and perhaps rectal, surface was also hypersensitive. The hyperæsthesia has diagnostic value, for there is no disease with which cerebro-spinal fever is likely to be confounded in which it is so great. It is due to the spinal meningitis, and is appreciable even in a state of semi-coma.

Tonic contraction of certain muscles, or groups of muscles, is present in all typical cases. In a small proportion of patients it is absent, or is not a prominent symptom, namely, in those in whom the encephalon is mainly involved, the spinal cord and meninges being but slightly affected, or not at all. This contraction is most frequent and marked in the muscles of the nucha, causing retraction of the head, but it is also common in the posterior muscles of the trunk, producing opisthotonos, and in less degree

in those of the abdomen and lower extremities, and hence the flexed position of the thighs and legs, in which patients obtain most relief. The muscular contraction is not an initial symptom. I have ordinarily first observed it about the close of the second day, but sometimes as early as the close of the first day, and in other instances not till the close of the third day. Attempts to overcome the rigidity, as by bringing forward the head, are very painful, and cause the patient to resist. In young children having a mild form of the fever with little retraction of the head, the rigidity is sometimes not easily detected. I have been able in these cases to satisfy myself and the friends of its presence, by observing the difficulty with which the head is brought forward on presenting to the patient a tumbler with cold water, which is craved on account of the thirst. The usual position of the patient in bed is with the head thrown back, the thighs and legs flexed, with or without forward arching of the spine (see figure). The muscular contraction continues from three to five weeks,

Fig. 15.



more or less, and abates gradually; occasionally it continues much longer. Through the kindness of Dr. Griswold, of Thirtieth Street, I was allowed to see an infant of seven months in the tenth week of the disease. It exhibited great fretfulness, decided prominence of the anterior fontanelle, probably from intracranial serous effusion, and marked rigidity of the muscles of the nucha with retraction of the head.

Paralysis occasionally occurs, but is less frequent than we would be led to expect from the nature of the lesions. It may occur early, but it is more frequently a late symptom. It may be limited to one or two of the limbs, as a leg, or arm and leg, or it may be more general. Thus a man treated by Dr. Law in the Dublin epidemic of 1865 could move neither arms nor legs, and Wunderlich saw a patient who had paralysis of both lower extremities and a considerable part of the trunk. As the paralysis is due to inflammatory processes in the cerebro-spinal axis, it usually dis-

appears in a few weeks as the inflammation abates, and convalescence is established, but it may be more protracted. Thus in Wunderlich's case there was only partial recovery after the lapse of five months.

Digestive System.—The tongue is ordinarily lightly covered with a whitish fur. Occasionally in cases attended with great prostration the fur is dry and brown, but only for a few days, when the moist whitish fur succeeds. The habitual brownish and dry fur on the tongue, and sordes upon the teeth, so common in typhus and typhoid fevers, are seldom observed in uncomplicated cases of this disease. Vomiting, which I have described as an initial symptom, usually ceases in a few hours, or not till the lapse of several days, and it frequently recurs at intervals during the periods of recrudescence, which are common in the progress of the fever.

It occurs with little effort, often like a regurgitation, as is common when this symptom has a cerebral origin. The ejecta consist at first of the contents of the stomach and afterwards partly of bile. It does not differ as a symptom from the vomiting which is so common in sporadic meningitis. Having a similar origin is a sensation of faintness or depression referred to the epigastrium.

The appetite is poor or entirely lost during the active period of the malady, and it is not fully restored till convalescence is well advanced. On account of the imperfect nutrition, patients progressively waste, and when the case is protracted there is notable emaciation. Thirst, already alluded to, and more or less constipation are common, but the latter readily yields to purgatives. On the other hand, diarrhœa sometimes precedes, and accompanies the disease. I observed this in a few instances in 1872, when the weather had become warm. The patients were young children.

Pulse.—The pulse in children is constantly accelerated. Even in mild cases it is rarely below 100 per minute, and its ordinary range is from 112 to 160. I have seventy-five recorded observations of the pulse in children who recovered, taken before there was any decided improvement. The maximum pulse in these observations was 168 per minute, which was on the first day; the minimum 82, and the average 123. The more severe and dangerous the attack, the greater the frequency of the pulse, unless occasionally in the comatose state. But even in profound coma the pulse was in my observations accelerated, and as death grew near, however great the stupor, it was progressively more frequent and feeble. Intermissions in the pulse do not seem to be as frequent as in sporadic meningitis. The pulse is liable to daily variations in frequency, which occur suddenly and without appreciable cause. The following consecutive enumerations of the pulse in four favorable cases which I have selected as typical will give an idea of these variations.

1st case, an infant of 14 months, 168, 120, 108, 120, 140, 150, 136, 128, 120.

2d case, an infant of 2 years, 136, 152, 130, 132, 136, 140, 152, 140, 136, 148.

3d case, a boy of 6 years, 120, 120, 88, 84, 92, 124, 128, 120.

4th case, a girl of 4 years, 116, 100, 124, 116, 120, 136, 140, 128, 128, 104.

I have preserved observations of this symptom made daily in nine fatal cases, and these show similar fluctuations in the frequency of the heart's contractions. The patients were children, all dying comatose. The maximum pulse in these observations was 204, which was on the first day; the minimum 88, and the average 140. The following are the consecutive enumerations of the pulse usually made twice daily in two of these cases. It will be seen that there was not only greater frequency of the pulse, but fluctuations from day to day similar to those in the favorable cases:—

1st case, age 8 months, 204, 164, 116, 160, 164.

2d case, age 2 years 8 months, 192, 168, 200, 152, 160.

In most inflammatory and febrile diseases exacerbations commonly occur in the latter part of the day, but in this disease they do not seem to be influenced by the time of day, so that sometimes the temperature is highest and pulse most frequent in the morning, sometimes in the evening, and then again at midday.

In favorable adult cases the pulse often remains under 100, and in certain patients it scarcely has more than the normal frequency, but if the type is severe it rises to 110, 120, or over. In the adult, as in the child, as death approaches, the pulse becomes more and more frequent and feeble, and it seldom even in the most asthenic cases has the fulness and force observed in idiopathic inflammations.

Temperature.—Certain of the older observers before the day of clinical thermometry asserted that the temperature is not increased. North remarked as follows: "Cases occur, it is true, in which the temperature is increased above the normal standard, but these are rare;" and Foot and Gallop made similar statements. I am surprised also that some of the recent writers state that febrile movement is often absent. Thus, in a well-written American treatise, bearing the date 1873, it is stated "that febrile symptoms do not necessarily belong to epidemic cerebro-spinal meningitis as a substantive disease, for it may and not unfrequently does occur without exhibiting any such symptoms." (Lidell.)

I have no doubt from the nature of cerebro-spinal fever, and from thermometric examinations, which I have made now in more than fifty cases, that there is always an elevation of the internal temperature above the normal standard during the active period of the disease. I have never observed a temperature of less than $99\frac{1}{2}^{\circ}$ if the examination were made within the first fourteen days, and the reason that certain other observers

state differently is probably because they have taken the temperature of the cutaneous surface, which is very fluctuating and is often much below that of the blood. The temperature should be ascertained *per rectum* where it corresponds pretty nearly with that of the blood. In one instance I supposed that I had met a case in which the temperature was not elevated, and I cite it as showing the liability to error in the thermometric examinations of these cases: A female patient, forty-seven years old, three days sick and comatose, whom I was allowed to examine with the family physician, exhibited no elevation of temperature when the instrument was placed in the mouth and the axilla, but on introducing it into the rectum it rose to 99½°.

The internal temperature, although uniformly elevated, undergoes greater and more sudden variations than occur in any other febrile or inflammatory disease. These fluctuations, which correspond with similar changes in the pulse, are observed during the different hours of the same day. I have in the statistics of my practice 146 observations of the temperature in 35 patients taken before the close of the second week. The highest I have already stated in speaking of the mode of commencement, namely 107⅔° in a child of two years. It fell a little subsequently, but rose again on the third day to 107°, when she died. In two other cases the temperature was 106° on the first day, and it did not afterwards reach so high an elevation. One of these died on the ninth day, and the other in the ninth week. The next highest temperature was 105⅘°, also on the first day, in an infant of eight months, who died on the ninth day. The first and last of these cases occurred in an old wooden tenement-house in the suburbs of the city and upon an elevated outcropping of rock. Wunderlich has recorded a temperature of 110° in one or two cases, but so great an elevation must be very rare in cerebro-spinal fever, and is of course prognostic of an unfavorable ending.

The external temperature undergoes similar but greater fluctuations, rising above and falling below the normal standard several times in the course of the same day. Similar fluctuations occur in sporadic meningitis, but they are much less pronounced. The more grave the case in those not comatose, the greater these variations. The following is a common example: the patient was two years old, and the case was one of considerable severity. The observations were made at four consecutive visits during the first week. The internal temperature varied from 101½° to 104⅘° as the extremes, while that of the fingers and hand at the first examination was 90½°, at the second 90°, at the third 103°, and at the fourth 83°. Thus the temperature of the extremities at the first and second examinations was about 8° below that of health, while at the third examination it had risen 13°, so as nearly to equal the internal temperature, and at the fourth examination it had again fallen 20°, or 15½° below the normal standard. The patient recovered. These sudden and great variations in

the pulse and temperature have considerable diagnostic value in obscure and doubtful cases.

Respiratory System.—The symptoms which are referable to the respiratory apparatus are for the most part quite subordinate except when an inflammatory complication occurs. The respiration in uncomplicated cases is quiet and easy, and a cough if present is usually slight and accidental. Intermittent, sighing, or irregular respiration is less frequent in cerebro-spinal fever than in sporadic meningitis, but it does occur. In ordinary cases the respiration is somewhat accelerated, but without any marked disturbance in its rhythm. In 31 observations in children who had the disease without complication, I found the average respirations 42 per minute, while the average pulse was 137. It is seen therefore that the respiration as compared with the pulse was proportionately more frequent than in health. This appears to be due to the fact, that certain muscles, which are concerned in respiration, as the abdominal and perhaps others, are embarrassed in their movements by the tonic contractions. In cases of pulmonary congestion, œdema, or inflammation, of course, the symptoms of this affection are superadded to those of the primary disease.

Cutaneous Surface.—The features may be pallid, of normal appearance, or flushed in the first days of the disease; but in advanced cases they are pallid, as is the skin generally. A circumscribed patch of deep congestion often appears, as in sporadic meningitis, upon some parts of them, as the cheek, forehead, and ear, and after a short time disappears. Friction for a moment upon any part of the surfaee, when the temperature is not reduced, produces the same appearance, a fact to which Trousseau and others have called attention as regards sporadic meningitis.

The following are the abnormal appearances of the skin which I have most frequently observed: 1st. Papilliform elevations, due to contraction of the muscular fibres of the corium, namely the so-called goose-skin. This is not uncommon in the first weeks. 2d. A dusky mottling, also common in the first and second weeks, in grave cases, and most marked where the temperature is reduced. 3d. Numerous minute red points over a large part of the surface, bluish spots a few lines in diameter due to extravasation of blood under the cuticle, resembling bruises in appearance, and large patches of the same color, an inch or more in diameter, less common than the others, and usually not more than two or three upon a patient. These last I believe from certain observations are sometimes the result of bruises, which the patients receive during the times of restlessness. 4th. Herpes. This is common. It sometimes occurs as early as the second or third day, but in other instances not till towards the close of the first week or in the second. The number of herpetic eruptions varies from six or eight to a dozen or more. This affection evidently has a neuropathic origin, the vesicles occurring chiefly on those parts of the surface which are

supplied by branches of the fifth pair of nerves. Its most common seat is upon the lips, but I have occasionally observed it upon the mucous membrane of the nasal and buccal surfaces, upon the cheek, around the ears and upon the scalp.

During the first days the skin is apt to be dry. Afterwards perspirations are not unusual, and free perspirations sometimes occur especially about the head, face, and neck. The quantity of urine excreted is normal, or it may be in excess of the normal amount. It occasionally contains a moderate amount of albumen, and in exceptional instances cylindrical casts and blood-corpuscles. A deposit of urates in the urine is not infrequent, but this so often occurs in inflammatory and febrile diseases, that it is of little moment.

Arthritic inflammation, apparently of a rheumatic character, has been occasionally observed. It is commonly slight, producing merely an œdematous appearance around one or more joints. Thus, in one case which came under my notice, and which was subsequently fatal, the parents, who were poor, and were therefore without medical advice till the case was somewhat advanced, had already diagnosticated rheumatism on account of puffiness, which they had noticed around one of the wrists.

The organs of the special senses are more or less involved in most cases, and the eye and ear are not infrequently the seat of serious lesions. Taste and smell are rarely affected, so far as known, but it is possible that they may sometimes be perverted or even temporarily lost during the time of greatest stupor. In one case at least the smell in one nostril was entirely lost. The affections of the eye and ear are the most important and interesting of those of the special senses. Strabismus is common. It may occur at any period of the fever, continuing a few hours or several days, and it may appear and disappear several times before convalescence is established. Occasionally it continues several weeks, but with few exceptions the parallelism of the eyes is finally restored. In a boy of five years, whom I last saw three months after convalescence, there was still convergent strabismus of the right eye and double vision.

Changes in the pupils are among the first and most noticeable of the initial symptoms, as I have already stated in describing the mode of commencement. These are dilatation, less frequently contraction, oscillation, inequality of size, feeble response to light, etc. Most patients present one or more of these abnormalities of the pupils, and they continue during the first and second weeks, and gradually abate as the condition of the patient improves. Inflammatory hyperæmia of the conjunctiva often occurs. It commences early, and, now and then, the conjunctivitis is so intense, that considerable tumefaction of the lids occurs, with a free muco-purulent secretion. The false diagnosis has indeed been made of purulent-ophthalmia, in cases in which this affection of the lids was early and severe. But such intense inflammation is quite exceptional. More frequently there

is a uniform diffused redness of the conjunctiva, not so dusky as in typhus, and the injected vessels cannot be so readily distinguished as in that disease.

In certain cases almost the whole eye (all, indeed, of the important constituents) becomes inflamed; the media grow cloudy, the iris discolored, and the pupils uneven and filled up with fibrinous exudation. The deep structures of the eye cannot, therefore, be readily explored by the ophthalmoscope, but they are observed to be adherent to each other, and covered by inflammatory exudation. They present a dusky red, or even a dark color, when the inflammation is recent. Exceptionally, the cornea ulcerates, and the eye bursts, with a loss of more or less of the liquids and shrinking of the eye. But ordinarily no ulceration occurs, and, as the patient convalesces, the œdema of the lids, hyperæmia of the conjunctiva, the cloudiness of the cornea, and of the humors, gradually abate, and the exudation in the pupils is absorbed. The iris bulges forward, and the deep tissues of the eye, viewed through the vitreous humor, which before had a dusky red color from hyperæmia, now present a dull white color. The lens itself, at first transparent, after awhile becomes cataractous. Sight is lost, totally and forever. This form of ophthalmia is sometimes rapidly developed, as in the following example :—

On July 5th, 1873, I was called to a boy, five years of age, who had reached the tenth day of cerebro-spinal fever without apparently any affection of the eyes, as both presented the normal appearance. On the following day the left eye was red and swollen from the inflammation and chemosis, so that the lids could not be closed, and the media were cloudy. Death occurred on the same day.

If the patient live, the volume of the eye diminishes, as the inflammation abates, to less than the normal size, even when there has been no rupture, and divergent strabismus is apt to occur. Professor Knapp, whose description of the eye I have for the most part followed, says: "The nature of the eye affection is a purulent choroiditis, probably metastatic." Fortunately so general and destructive an inflammation of the eye, as has been described above, is comparatively rare. On the other hand, conjunctivitis of greater or less severity, and hyperæmia of the optic disk, consequent on the brain disease, are not unusual, but they subside, leaving the function of the organ unimpaired.

Inflammation of the middle ear of a mild grade, and subsiding without impairment of hearing, is common. The membrana tympani, during its continuance, presents a dull yellowish, and in places a reddish, hue. Occasionally a more severe otitis media occurs, ending in suppuration, perforation of the membrana tympani, and otorrhœa, which ceases after a variable time. But otitis media is not the most severe affection of the sense of hearing. Certain patients lose their hearing entirely and never regain it, and that, too, with little otalgia, otorrhœa, or other local symp-

toms, by which so grave a result can be prognosticated. This loss of hearing does not occur at the same period of the disease in all cases. Some of those who become deaf are able to hear as they emerge from the stupor of the disease, but lose this function during convalescence, while the majority are observed to be deaf as soon as the stupor abates and full consciousness returns.

Two important facts have been observed in reference to the loss of hearing in these patients, namely, it is bilateral and complete. When first observed it is in some, as stated above, complete, but in others partial, and when partial it gradually increases till after some days or weeks, when it becomes complete. I have the records of ten cases of this loss of hearing, or about one in ten of the total number of cases which have either come under my observation, or have been reported to me by physicians in whose practice they occurred. One was a young lady, and the others children under the age of ten years. Prof. Knapp has examined thirty-one cases. "In all," says he, "the deafness was bilateral, and with two exceptions, of faint perception of sound, complete. Among the twenty-nine cases of total deafness there was only one who seemed to give some evidence of hearing afterwards."

One theory attributes the loss of hearing to inflammatory lesions, either at the centre of audition within the brain, or in the course of the auditory nerves before they enter the auditory foramina. Thus Stillé says: "This symptom appears to depend chiefly upon the pressure of the plastic exudation in which the nerves are imbedded." The other theory attributes the loss of hearing to inflammatory disease of the ear, and especially of the labyrinth. Dr. Sanderson, who is an advocate of this latter theory, remarks as follows: "As regards the nature of the affection, there appears to be good reason for believing that, like the blindness observed under similar circumstances, and sometimes in the same cases, it is dependent on inflammatory changes in the organ of hearing itself. Dr. Klebs was kind enough to show me in the pathological museum of the Charité, at Berlin, a preparation of the internal ear of a soldier who had died of epidemic meningitis complicated with deafness, in which fibrinous adhesions existed between the bones of the internal ear and the walls of the vestibule. Dr. Klebs stated that in the recent state the mucous lining of the vestibule was detached." In the case of a young woman who was deaf from the commencement and died on the eighth day, "both tympana were natural, but in the left membrana tympani was found a dense white thickening as large as a pin's head. On the same side the lining membrane of the semicircular canals was distinctly thickened and loosed, and in the anterior canal there was semifluid purulent masses." Professor Knapp also states: "The nature of the ear disease is, in all probability, a purulent inflammation of the labyrinth." According to him no disease of the middle ear could cause such complete deafness, and, as evidence that the

deafness is not due to central disease, Dr. Gruening obtained by electrization the normal reaction of the auditory nerve within the cranium. Moreover, if the lesion which destroys hearing is within the cranium, why is not the function of the other cranial nerves also abolished. Drs. Keller and Lucae have also, in three post-mortem examinations, found evidences of disease of the labyrinth.

An argument in support of the former of these theories is the fact, that the lesion which produces the deafness is not ordinarily attended by any marked subjective symptoms referable to the ear, as otalgia, etc. Again, the fact that the deafness is always bilateral and simultaneous in the two ears, comports better with the doctrine of a central lesion than with that which locates the lesion in the ear. But the true theory can only be positively established by dissections, and as we have seen, several post-mortem examinations have revealed inflammatory disease of the labyrinth in those who have died having this form of deafness, while in no case, so far as I am aware, has the ear been found free from inflammatory lesions. Therefore, the theory which ascribes the deafness to disease of the ear is much better established than the other, and in the present state of our knowledge we must accept it. Moreover, most of the aurists of this city, who have had excellent opportunities to examine these cases, believe in this theory.

NATURE.—If we examine the literature of cerebro-spinal fever we will find that three theories relating to its nature have been advocated: one that it is a local disease, occurring epidemically; the second, that it is akin to typhus fever, or is a form of it; and the third, that it is a disease *sui generis*.

The first theory, that it is an epidemic local disease, once had many adherents, but it is now nearly discarded. Job Wilson, in 1815, considered it a form of influenza, and he could discern no utility in drawing a distinction between spotted fever and influenza. We, in this day, can see no resemblance between the two, except that they are both pandemics. A more plausible view is, that it is merely an epidemic inflammation of the cerebral and spinal meninges. Even Niemeyer says that it presents no symptoms except such as are referable to the local affection. But a moment's thought will show us that cerebro-spinal fever differs as widely from simple meningitis, as scarlet fever with its pharyngitis differs from idiopathic pharyngitis. Cerebro-spinal fever begins abruptly, usually in those with previous good health; and its initial symptoms, we have seen, are severe; while sporadic meningitis ordinarily occurs in those of feeble or failing health, with an insidious approach, and with gradually increasing symptoms. And though the two diseases have many symptoms in common, they differ in others. Scantiness of the urine, dryness of the skin, and retraction of the abdomen, are observed in sporadic meningitis, while a normal or increased amount of urine, a normal or even rounded fulness

of the abdomen, and often, also, perspiration, are symptoms of cerebro-spinal fever. The two diseases differ also strikingly as regards the periods of greatest danger and the prognosis; but the conclusive proof that the disease of which we are treating is not a local affection, but constitutional, with local manifestations, is found in the fact of a constant and early blood change, which in all severe cases is manifested by the appearance of the skin, and in other ways.

Cerebro-spinal fever differs widely in many particulars from typhus, although it is probable that it was confounded with it previously to the present century, and many even now consider it a form of that disease. Their theory is, that from some unknown cause or influence the poison of the constitutional disease acquires for the time an affinity for the great nervous centres, producing their congestion and inflammation, just as that of scarlet fever causes a pharyngitis, and if we could detach from it these local manifestations, we would have a malady which differs but little, if at all, in its clinical history and nature, from typhus.

The following are some of the differences which, in my opinion, not only establish the non-identity of these two fevers, but show that there is no close relationship between them. The causes of typhus are determined. Crowding, personal uncleanliness, and imperfect ventilation are sufficient to produce it in any season or climate. Such is not the case with cerebro-spinal fever. The most that can be said of the agency of these and similar anti-hygienic conditions in causing this fever is, as we have already stated, that they produce deterioration in the tone of the system, so that it is less capable of resisting the prevailing epidemic influence. The cause of cerebro-spinal fever occurs independently of the usual conditions of life, and is present or operative only at long intervals; else the epidemic would not be so rare. Typhus is highly contagious; cerebro-spinal fever is not contagious, or is feebly so. Typhus is rare under the age of ten years, and is most frequent in youth and manhood, while the reverse is true of cerebro-spinal fever. Typhus commences with mild or moderately severe symptoms, which increase in severity day by day, and the period of greatest danger is therefore at an advanced stage of the disease. Contrast this with the violence of the initial symptoms of cerebro-spinal fever, and the fact that the first and second days are most perilous. Moreover, typhus does not seem to be more prevalent during epidemics of cerebro-spinal fever than at other times.

If we pass over those many symptoms due to lesions of the cerebro-spinal axis, which are present in cerebro-spinal fever, but are absent in typhus fever, there are other points of dissimilarity which cannot be satisfactorily explained, except on the supposition of an essential difference in the two diseases. The sordes on the teeth and gums, dry and brown fur upon the tongue, peculiar mouse-like odor, and more definite duration of typhus, are points of contrast with cerebro-spinal fever. Moreover, and

as, in my mind, very conclusive evidence of the non-identity of typhus and cerebro-spinal fever, that common lesion of the former, namely, enlargement and softening of the spleen, is seldom present in the latter. The spleen has usually been found normal or moderately congested in most post-mortem examinations of cerebro-spinal fever.

Where, therefore, should cerebro-spinal fever be placed in the catalogue of diseases? It resembles scarlet fever in the suddenness and violence of its onset; sporadic meningitis on the one hand, and typhus on the other, as we have seen, in many of its symptoms; influenza and cholera, in the infrequency of its visitations, and its pandemic nature. But the particulars in which it differs from these diseases are more numerous and important than those in which it resembles them. Like a rare object in nature, which naturalists are not able to classify with others on account of dissimilarities, though it has its resemblances to more than one, cerebro-spinal fever appears to stand alone, as a peculiar constitutional disease, having a peculiar but obscure cause, and a dangerous manifestation or expression located in the cerebro-spinal system.

Prognosis.—Cerebro-spinal fever is justly one of the most dreaded of the epidemic diseases, on account of the great mortality which attends it, and the fact that those who survive are often left with some incurable ailment. The following are the statistics of fifty-two cases, most of which occurred in my own practice, and the rest I visited in consultation; twenty-six were cured and twenty-six died. Sixteen of the twenty-six who died were profoundly and hopelessly comatose within the first seven days, most of them dying within that time, and some even on the first and second days, while others lingered into the second week and died without any sign of returning consciousness. These statistics therefore show, and the same is true of the statistics of other observers, that the first week is the time of greatest danger, and if no fatal symptoms are developed during this week recovery is probable. Only three deaths occurred after the twenty-first day, one from purpura hemorrhagica, the hemorrhages taking place from the mucous surfaces, and the other two after a sickness of more than two months, in a state of extreme emaciation and prostration. In these last cases muscular tremors and convulsions preceded death. The ten who subsequently died, but did not become comatose during the first week, were nevertheless seriously sick from the first day, but there was hope and some expectation of a different issue till near death.

There is probably no disease which falsifies the predictions of the physician more frequently than this. This is due partly to the severity of the cerebral symptoms in the commencement, which, did they occur in the common forms of meningitis, with which he is more familiar, would justify an unfavorable prognosis, and partly to the remissions and exacerbations, the occurrence alternately of symptoms of apparent convalescence and recrudescence, or relapse, which characterizes the course of this disease.

Grave initial symptoms, which might seem to have a fatal augury, are often followed by such a remission, that all danger seems past, and in a few hours later perhaps the symptoms are nearly or quite as grave as at first.

Under the age of five years, and over that of thirty, the prognosis is less favorable than between these ages. An abrupt and violent commencement, profound stupor, convulsions, active delirium, and great elevation of temperature are symptoms which should excite solicitude, and render the prognosis guarded. If the temperature remain above 105° death is probable, even with moderate stupor. Numerous and large petechial eruptions show a profoundly altered state of the blood, and are therefore a bad prognostic, and so is continued albuminuria, as it indicates great congestion of the kidneys, associated probably with other internal congestions. In one case, a boy, which I had an opportunity of examining nearly a year after the attack, the kidneys were still affected. There was anasarca of the face and extremities with albuminuria. The renal congestion had apparently degenerated into a chronic Bright's disease. The result of the case I have not ascertained. Profound stupor, though a dangerous symptom, is not necessarily fatal as long as the patient can be aroused to partial consciousness, and the pupils are reponsive to light. So long as it does not pass into actual coma, it is less dangerous than active or maniacal delirium, which is apt to eventuate in this coma.

A mild commencement, with general mildness of symptoms, as the ability to comprehend and answer questions, moderate pain and muscular rigidity, some appetite, moderate emaciation, little vomiting, etc., justifies a favorable prognosis, but even in such cases it should be guarded till convalescence is fully established.

Death in the first stages of cerebro-spinal fever appears to occur ordinarily from coma, but we will see from the lesions that congestion of the posterior portions of the lungs is frequent, and Sanderson says :—

"In all the fatal cases which came under my notice, the most prominent symptoms, which preceded death, were those which indicate impairment and perversion of the respiratory functions. As the breathing became more hurried and difficult, the general depression became more intense, the pulse became weaker and quicker, and the temperature of the skin more elevated."

He cites the case of a child, who died in that way, but was at the same time comatose. In more protracted cases in which there is softening of portions of the cerebro-spinal axis, or fibrino-purulent collections around it, which are not absorbed, death may occur either from convulsions and coma, or from exhaustion. We have already alluded to one case in which purpura hemorrhagica was developed, and the child was exhausted by the hemorrhages.

Those who fully recover often exhibit symptoms usually of a nervous

character, as irritability of disposition, headache, etc., for months after convalescence is established.

Diagnosis.—Cerebro-spinal fever, on account of the nature and severity of its symptoms and the suddenness of its onset, may be mistaken for scarlatina, and *vice versâ*. In one instance, to my knowledge, this mistake was made. High febrile movement, vomiting, convulsions, and stupor, are common in the commencement of scarlet fever, and we have seen that the same symptoms ordinarily usher in the severer forms of cerebro-spinal fever. It will aid in diagnosis to ascertain whether there is redness of the fauces, for this is present in the commencement of scarlet fever, and in a few hours later the characteristic efflorescence appears upon the skin.

The diagnosis of cerebro-spinal fever from the common forms of meningitis is ordinarily not difficult, for while in the former there is the maximum intensity of symptoms on the first day, in the latter there is a gradual and progressive increase of symptoms from a comparatively mild commencement. Moreover cases of ordinary or sporadic meningitis occurring at the age when cerebro-spinal fever is most frequent, are commonly secondary, being due to tubercles, caries of the petrous portion of the temporal bone, or other lesion, and there are, therefore, in these cases preceding and accompanying symptoms, which are directly referable to the antecedent disease. We have seen how different the case is with cerebro-spinal fever, which in most patients begins abruptly in a state of previous good health. Again in cerebro-spinal fever, after the second or third day, hyperæsthesia, retraction of the head, and other characteristic symptoms occur, which are either not present, or are much less pronounced, in ordinary meningitis. The symptoms of hysteria sometimes bear a close resemblance to the delirium observed in certain cases of cerebro-spinal fever. But the thermometer enables us to make the diagnosis, for in hysteria there is no febrile movement. In our remarks on the nature of cerebro-spinal fever we have sufficiently described the differences between this disease and typhus.

Anatomical Characters.—I have notes of the post-mortem appearances in 76 cases, published chiefly in British and American journals; 29 died within the first three days; 28 between the third and twenty-first day; 8 died after the twenty-first day, and the duration of the remaining 11 was unknown. These records furnish the data for the following remarks:—

The blood undergoes changes, which are due in part to the inflammatory, and in part to the constitutional and asthenic, nature of the disease. The proportion of fibrin is increased in cases that are not speedily fatal, as it ordinarily is in idiopathic inflammations. Analyses of the blood, published by Ames, Tourdes, and Maillot, show a variable proportion of fibrin from 3.40 to more than six parts in 1000. In sthenic cases accompanied by a pretty general meningitis, cerebral and spinal, there is, after the fever has continued some days, the maximum amount of fibrin, while

in the asthenic and suddenly fatal cases, with inflammation slight, or in its commencement, the fibrin is but little increased. The most common abnormal appearance of the blood observed at autopsies is a dark color with unusual fluidity, and the presence of dark, soft clots. Exceptionally bubbles of gas have been observed in the large vessels and the cavities of the heart. An unusually dark appearance of the blood, small and soft dark clots, and the presence of gas bubbles, when only a few hours have elapsed after death, indicate a malignant form of the disease, in which this fluid is early and profoundly altered. In certain cases the blood is not so changed as to attract attention from its appearance. The points or patches of extravasated blood which are observed in the skin during life in a certain proportion of cases, usually remain in the cadaver. In incising them the blood is seen to have been extravasated, not only in the layers of the skin, but also in the subcutaneous connective tissue. Extravasations of small extent are also sometimes observed upon the thoracic and abdominal organs.

In those who die after a sickness of a few hours or days, namely, in the stage of acute inflammatory congestion, the cranial sinuses are found engorged with blood, and containing soft, dark clots. The meninges enveloping the brain are also intensely hyperæmic in their entire extent in most cadavers; but in some, in certain parts only, while other portions appear nearly normal. In those cases which end fatally within a few hours, this hyperæmia is ordinarily the only lesion of the meninges; but if the case is more protracted, serum and fibrin are soon exuded from the vessels into the meshes of the pia mater, and underneath this membrane over the surface of the brain. Pus-cells also occur mixed with the fibrin, sometimes so few as to be discovered only by the microscope, but in other cases in such quantity as to be much in excess of the fibrin, and be readily detected by the naked eye. Pus, which in these cases, no doubt, consists of white blood-corpuscles which have escaped with the fibrin from the meningeal vessels, sometimes appears early in the disease. Thus, in the *Dublin Quarterly Journal*, 1866, Dr. Gordon relates the history of a case in which death occurred after a sickness of five hours, and a purulent-appearing greenish exudation had already occurred in places under the meninges. The exudation of fibrin commences also in the course of a few hours. Thus in a case of thirty hours' duration, published by Dr. William Frothingham, in the *American Medical Times*, April 30th, 1864, and in another of one day's duration, published by Dr. Haverty, in the *Dublin Quarterly Journal* for 1867, exudation of fibrin had already occurred in and under the pia mater. The arachnoid soon loses its transparency and polish, and presents a cloudy appearance over a greater or less extent of its surface. This cloudiness is greatest in the vicinity of the fibrinous exudation, but it occurs also where no such exudation is apparent to the naked eye. Dr. Gordon describes a case of only eight hours' duration, in which

the arachnoid was already opaque at the vertex, but of normal appearance at the base of the brain (*Dublin Quarterly Journal*, 1866), though the vessels of the pia mater were everywhere greatly congested.

The exudation, serous, fibrinous, and purulent, occurs, as in other forms of meningitis, within the meshes of the pia mater, and underneath this membrane over the surface of the brain. The fibrin is raised from the surface of the brain with the meninges. It is most abundant in the intergyral spaces around the course of the vessels, over and around the optic commissure, the pons Varolii, the cerebellum, medulla oblongata, and along the Sylvian fissures. It is most abundant in the depressions, where it sometimes has the thickness of $\frac{1}{10}$ to $\frac{1}{4}$ of an inch, but it often extends over the convolutions so as to conceal them from view.

Most other forms of meningitis have a local cause, and are therefore limited to a small extent of the meninges, as for example meningitis from tubercles, or caries of the petrous portion of the temporal bone, in both of which it is commonly limited to the base of the brain, or from accidents when the meningitis commonly occurs upon the side or summit of the brain. The meningitis of cerebro-spinal fever, on the other hand, having a general or constitutional cause, occurs with nearly equal frequency upon all parts of the meningeal surface, except that it is, perhaps, most severe in the depressions where the vascular supply is greatest. In cases of great severity, the inflammatory exudation, fibrinous, or purulent, or both, may cover nearly, or quite, the entire surface of the brain. Thus, in the case of a negro, 35 years old, only four days sick, whose body was examined at Bellevue Hospital on May 30th, 1872, the record states that there was a purulent exudation over the entire surface of the cerebrum and cerebellum. The quantity of serous exudation varies according to the duration and amount of congestion. In some the quantity is so small as scarcely to attract attention, but in other instances, especially when the disease is protracted, it is large. In a case reported by Dr. Moorman in the *Amer. Journ. of Med. Sci.* for Oct. 1866, it is stated that about three pints of turbid serum escaped from the cranial cavity in attempting to remove the brain, but as there was no measurement the statement may be somewhat exaggerated.

In those who die at an early stage of the disease, the vessels of the brain, like those of the meninges, are hyperæmic, so that numerous "puncta vasculosa" appear upon its incised surface. At a later period the hyperæmia, like that of the meninges, may disappear. If there is much effusion of serum within the ventricles and over the surface of the brain, the convolutions are apt to be flattened, and the pressure may be such that the amount of blood circulating within the brain is reduced below the normal quantity. Thus, in the case of a child of three years, who lived sixteen days, and was examined after death by Burdon-Sanderson, the ventricles

contained a large amount of turbid serum, and the brain-substance was everywhere pale and anæmic.

Cerebral *ramollissement* occurs in certain cases. At one of the examinations in Charity Hospital, the patient having been only three days sick, the brain was found much softened. The dissection was made seven hours after death, so that the softening could not have been the result of decomposition. At one of the post-mortem examinations in Bellevue Hospital, softening of the fornix, corpus callosum, and septum lucidum was observed; and in another, softening in the neighborhood of the subarachnoid space. In a case related by Dr. Moorman in the *Amer. Journ. of Med. Sci.* for Oct. 1866, it is stated that portions of the brain, medulla oblongata, and pons Varolii were softened. In a case observed by Dr. Upham, there was softening of the superior portion of the left cerebral hemisphere. Occasionally the whole brain is somewhat softened. Burdon-Sanderson, Russell, and Githens, each relate such a case. Moreover the walls of the lateral ventricles are ordinarily more or less softened in these cases, as in the ordinary form of meningitis. In rare instances the brain is œdematous, as in a case published by Dr. Hutchinson in the *Amer. Journ. of Med. Sci.* for July, 1866. In this case the patient was only four days sick, and the whole brain was œdematous, serum escaping from its incised surface.

The ventricles contain liquid, in some patients transparent serum, in others serum turbid, and containing flocculi of fibrin or fibrin with pus. The liquid in the different ventricles as they intercommunicate is similar. The choroid plexus is either injected or it is infiltrated with fibrin and pus. In advanced cases with the abatement of the inflammation absorption commences. The serum obviously disappears soonest, and the pus and fibrin more slowly, by fatty degeneration and liquefaction. Still absorption and the return of the brain and meninges to their normal state are slow, and hence the tediousness of convalescence. An infant, whom I was allowed to examine in the practice of another physician, took the disease at the age of five months, and two months subsequently, great prominence of the anterior fontanelle and other symptoms indicated still the presence of a considerable amount of effusion within the cranium. No post-mortem examinations, so far as I am aware, have yet revealed the state of the brain and meninges in those who have had this disease at some former period and recovered from it, but it is not improbable that some opacity and preternatural adhesions in places may continue for life.

The remarks made in reference to the cerebral, apply for the most part to the spinal meninges. There is at first intense hyperæmia of the membranes usually over the entire surface of the cord, soon followed by fibrinous, purulent, and serous exudation, in the meshes of the pia mater, and underneath this membrane. Thickening and opacity of the meninges, and often adhesions, occur in protracted cases. The exudation is sometimes

confined to a portion of the meninges, more frequently that covering the posterior than anterior aspect of the cord, but it may occur in any part, and in severe cases the entire pia mater of the spine is infiltrated with it. The exudation may have the usual appearance of fibrin and pus, but it is sometimes greenish and sometimes bloodstained. Small extravasations of blood almost necessarily occur as a result of the intense hyperæmia, and in one case related by Burdon-Sanderson it is stated that there was a layer of blood one-eighth of an inch thick over the whole cord below the bronchial swelling. In post-mortem examinations the central canal of the cord has usually been overlooked. Ziemssen relates a case, and Gordon another, in which it was dilated and filled with purulent fluid. The anatomical changes which have been observed in the cord itself have been injection of its vessels in recent cases, and occasional softening of portions. Thus, in a case which was examined in Bellevue Hospital, April 13th, 1872, it is stated that there was softening of the cord in the upper part of the dorsal region. In most of the examinations the only abnormal appearance observed in the cord was hyperæmia, but in a considerable proportion of cases the records state that the substance of the cord appeared normal.

No constant or uniform lesions occur in the organs of the trunk. The most common is congestion of the lungs, especially of the posterior portions, with more or less œdema, and nodules of hepatization or points of extravasation. Effusion of serum, sometimes bloodstained, occasionally occurs in the pleural and other serous cavities. The auricles and ventricles of the heart, as already stated, contain more or less blood, with soft dark clots in the more malignant and rapidly fatal cases, but larger and firmer in those which have been more protracted. The spleen, liver, kidneys, stomach and intestines, one or more, are sometimes congested, but in other cases their appearance is normal. The absence of uniformity as regards the state of the spleen, the fact that in many patients it undergoes no appreciable change, is important, since this organ is so generally enlarged and softened in infectious diseases. The agminate and solitary glands have ordinarily been overlooked at post-mortem examinations, but in certain cases they have been found prominent.

Treatment. *Preventive.*—Although we do not fully understand the conditions in which cerebro-spinal fever originates, it is certain, from facts observed in epidemics, that we are able to do something to diminish its severity and prevalence and to protect the community. Measures to this end must be of a twofold character, namely, such, in the first place, as are calculated to improve the surroundings of the individual, so as to conduce to a better state of health, and secondly, the regulation of his mode of life. Cleanliness and dryness of streets and domiciles, perfect drainage and sewerage, prompt removal of all refuse matter, avoidance of overcrowding, so as to procure the utmost salubrity in the atmosphere, the use

of plain and wholesome food—in a word, the strict observance of sanitary requirements in all the surroundings—cannot fail to reduce the number and diminish the severity of cases; for, as we have seen, this disease assumes its worst form and numbers the most victims where anti-hygienic conditions most abound. Of scarcely less importance is a strict surveillance of the mode of life, especially of children and young people, during the time of an epidemic. We have seen that this disease not infrequently follows irregularities in the mode of life, excesses of whatever kind, and fatigue, mental or bodily. These should therefore be avoided. A quiet mode of life and moderate exercise, plain and wholesome and regular meals, and the full amount of sleep, afford some, but not complete, security in the midst of an epidemic.

Curative.—It will aid in determining the proper mode of treatment to bear in mind the anatomical characters as ascertained by post-mortem examinations. As the chief danger in the first days is from the intense inflammatory congestion of the cerebro-spinal axis, the prompt employment of measures calculated to relieve this is of the utmost importance. To this end bladders or bags of ice should be immediately applied over the head and nucha, and constantly retained there during the first week. Bran mixed with pounded ice produces a more uniform coldness, and is more comfortable to the patient, than ice alone. Cold produces a prompt and powerful effect in diminishing the turgescence of the cerebral and meningeal vessels. A hot mustard foot-bath or general warm bath with mustard, should also be employed as early as possible, since it acts so powerfully as a derivative from the hyperæmic nerve-centres, tends to calm the nervous excitement and prevent convulsions. An enema to open the bowels is also proper.

Should bloodletting be employed, especially in the more sthenic cases? Even in the commencement of the present century, when it was customary to bleed generally or locally in the treatment of inflammatory and febrile diseases, a majority of the American practitioners whose writings are extant discountenanced the use of such measures in the treatment of this disease. Drs. Strong, Foot, and Miner, though under the influence of the Broussaian doctrine, were good observers, and they soon abandoned the use of the lancet and leeches in the treatment of these patients for more sustaining measures. Strong, who published a paper on spotted fever in the *Medical and Philosophical Register*, in 1811, states that certain physicians employed venesection as a means of relieving the internal congestions, but finding that the pulse became more frequent after a moderate loss of blood, they soon laid aside the lancet. Some experienced physicians of that period, however, continued to recommend and practise depletion, general as well as local, as, for example, Dr. Gallop, who treated many cases in Vermont in the epidemic of 1811.

No physician at the present time recommends venesection, but some of

the best authorities, as Sanderson and Niemeyer, approve of local bleeding in certain cases. It may be stated, as a safe rule, that leeches or other modes of local depletion should not be prescribed in a large majority of cases, and if prescribed in any case it should be on the first day, for on the first day the maximum of inflammatory congestion is attained, and in no case should more than a very moderate quantity of blood be abstracted. Blood should only, in my opinion, be abstracted, and in small quantity, from the temples or behind the ears, in the more sthenic cases, in which, after the prompt employment of the other measures recommended, the stupor becomes more and more profound, and the patient appears already in incipient coma. But in allowing a moderate depletion it must not be forgotten that the disease is in its nature asthenic, and in its subsequent course will require sustaining measures. It is apparent, however, that the abstraction of blood, if once allowed, is likely to be recommended too frequently in the treatment of this disease by those who have had but little experience with it, for the state of most patients in the commencement seems so critical, and the stupor so great, that the most energetic measures seem to be required. But if the blood of patients is spared, and they are promptly and properly treated otherwise, it is surprising to see how many emerge from the stupor and finally recover. For example, in a case related to me by Dr. Griswold, the patient seemed to be comatose for three days, being apparently unconscious and the pupils scarcely responding to light, but he recovered without losing blood. In only one case have I recommended the abstraction of blood, and this was so instructive that I will briefly relate it.

M., a female, 4 years old, was seized at 2 A. M., March 7th, 1873, with vomiting, chilliness, and trembling, followed by severe general clonic convulsions lasting about fifteen minutes. On visiting her early in the morning, I found her semi-comatose, with a pulse of 132, which in a few hours rose to 156; temperature 101¼°, respiration 44; eyes closed; pupils moderately dilated and responding feebly to light; surface presenting a dusky mottling; constant tremulousness, and frequent twitching of limbs. Four grains of bromide of potassium were ordered to be given every hour to two hours, with the usual local measures, namely, ice to the head and nucha, and a hot mustard foot-bath, followed by sinapisms to the extremities.

8th. Pulse 136; is partly conscious when aroused, but immediately relapses into sleep; head considerably retracted; bowels constipated; vomits occasionally; temperature 102°. Treatment, a leech to each temple, on account of the extreme stupor; other treatment to be continued.

9th. The leech-bites bled, though slowly, nearly five hours; pulse 180, and so feeble as to be counted with difficulty; temperature 101½°. The patient is evidently sinking. Treatment, a teaspoonful of Bourbon whiskey in milk every two hours, beef-tea and other nutritious drinks frequently, also the bromide at intervals. Evening, pulse 172, still feeble.

10th. Pulse 180, barely perceptible; great hyperæsthesia; temperature

of axilla 100°, of fingers and hand below 90°; axes of eyes directed downwards.

11*th*. Pulse still very feeble, varying from 160 to 228; temperature 102¼°. There has been no intermission in the use of the stimulants or nutriment night or day; pupils moderately dilated and somewhat more sensitive to light.

After this the patient gradually rallied for a time, so that the pulse became stronger and less frequent, but death finally occurred after nine weeks in a state of emaciation and extreme exhaustion. Slight convulsions occurred in the last hours.

It is seen that, after the loss of blood from two leech-bites, this patient passed into a state of extreme exhaustion so that for three days I did not believe that she would live from one hour to another, and death finally occurred. Although the loss of blood may have been useful in relieving the stupor, yet a worse danger resulted. Experience like this, which I believe corresponds with that of other observers, shows how seldom and with what caution the blood of the patient should be abstracted.

The internal remedy most in favor with the profession of this city, in the first stage of this disease, and properly so, is the bromide of potassium, especially in the treatment of children. Evidently a remedy is required which will diminish the calibre of the arterioles, and consequently the hyperæmia of the cerebro-spinal axis and its meningeal covering. Ergot has been employed for this purpose, and in some instances with a satisfactory result; but bromide of potassium, while it contracts the arterioles of the encephalon, is at the same time a powerful sedative to the nervous system. More than any other safe internal remedy, it prevents convulsions in children, which occurring in this disease add a passive to the already intense active congestion of the cerebro-spinal axis. This agent in medicinal doses produces no ill effect except when given frequently for a lengthened period, when it may produce muscular weakness. A child of five years may take five or six grains every two, three, or four hours, according to the urgency of the case. After the first week it should be given less frequently, and finally omitted. The practice of some physicians, who continue the use of the bromide in frequent large doses after the first or perhaps second week, is to be deprecated, since after a time it is apt to produce symptoms which can with difficulty be discriminated from those of cerebro-spinal fever. These are stated as follows by Mr. Wood: "Great muscular debility, dimness of sight with dilated pupils, irregular gait, the patient reeling as though intoxicated, whilst nausea, vomiting, or purgation, with abdominal pain of a dull aching character, may also be present." (*British Med. Journ.*, October 14th, 1872.) It is obviously better after the first week, if the symptoms are no longer urgent, to discontinue the bromide entirely, than to continue its use in such doses and for such a period that there may be danger of producing its physiological effects. Nevertheless

it is proper to resume its use during its periods of recrudescence which are so apt to occur at any stage of the disease.

The bromide cannot be depended on to allay the pain, which often, on account of its severity, requires immediate treatment, and sometimes it does not allay the excessive agitation. For these symptoms an opiate is indicated, which in my practice has produced a much more satisfactory result than hydrate of chloral. Quite moderate doses are sufficient to produce the effect desired. A patient of six years was quieted by $\frac{1}{32}$ part of a grain of sulphate of morphia. So useful are opiates in allaying pain in this disease, that some observers, as Niemeyer and Ziemssen, consider them the most valuable of the internal remedial agents which we possess, and the benefit from their use in these cases has certainly had considerable effect in disabusing the minds of physicians of the dread which they have entertained of their employment in acute affections of the brain. Mannkoff and others have employed subcutaneous injections of morphia.

Quinia is suggested as a remedy by the paroxysmal character of the pains and the fever, but I believe that I am sustained by the general experience of physicians in this city in stating that it has very little effect upon either of these symptoms, or upon the course of the disease. I have employed it in small and large doses, as many as fifteen grains per day to a child of thirteen years, but am not aware that it has been of any service except as a tonic. There is perhaps no better remedy for the nausea than bismuth in large doses.

Frequent counter-irritation along the spine by dry cups or an irritating liniment is useful from the first, and vesication of the nucha by cantharidal collodion or otherwise when the ice-bag is discontinued. Sustaining measures should also be commenced early. Tonics, vegetable and ferruginous, should be administered after the disease has continued a few days, alternating with and finally superseding the bromide. I have in some cases employed the citrate of iron and ammonia. The diet must be nutritious, consisting of the meat broths, milk, etc., during the entire course of the malady. Most patients require alcoholic stimulants sooner or later. In cases presenting a feeble pulse, and other evidences of prostration, their early and continued employment is advisable, as in the case which I have related, in which whiskey was administered every two hours after the second day. The constipation is ordinarily best relieved by enemata. The room should be dark, of comfortable temperature, and quiet.

CHAPTER V.

ACUTE RHEUMATISM.

Rheumatism is a constitutional disease with a local manifestation, namely, an inflammation of the sero-fibrous tissues, chiefly in and around the articulations, but occasionally in other parts. It is less frequent prior to than in the years succeeding puberty; still, it is not uncommon in children after the fifth year. Under this age it is stated to be rare, but is probably not so infrequent as is commonly supposed. For while in the adult the diagnosis of rheumatism is easy, in children this disease is likely to be overlooked, if, as is true in a large proportion of cases in early life, the swelling and redness of the affected joints are slight, and only a few joints are inflamed. If there is cardiac inflammation, the articular affection may be nearly absent, thus rendering the diagnosis more obscure. That rheumatism is not so very rare under the age of five years, I infer from the fact that we now and then meet with cases of valvular disease in children of this age or older, which, there can be little doubt, had its origin in rheumatism, although the parents are not aware that there has ever been an attack of this disease. Such cases have not infrequently been brought to the children's class in the Outdoor Department at Bellevue. Thus, in January, 1871, a little girl, three years old, was presented, having distinct aortic direct, and mitral regurgitant murmurs. The mother was not aware that she had had rheumatism, but at the age of twenty months she had for several days pretty active febrile symptoms, which the physician attributed to some other ailment. In April, 1871, another girl, of the same age, was brought to the clinique, having a distinct mitral regurgitant murmur. The mother stated that she had been well till a month previously, when she was confined to her bed for a few days, having a high fever. She was attended by a homœopathic physician, and the exact character of her sickness the mother was not able to state. Further medical advice was sought, as the child remained delicate, though her health was better than at first. There can be little doubt that the obscure fever in this case had been rheumatic. In another child treated elsewhere, not old enough to relate the subjective symptoms, there was, in addition to an intense fever, evident pain in one foot or leg, when the limb was moved. Still, the nature of the disease was not diagnosticated till some time after recovery, when a valvular murmur was accidentally discovered. Such histories, which I do not think are rare, show, if my opinion of them is correct, that rheumatism may occur not very rarely in

young children, even infants, for which purpose they are here introduced, but they inculcate the important practical lesson, that the disease at this age may be so obscure, or latent, as to be overlooked even by good diagnosticians.

Some observers, meeting cases of valvular disease in children, without the history of rheumatism, have concluded that rheumatism is not the chief cause of endocarditis at this age (Dr. A. Steffen, *Jahrbuch für Kinderk.*, 1870); but the explanation which I have given seems to me more in consonance with the facts. Scarlet fever not infrequently causes endocarditis, but this exanthem is not apt to occur without detection, and it has been as often absent as has rheumatism from the histories as given by the parents of young children with valvular disease, whom I have examined. Moreover, the endocarditis of scarlet fever is in many cases associated with, if it do not result from, scarlatinous rheumatism.

Rheumatism in children is primary or secondary. The secondary form occurs chiefly in the declining stage of scarlet fever and variola. It is stated, also, to occur occasionally in new-born infants during epidemics of puerperal fever. I have not observed such cases.

Causes.—An inherited rheumatic diathesis is universally recognized as an important predisposing cause of this disease, so that it is apt to occur in different members of the same family. When the family history shows a strong predisposition to rheumatism, it occurs in the child from a slight exciting cause; if no such predisposition exists, it only occurs through unusual circumstances of exposure. The ordinary exciting cause is the same as in most idiopathic inflammations, namely, exposure to cold; but a strong rheumatic diathesis appears to be sufficient in itself to produce an outbreak of the disease. Children who have had one attack are especially liable to another.

Symptoms.—The commencement of acute idiopathic rheumatism is in most cases sudden; occasionally fever, and a degree of soreness or stiffness, precede the articular affection for a few hours or days. The inflammation, slight at first, increases gradually, attaining its maximum intensity within one or two days. The joint is painful, red, hot, and swollen. The swelling is due to inflammatory œdema of the tissues surrounding the joint and effusion within the joint. As in all inflammations, the vascularity of the parts involved is increased, the synovial membrane loses more or less its lustre, and the effused fluid, which is mainly serum, has been found, in most of the cases in which an opportunity was presented to examine it, to contain, like the pleuritic exudation, a few globules of pus. Rarely, in a reduced state of the system, so much pus is produced within the joint as to constitute a true abscess, and rarely also fibrin is exuded, producing a rubbing sensation when the joint is moved, and endangering permanent adhesion of the articular surfaces. Fortunately, however, in the vast majority of cases, the substance exuded both without and within the joint

is mainly serum, and hence the rapid subsidence of the swelling when the inflammation ceases. The pain is commonly not severe when the child is quiet, but it is greatly increased if the joint is pressed or the limb moved.

The joints of the extremities are most frequently the seat of rheumatic inflammation, but occasionally those of the trunk, as the intervertebral, the symphysis pubis, etc., are involved. As the inflammation abates in the articulations first affected, it reappears in others, unless the materies morbi has been eliminated from the system. It is seldom that more than two or three of the joints are in a state of active inflammation at the same time.

The temperature in acute rheumatism is elevated two or three degrees above that of health, and the pulse varies from 120 to 140, its frequency depending on the age of the patient, as well as the gravity of the disease. Perspiration is a common symptom. The appetite is impaired, the tongue slightly coated, and the bowels constipated. The watery element in the urine is diminished, as in most febrile diseases. There is no corresponding reduction in the solid elements, so that the urine is rendered more dense, and its specific gravity is high. The amount of urea and coloring matter excreted from the kidneys is augmented during the active period of rheumatism, and the urine, when it cools, deposits urates. In ordinary cases there is no prominent symptom referable to the nervous system, with the exception of pain in the affected joint.

Acute rheumatism, if only the articulations were involved, would be a disease of little danger, however painful, but unfortunately, in its proneness to produce specific inflammation of the sero-fibrous tissues, the heart frequently becomes involved, less frequently the lungs and pleura, and in rare instances the cerebral or spinal meninges. Endocarditis is the most frequent of the heart inflammations occurring in rheumatism; pericarditis, though less common, is not infrequent, while in rare instances myocarditis occurs, usually associated with the other inflammations. Endocarditis is limited to the left side of the heart, and seldom continues long without engaging the valves, aortic or mitral, or both, causing their infiltration, fibroid degeneration, with consequent thickening, and sometimes adhesion. The valvular lesion thus produced is in most instances permanent, so impairing the action of the valves as to obstruct in greater or less degree the flow of blood through the orifice or allow its regurgitation.

The mitral valve is more frequently affected than the aortic, at least *bruits* produced by this lesion are more frequent in the mitral than aortic orifice, and when they are heard in both orifices they are commonly loudest in the mitral. This fact, noticed by different observers, I have repeatedly verified by observations in this city.

While the articular affection pertains to the clinical history of rheumatism, the internal inflammation, whether of the heart, lungs, pleura, or

meninges, though similar as regards its pathological character, is properly regarded as a complication. Acute rheumatism is so frequently complicated by one or the other of these affections, that any disproportionate severity in the general symptoms, as compared with the inflammation of the joints, or any sudden and unexpected increase in the symptoms, should always lead the physician to examine thoroughly the condition of those organs which are most frequently affected.

Inflammatory complications occur, as a rule, during the active period of rheumatism, when the inflammation is passing from joint to joint. If the general symptoms begin to improve, and no new joints are involved, the liability to complications is greatly diminished. Secondary rheumatism, occurring in most instances in connection with certain eruptive fevers, especially scarlatina, commonly affects only a few joints, often only one or two, as the wrist, and, though painful, is attended by slight swelling and redness.

Duration—Prognosis.—With proper treatment and without complication the febrile action in a few days begins to abate, and the disease commonly terminates within two weeks. Its duration is ordinarily shorter than in rheumatism of the adult. Fluctuations, however, are liable to occur. The disease may appear to be abating, and the articular inflammations nearly cease, when they return for a time, often without new exposure and without appreciable cause. The prognosis, even when cardiac imflammation has supervened, is in most cases favorable, except so far as the lesion resulting from this inflammation is concerned, which being permanent may entail much subsequent suffering, and occasion death after months or years. Indeed, what is most to be dreaded in cases of acute rheumatism is valvular disease or pericardial adhesion with its remoter consequences, namely, hypertrophy of heart, congestion and œdema of the lungs, dropsies, etc.

Secondary rheumatism occurring in scarlet fever is sometimes also complicated with, or rather coexists with, cardiac inflammation, pleuritis, or pneumonitis, rendering the prognosis more unfavorable.

In rare instances the acute symptoms of rheumatism abate, but the joints remain stiff and more or less swollen, and painful when moved. The acute has lapsed into a subacute or chronic rheumatism. Such a case, represented in the accompanying figure, was brought to the children's class in the Outdoor Department at Bellevue Hospital, in February, 1871. E. H., female, $3\frac{1}{2}$ years old, had intermittent fever from the age of nine to fifteen months. From this time she remained well till the age of two years, when she was taken with acute rheumatism, commencing in her ankles and extending to other joints. The knee and hip joints on both sides have only partially recovered their mobility, and both legs and both thighs are permanently flexed, so that the gait is slow and unsteady. It is impossible to straighten either limb without causing great pain, and

attempts to straighten the thigh produce the arch in the back very similar to that in coxalgia.

Diagnosis.—This is not difficult in ordinary cases, if a proper examination is made. In the commencement, if the affection of the joints is slight, rheumatism might be mistaken for remittent, typhoid, one of the eruptive fevers, or meningitis; but, on careful examination, tenderness will be observed of one or more of the articulations, and probably some swelling. This tenderness is readily distinguished from the hyperæsthesia which is common in the first stage of the essential fevers, and which is observed when pressure is made upon the chest or abdomen as well as upon the limbs, and is more marked between the joints than in them. Any doubt which may at first exist, whether the patient may not have one of those diseases, is soon dispelled, since their clinical history presents notable differences from that of rheumatism.

Fig. 16.

I have known scrofulous arthritis, or scrofulous ostitis near the joint, present so close a resemblance to acute rheumatism as to be at first mistaken for it. In one instance this inflammation commenced in three joints distant from each other, so that the diagnosis at first was difficult. But scrofulous inflammation as well as that from pyæmia can be diagnosticated from rheumatic disease of the joints, by its greater persistence, less induration and symmetry in the swelling, and by the history of the case. Chronic rheumatism may produce deformity similar to that from chronic scrofulous inflammation, as in the case mentioned above, but the rheumatic history, number of joints affected, bilateral character of the inflammation, good general health, etc., are sufficient to establish a clear diagnosis.

Treatment.—The theory of the pathology of a disease determines the mode of treatment, and the theory that rheumatism is due to an acid in the blood, probably lactic, though not established, has been widely received, and has led to the extensive employment of alkalies, as tartrate of soda and potassa, acetate of potassa, etc. The alkaline treatment apparently materially abridges the duration of acute rheumatism; but lately a new remedy, namely, salicylic acid, has been found to act almost as a specific in a large proportion of cases, quickly relieving the pain, and subduing the inflammation, so that a few days suffice to effect a cure. Speedy cure of this malady is urgently demanded, on account of the imminent peril of the heart. Children seem very liable to the cardiac complication. Although salicylic acid frequently causes the disappearance of all symptoms within a week, they are apt to reappear unless the medicine is continued

in occasional doses for some days subsequently, as I have had opportunity to observe. It should be prescribed with an alkali, as in the following formula, which is similar to one employed in the Out-Door Department at Bellevue:—

℞. Acid. salicylic., ʒij ;
Potas. acetat., ℥ss ;
Glycerinæ, ℥j ;
Aquæ, q. s. ad ℥v. Misce.

Give one teaspoonful every three hours to a child of six years.

A new remedy, producing useful therapeutic effects, is apt to be prescribed at first for too many distinct pathological states, till finally its use is restricted to such conditions as it is found to relieve. Salicylic acid has undergone this trial, and, while it has been rejected as a remedy for the infectious diseases, it is recognized as the most useful of all remedies for the disease which we are now considering. An occasional opiate, as Dover's powder, may also be needed between the doses of the acid.

During the declining period of rheumatism and in convalescence quinine or some preparation of cinchona should be employed and the above medicine given less often. This tonic does indeed appear to exert a beneficial effect on the course of rheumatism, and it is employed by some judicious and experienced physicians from the commencement.

If there are a high temperature and a quick pulse, quinine administered in an occasional large dose will be found very useful. Three to five grains may be given to a child of five years.

Rheumatism impoverishes the blood, and the patient often begins to present an anæmic appearance, when he requires iron in addition to the vegetable tonic. The citrate of iron and quinine may then be employed.

Secondary rheumatism requires sustaining treatment from the first. Such cases ordinarily do well without anti-rheumatic treatment, with the general supporting measures employed for the primary disease.

Pneumonitis complicating rheumatism is best treated by moderate counter-irritation and emollient poultices, and the internal use of carbonate of ammonia ; or, if there is anæmia, carbonate of ammonia with citrate of iron and ammonia. The other internal inflammations which are liable to arise as complications require iodide of potassium in decided doses. In pericarditis or endocarditis, if, as is commonly the case, the movements of the heart are accelerated, quinia in large doses, or the tincture or infusion of digitalis, is urgently demanded to the extent of reducing the number of pulsations to near the normal frequency. A child of six years can take three or four drops of the tincture or a large teaspoonful of the infusion, to be repeated, if necessary, in three hours, till the required reduction of the pulse is effected. Patients often experience relief, by the use of this agent, from the palpitation and dyspnœa consequent upon the embarrassed movements of the heart. If the heart disease is severe and pulse feeble, quinine is also useful.

The patient should be kept quiet, in a room of uniform temperature, and not exposed to draughts of air. By such precaution the danger of complications is greatly diminished. Repellent applications, as cold or irritants, should not be applied to the joints, as long as the disease is acute, for they also increase the danger of complications. The affected joints should be enveloped in flannel or cotton, and the pain, if intense, may be diminished by applying flannel wrung out of warm water. If the disease becomes subacute or chronic, if the urates have disappeared from the urine, and the inflammation ceases to pass from joint to joint, the tincture of iodine, or moderately stimulating embrocations, applied to the joints, involve no danger and are useful.

CHAPTER VI.

ERYSIPELAS.

The term erysipelas is applied to a constitutional or blood disease, which is characterized by inflammation of the skin and subcutaneous connective tissue, and by a tendency to spread. It is accompanied by pungent and pricking heat, swelling, and subcutaneous infiltration.

In rare instances, in young infants, an inflammation which has been designated erysipelas occurs in and around the umbilicus. It commences about the time of the detachment of the umbilical cord, and is accompanied by redness of the skin, tumefaction, and hardness of the connective tissue surrounding the umbilicus. It usually causes ulceration of the umbilical fossa, and, in fatal cases, pus is sometimes found in the umbilical vessels. This disease does not show any tendency to spread; the diameter of the inflamed surface is not more than three or four inches, with the umbilicus at the centre. It is generally fatal; but two favorable cases have been reported to me, in one of which there was considerable ulceration, and after recovery a firm cicatrix occupied the site of the umbilicus. The most reasonable view is that this disease is primarily an inflammation of the umbilical fossa and vessels, induced by uncleanliness, cachexia, or other cause. It lacks the distinguishing feature of erysipelatous inflammations, namely, the tendency to spread, and I shall, therefore, take no further notice of it in this connection. (See Diseases of the Umbilicus.)

Erysipelas seldom occurs in childhood; the few cases which are met in this period present nearly the same features, and pursue nearly the same course, as in the adult. In infancy, on the other hand, erysipelas is a common disease. Every practitioner is called to cases, from time to time. The following remarks relate to erysipelas occurring in this period of life. They are based on data derived mainly from the records of cases which occurred in this city, some in my own practice, and others in the practice

of physicians known to be good observers. The points of chief interest in forty-one cases are embraced in the following table :—

Cases of Infantile Erysipelas.

No.	Sex.	Age.	Point of commencement.	Parts affected.	Duration.	Result.
1	M.	5 months.	Right knee.	Entire surface, except face and scalp.	5 weeks and 3 days.	Recovered.
2	M.	2 years.	Left knee.	From a little above the knee to the ankle.	7 days.	Recovered.
3	M.	10 months.	Elbow.	Whole arm and forearm.	.....	Recovered.
4	F.	20 months.	Below right knee.	Entire leg, thigh, and trunk to the umbilicus.	7 days.	Recovered.
5	F.	9 months.	Vulva.	Abdomen, chest, and all the extremities.	18 days.	Recovered.
6	M.	9 days.	Genitals.	Both lower extremities, abdomen to the umbilicus.	6 days.	Died.
7	F.	1 year.	Vulva.	Entire surface, except face.	6 weeks.	Recovered.
8	F.	6 weeks.	At or near the ear.	Forehead and side of face.	1 week.	Died in tetanic spasm.
9	..	9 months.	Epigastric region	Trunk and lower extremities.	2 weeks.	Died in tetanic spasms.
10	F.	10 months.	At angle of mouth.	Entire face and scalp.	10 days.	Recovered.
11	F.	4 weeks.	Vulva.	Entire surface, except face.	3 weeks.	Died.
12	F.	3 months.	Vulva.	Surface of abdomen to umbilicus and right lower extremity.	2 weeks.	Recovered.
13	F.	4 to 5 mos.	Vulva.	All the limbs and trunk, except the chest.	3 to 4 weeks.	Died.
14	F.	5 months.	From syphilitic sores around anus.	Trunk and both lower extremities.	.....	.....
15	F.	3 months.	Vulva.	Entire trunk and both upper extremities.	3 weeks.	Recovered.
16	M.	8 months.	Face near nostrils.	Entire trunk and both upper extremities.	About 2 weeks.	Recovered.
17	F.	4 months.	Vulva.	Entire trunk and all the extremities.	1 week.	Died.
18	F.	7 months.	Knee.	A portion of trunk and both lower extremities.	3 weeks.	Recovered.
19	F.	6 months.	Near the ear.	Entire face and forehead.	10 days.	Recovered.
20	M.	7 days.	Left eyelid.	Left side of face.	3 days.	Died.
21	M.	14 days.	Genitals.	Extended to knees, over abdomen to the chest.	4 days.	Died.
22	M.	3 months.	Under the chin.	Chin, left cheek, neck, left side of trunk, left thigh and leg.	.....	.....
23	F.	28 months.	Right shoulder.	Arm and forearm.	1 day.	Died in convulsions.
24	F.	3 or 4 days.	Vulva.	Body and all the limbs.	12 days.	Died.
25	F.	3½ mos.	Under left ear.	Neck, chest, and arms.	About 2 weeks.	Died.
26	..	7 months.	Below right knee.	Trunk, neck, and head, and all the limbs.	2 weeks.	Died comatose.
27	F.	6 months.	Vulva.	Both thighs, and nearly entire trunk.	3 days.	Died comatose.
28	M.	19 months.	Near point of vaccination.	Shoulder, arm, and forearm.	21 days.	Recovered.
29	M.	4 months	Near point of vaccination.	Chest, and both upper limbs.	2 weeks.	Recovered.
30	F.	2 months.	Near vaccine vesicle.	Trunk and all the limbs.	10 days.	Died.
31	..	3 to 4 mos.	Near vaccine vesicle.	Arm, forearm, and shoulder on one side.	2 to 3 weeks.	Died.
32	F.	4 months.	Near vaccine vesicle.	Arm, forearm, and trunk.	2 months.	Died.
33	M.	2 months.	Near vaccine vesicle.	Nearly entire surface.	1 week.	Died with peritonitis.
34	M	5½ mos.	Near point of vaccination.	Arm and forearm.	.....	Recovered.
35	M.	2½ mos.	Near point of vaccination.	Arm.	7 days.	Died, probably of peritonitis.
36	M.	8 months.	Near vaccine vesicle.	Arm and forearm.	17 days.	Died.
37	..	5 months.	Left foot.	Leg, thigh, and lower part of trunk.	2 weeks.	Died with pneumonitis.
38	..	5 weeks.	At one ear.	Entire surface.	2 weeks.	Recovered.
39	..	2 months.	Left leg.	Trunk, and all the limbs.	2 weeks.	Recovered.
40	..	4 months.	Near point of vaccination.	Trunk, and all the limbs.	2 weeks.	Died.
41	M.	14 months.	Face.	Trunk, and all the limbs.	4 weeks.	Recovered.

Age.—Of the above cases, 27 were under the age of six months; 9 from six months to twelve, and only 5 above the latter age. A large majority, therefore, of cases of infantile erysipelas occur in the first year of life.

Point of Commencement.—In 58 cases in which I have ascertained the point of commencement, it was in 13 cases the vulva, 17 the arm after vaccination, 7 the leg, 6 the face, 3 the male genital organs, 3 at or near the ear, 1 the elbow, 1 the shoulder, 1 the nates, 1 the foot. In the adult, idiopathic erysipelas commonly commences upon the face, and affects only the face, ears, forehead, and scalp. On the other hand, in infantile erysipelas, statistics show that the rash commences upon the face only in a small proportion of cases, one in nine, and that it rarely extends to the face when it commences in other parts.

Causes.—In erysipelas the first departure from the healthy state occurs in the blood, or the system generally. This undergoes certain changes which predispose to erysipelas, or are sufficient in themselves to give rise to it. Among the causes which produce this state of system, uncleanliness, residence in damp, dark, and crowded apartments, and defective alimentation, hold a principal place. Hence this disease is more common in the poor quarters of the city than in the country, and in dispensary and hospital than in civil practice.

In a large proportion of cases there is a local exciting cause of the erysipelatous eruption, namely, an irritation or inflammation at some point, generally trivial, but which is sufficient to develop the disease in the system already prepared for it. It is very apt to commence at or near a simple ecthymatous or impetiginous eruption, around burns or suppurating sores or syphilitic eruptions; it frequently commences, as is seen by the above table, near the point of vaccination immediately after vaccination, or when the pock is developed, or again when it has run its course and been detached. In a considerable proportion of cases it commences at a point where the skin is thin and delicate, or where it unites with a mucous surface, probably from some uncleanliness or irritation of those parts. Thus, I have records of cases in which it commenced at the external ear, commissure of the mouth, and at the vulva. Indeed, the frequency with which it commences at the vulva renders female infants more liable to it than males. In some instances erysipelas begins without any local exciting causes, upon smooth and sound skin, even when there are sores upon various parts of the surface.

Vaccination, as an exciting cause of erysipelas, demands particular notice. Often, doubtless, it is the inflammation which necessarily arises from the cut or the vesicle, which operates as an exciting cause of the erysipelatous affection, and not any deleterious property contained in the virus which is employed, so that an equal degree of inflammation occurring in any other way, as from a burn, would be attended by a like result. But facts show that the virus itself occasionally contains a latent noxious prin-

ciple, which, introduced into the system, operates as a cause of erysipelas. Thus, a little girl was vaccinated by me in November, 1860, and about the time when the vesicle began to fill she was seized with severe inflammation of the fauces, attended by tumefaction and infiltration of the submucous connective tissue. The inflammation rapidly subsided, and within a week from its commencement the throat affection had nearly or quite disappeared. I now believe that the disease of the fauces was erysipelatous, although it was not suspected at the time to have this character.

As the girl was otherwise healthy, and the vaccine vesicle passed through its usual stages, and presented the usual appearance, the scab was employed six weeks afterwards to vaccinate two infants. Within twenty-four hours after vaccination both these infants were seized with high fever, ushering in severe erysipelas, commencing in one around the point of vaccination, and in the other around syphilitic sores near the anus. In the former case the erysipelatous rash extended from the shoulder over the entire limb, and was obstinate, twice reappearing, and extending over the same surface; in the latter (a mulatto child) it extended over both lower extremities and a considerable part of the trunk, when the case passed into the hands of another physician, and the result is not known. The instrument with which the vaccinations were performed was clean. The vaccine disease did not appear in either of these cases.

Again, a well-known physician of this city vaccinated three infants, one his own (No. 32 of the table), with part of a scab which had been pronounced good, but was taken from a child that he had not seen, and with whose state he was not familiar. These infants were all affected with erysipelas from the vaccination, his own dying. He had taken the precaution to rub the lancet on his boot before using it. Another physician of this city has informed me that he vaccinated two children in the same family with a scab, with all the precautions that he had ever used, and both were soon after affected with erysipelas of a severe form, extending from the point of vaccination; the vaccine disease did not appear. I have heard of no case in which the vaccine lymph gave rise to erysipelas, and, probably, it rarely or never does. In the lymph there is no admixture of foreign substances, whereas in the scab there is a large proportion of animal matter.

There is a form of erysipelas which occurs in the infant immediately after birth, and which is sometimes met in private practice, but is most frequently observed as an epidemic in lying-in wards. It is associated with severe, and commonly fatal, puerperal or septic fever, or erysipelas of the mother. This form of erysipelas is fatal, almost without exception, and its contagiousness is generally admitted by those, who have had an opportunity to observe cases.

A case showing the relation of erysipelas in the newly-born infant to disease of the mother occurred in the practice of Dr. Leaming, of this

city. A woman gave birth to a healthy infant, on the 27th of July, 1860. A few days subsequently she was seized with a chill, followed by erysipelas, commencing on the thighs, and terminating fatally August 17th. As no autopsy was allowed, the state of the internal organs was not ascertained. A few days before her death the same disease commenced on the infant. It extended around the neck, upon the ears, down the arms, and terminated fatally August 24th. But erysipelas in the new-born infant, occurring in connection with erysipelas in the mother, is more rare than its occurrence with puerperal fever. The records of lying-in asylums furnish many examples of epidemics of puerperal fever, in which the infants of affected mothers perish of erysipelas.

The late Dr. Folsom, of this city, furnished me the following sketch of cases which occurred in his practice and that of his partner: "About the year 1840, being then in practice in New Bedford, Mass., I was called to visit a man who complained of pain in the knee. The next morning he was easier, but the following evening his symptoms grew worse, and as I was engaged in a case of obstetrics, my partner, Dr. E. C., now dead, visited him. At my call, next morning, I unexpectedly found the patient dying. The disease was obscure, and at the autopsy next day no lesion was discovered. In making the examination, Dr. C. pricked his finger, and experiencing little inconvenience from it at first, he attended a case of confinement on the following morning. A few hours subsequently he was taken sick, and I took charge of the lady, who died in three days, having the tumid abdomen and symptoms of childbed fever. The infant of the patient was seized, when two days old, with erysipelas, appearing on the face and in spots on the trunk and limbs, and terminating fatally in one day. Dr. C.'s finger became swollen and painful, and the lymphatics of the forearm and arm became inflamed, presenting red lines, and the axillary glands suppurated. Though feverish and much prostrated, there was no appearance of erysipelas in his case. In about two weeks he resumed practice, and as at that time physicians in this country were not fully aware of the danger of communicating puerperal fever, he attended two, three, or four obstetrical cases each week, until the number reached fifteen. All the mothers died with symptoms of metro-peritonitis, and all the infants had erysipelas, commencing on the face or some part of the body, generally on the second or third day after birth, and in all terminating fatally within a week. This sad record was finally ended by the doctor's temporarily retiring from practice."

Dr. Condie, in his *Treatise on Diseases of Children*, says: "Erysipelas of infants very commonly occurs during the prevalence of epidemic puerperal fever. Children of mothers who become affected with the fever are often born with erysipelatous inflammation; others are attacked almost immediately after birth. Whether, in these cases, the disease is to be referred to a morbid matter applied to the skin in the womb, or to the same

epidemic or endemic influence which gives rise to the disease of the parent, it is difficult to say. According to M. Trousseau, infantile erysipelas is principally observed when puerperal fever prevails in the wards of the lying-in hospitals at Paris." In private practice it is rare that we meet erysipelas of the infant associated with erysipelas or with puerperal fever in the mother. Some of the oldest physicians of this city, with whom I have conversed, and who are engaged in extensive general practice, state that they have never met a case in which there was this relation. Cases like those observed by Drs. Folsom and Leaming only occur when epidemic erysipelas or puerperal fever is prevailing.

Premonitory Symptoms.—Infantile erysipelas in certain cases has no premonitory stage, or, if present, it escapes notice. In other instances there are well-marked precursory symptoms, as drowsiness, or restlessness, febrile movement, oppressed respiration, with perhaps vomiting, and starting or twitching of the limbs. In Cases 28 and 37 of the table, which occurred in my practice, the febrile movement, restlessness, and oppressed respiration were so great for three days before the appearance of the eruption, as to cause much anxiety. In the adult, pharyngitis often precedes the occurrence of the rash upon the skin. The same inflammation may be present in the premonitory period of infantile erysipelas, as well as during the period of erysipelatous eruption. The hurried and difficult respiration, which is present in the commencement of some cases, is probably due to an erysipelatous turgescence of the bronchial mucous membrane.

Symptoms.—The patient with this disease is usually restless, in consequence of the burning pain which accompanies the eruption. In severe cases there is little sleep, night or day, except from medicine. The sleep is short, and is often interrupted by sudden starting, or twitching of the limbs. Convulsions may occur, but are not common.

Febrile movement is constant, and is proportionate to the extent and gravity of the erysipelas. I have notes of cases in which the pulse was more than 200 per minute, although other symptoms did not indicate immediate danger. The skin not affected by erysipelas is dry and hot, though not possessing the pungent heat of the inflamed portion; face often flushed; tongue moist, and covered with a light fur; stomach usually retentive. The state of the bowels varies; sometimes they are regular, sometimes variable, while in other cases the stools are green, and more frequent than natural. I have records relating to the state of the bowels in twenty cases, as follows: in seven, regular; in nine, loose; in two, constipated; in one, constipated, then loose; and in one, constipated, then regular. Diarrhœa, when present, is usually mild, requiring little or no treatment. The erysipelatous redness is not in all cases so pronounced as in the adult, but otherwise there is nothing peculiar in its appearance. In feeble infants, with an impoverished state of the blood, its color is pink,

instead of the deep red which characterizes the inflammation in the robust. Points of vesication may occur where the inflammation is most severe, as in the adult, and subsequently the same desquamation and œdema.

If the infant is debilitated, there is great danger of the formation of abscesses, around which the inflammation lingers after it has disappeared from every other part of the body. Sometimes also, in very young infants, gangrene occurs, especially of the genital organs in the male. Several of these cases have been related to me, all under the age of a month or six weeks, and all fatal. Occasionally the sloughing is so great as to denude the testicles. A noteworthy feature of erysipelas in infants is its proneness to return. When it has been progressively subsiding, and hope is entertained of its speedy disappearance, it not infrequently is suddenly relighted from some unknown cause, travelling again over the same, or parts of the same, surface. In one case the disease, arising from vaccination, extended three times over the arm and forearm; and in another case, a second time over both legs and a considerable part of the trunk.

The internal inflammations, which most frequently complicate erysipelas, and give rise to symptoms which are superadded to those pertaining to the erysipelas, are pharyngitis and peritonitis; and more rarely bronchopneumonia or enteritis. In a case which I examined after death, in the Nursery and Child's Hospital, and in which, the erysipelatous inflammation having extended over the abdomen, the lesions of peritonitis were present, it seemed probable, from the thinness of the abdominal walls, that the inflammation had extended through the parietes from the external to the internal surface.

Prognosis.—Erysipelas is much more fatal in infancy than in adult life. In the death statistics of this city for three years, I find eighty deaths from erysipelas of infants under the age of one year, to eighty-three deaths from this disease above that age. Age greatly influences the prognosis. Infants under the age of three weeks usually die; from the age of three weeks to six months the result is doubtful; while above the age of six months a majority recover with correct treatment. It will be seen by the foregoing table that seven infants under the age of six weeks had erysipelas, and six died; from the age of six weeks to six months, six recovered and nine died; and above the age of six months, nine recovered and four died.

With the exception of a case of the so-called umbilical erysipelas, the youngest child who recovered, of whom I have obtained information, was three weeks old. In this case the rash extended nearly over the entire surface, beginning with the face. Case 38 of the table, treated by myself, was very similar as regards the extent of the erysipelatous eruption and the result. This infant was five weeks old.

It is scarcely necessary to state that erysipelas is more favorable when it affects the limbs than when it invades the head, neck, or body; when it

spreads slowly than rapidly; when it is superficial than when phlegmonous. In those cases in which the connective tissue is much involved, the infant is not always safe after the disease has run its course; he sometimes dies exhausted from the discharge of abscesses: I have records of two such cases.

Duration.—In sixteen cases that recovered, the erysipelas terminated within the first week in two, the second week in six, the third week in five, fourth week in one, and in two cases it lasted five and six weeks. The average duration was fifteen days. In nineteen fatal cases, ten died within the first week, five the second week, three the third week, and one in the fourth week. The average duration of fatal cases was about ten days.

Modes of Death.—Death occurs in different ways; in clonic or tonic convulsions followed by coma, from exhaustion, and from internal inflammation, that from exhaustion being probably the most common.

Pathological Anatomy.—The blood doubtless in this disease undergoes certain pathological alterations previously to the occurrence of the eruption, but the exact changes are not known. Our knowledge of the morbid anatomy of erysipelas relates chiefly to the local affections, which, with the exception of the inflammation of the skin, are not constant, and may, therefore, be regarded as complications. The cutaneous inflammation affects all the structures of the skin, and in greater or less degree also the subcutaneous connective tissue. The inflammation is accompanied by more or less serous effusion or œdema.

The not infrequent occurrence of peritonitis in connection with erysipelas has long been known. In Heberden's *Epitome Morborum Puerilium*, the anatomical character of erysipelas is expressed in one sentence: "When the body has been opened after death, the intestines have been found glued together and covered with coagulable lymph." Since Heberden's time, nearly all who have written on diseases of infancy and childhood have mentioned peritonitis as one of the most common complications. Underwood says: "Upon examining several bodies after death, the contents of the body have frequently been found glued together and their surface covered with inflammatory exudation, exactly similar to that of women who have died of puerperal fever." Similar remarks in reference to the frequency of peritonitis in this disease are made by recent writers.

The statistics in reference to erysipelas as well as peritonitis show that in infants in hospital practice, and in those affected by erysipelas during epidemics of puerperal fever, peritonitis is a not infrequent complication. On the other hand, as we commonly meet cases of infantile erysipelas occurring sporadically in private practice, there are not sufficient abdominal distension and tenderness to indicate peritonitis. In only one of the cases embraced in the foregoing table was a post-mortem examination made, and in that there had been no peritonitis. The occurrence of pharyngitis in connection with erysipelas has been already mentioned.

Enteritis has been alluded to as another complication in infants. Diar-

rhœa has been stated to be a symptom in certain cases; it has been found to be dependent on enteritis of a mild grade. Billard made post-mortem examinations of sixteen infants who died of erysipelas, and "found in two gastro-enteritis, in ten enteritis, in three pneumonia complicated with enteritis and cerebral congestion, and in one pleuro-pneumonia."

Treatment.—On this side of the Atlantic great uniformity prevails as regards the treatment of erysipelas. Sustaining measures are prescribed, and the tincture of the chloride of iron is the tonic generally preferred. Whatever the intensity of the febrile reaction and the stage of the disease if there is no intestinal complication, ferruginous or other tonics should be administered. The largest doses of the tincture of the chloride of iron given in any of the cases in the above table were in case No. 4, namely, ten drops every two hours, and this patient recovered in seven days from a pretty severe attack. Probably, however, nothing is gained by such large doses, and they may irritate the intestinal surface, and increase the liability to enteritis, which, we have seen, complicates a certain proportion of cases. Four drops may be given every three hours to a child from one to two years of age. Instead of the iron, or in addition to it, one of the preparations of cinchona may be prescribed. Beef-tea, and wine-whey or other alcoholic stimulant, are required.

The depressing measures recommended by certain writers cannot be too strongly censured. One author says: "We should endeavor from the first to allay the inflammation of the skin by energetic treatment. . . . Local abstraction of blood, by means of one or two leeches applied at the circumference of the primary seat of the erysipelas, should be put in force, provided the power of the constitution of the children permits." Such treatment may explain one of this author's aphorisms, namely, *the erysipelas of infants is a fatal disease.*

Local treatment may be employed to arrest the extension of the inflammation, but the result in most cases is not encouraging. Solid nitrate of silver was employed in two cases, of which I have records, aud in both the result was pernicious. Troublesome sores were produced, from which blood escaped, and in one of the cases, at least, death was attributed by the parents to this treatment, rather than to the disease.

Tincture of iodine is a better remedy for arresting the extension of erysipelas. It should be applied from the margin of the inflammation, over the sound skin, to the distance of about two inches. It may be ineffectual, but it does not produce any unfavorable result. Soothing applications, like rye flour, or a lotion of sugar of lead, may be made to the inflamed surface, as in erysipelas of the adult. I prefer, however, for local treatment, the constant application of vaseline or glycerin and water, to which a few drops of carbolic acid are added.

PART III.

SECTION I.

DISEASES OF THE CEREBRO-SPINAL SYSTEM.

Diseases of the brain and spinal cord are less frequent than those of the respiratory and digestive systems. They are also less amenable to treatment, and are much more fatal. They largely increase the aggregate of deaths. They contrast with the diseases of the other systems in their greater relative frequency in infancy and childhood than in adult life. This is explained, as regards the brain, by the rapid development and active molecular change in this organ in early life, its great impressibility by the emotions, and the thinness of the covering which protects it from external agencies.

Some of the most interesting of the cerebro-spinal diseases which are to engage our attention, are peculiar to early life, as tetanus infantum. The diseases of this system also contrast with other local affections in their greater obscurity, especially in their commencement; for, while maladies of the thorax can be readily ascertained by auscultation and percussion, or those of the abdomen by the nature of the evacuations or the degree of tenderness or distension, our means of conducting examination through the bony encasement of the cerebro-spinal axis are meagre and unsatisfactory. The condition of the brain and spinal cord must be determined, chiefly, by the study of symptoms, and not by direct examination. The condition of the anterior fontanelle in young infants, however, enables us to determine the presence or absence of active congestion of the brain. If there is an excess of arterial blood, it is convex. Prominence of the fontanelle is common in inflammatory and febrile diseases, and is a sign of considerable diagnostic and prognostic value.

Within a few years, the ophthalmoscope has been employed as a means of diagnosis in cerebral diseases, and although the employment of this instrument for such purpose is but recent, enough has been elicited to prove its value as an aid in determining the state of the brain. Prof. H. D. Noyes remarks on this subject: . . . . "The argument for making ophthalmoscopic examination in all cases of brain disease, becomes irresistible. Indeed, a moment's reflection would lead to this conclusion with-

out any considerations drawn from pathology. The optic nerve is only an outlying portion of the brain; its extremity is fully exposed to view. Situated within about two inches of the brain, it is the only nerve in the body which we can inspect; it contains bloodvessels which communicate directly with the intracranial circulation. We thus come into relation with the cerebrum, by continuity of nerve-structure and also of bloodvessels."

Structural changes in the optic nerve and retina have been discovered by means of the ophthalmoscope in meningitis, hydrocephalus, phlebitis of the sinuses, apoplexy, etc. Among the lesions which have been observed by this instrument, are hyperæmia, more or less opacity and tumefaction of the optic nerve, engorgement of the vessels of the retina, with serous or sero-fibrinous exudation and ecchymotic points. In certain protracted diseases, as chronic hydrocephalus, in which dimness or loss of sight occurs, the ophthalmoscope discloses a state of atrophy of the optic nerve. Heretofore this instrument has been chiefly employed by oculists, but as it comes into more general use, there can be little doubt that it will be recognized as an important aid in the diagnosis of obscure cerebral diseases.

Still, with all possible aids to diagnosis, the obscurity which attends the invasion of many of the cerebro-spinal diseases must be acknowledged. To the hasty and careless physician, their symptoms are often deceptive. Careful weighing of the phenomena, and thorough and protracted examination, are requisite in order to insure correct diagnosis and proper treatment. Some of the cerebro-spinal affections are, in reality, sequelæ of other diseases, as, for example, spurious hydrocephalus; and some are, strictly speaking, only symptoms, as convulsions; but, on account of their importance, and because they require special treatment, it is proper to consider them as diseases *per se*.

The brain presents certain peculiarities in infancy and childhood. In the fœtus, while the other organs are well formed, the brain, especially its cerebral portion, is still diffluent, and at birth it has so little consistence that it must be handled carefully to prevent laceration. This softness is due to the large proportion of water which it contains. The following analyses show the composition of the brain in three periods of life:—

	Infant.	Youth.	Adult.
Albumen,	7.00	10.20	9.40
Cerebral fats,	3.45	5.30	6.10
Phosphorus,	.80	1.65	1.80
Osmazome, salts,	5.96	8.59	10.19
Water,	82.79	74.26	72.51

At birth the brain has a nearly uniform white color. The gray substance, in which the nervous power originates, is undeveloped. The date of its appearance corresponds with the first exhibition of emotion or intel-

ligence, and the decided gray color which we observe in the brain of the adult does not appear until the age of full mental activity.

In the new-born the brain is large in proportion to the rest of the body, and its growth during infancy and childhood is rapid. Until the fifth year, as appears from the observations of Dr. Peacock, its weight is about one-seventh or one-eighth that of the entire system, the proportions varying somewhat in different cases.

The brain does not attain its full size, as stated by Dr. West, at the age of seven years, but, according to Dr. Peacock's statistics, it continues to increase till the age of twenty-five or thirty, although its growth is less rapid after the age of seven years than previously.

The membranous covering of the cerebro-spinal axis is scarcely less interesting to the pathologist than the axis itself. I shall speak in the following pages of the arachnoid and cavity of the arachnoid, for convenience of description, although aware of the fact that some eminent authorities, as Virchow and Kölliker, whose opinions in reference to the minute anatomy of the system always command attention, if not assent, believe that there is no arachnoid, but what has heretofore been called by this name is on the one side the smooth surface of the dura mater and on the other of the pia mater.

The dura mater is seldom involved in the diseases of early life, except as it is affected by pressure, while the pia mater and arachnoid are the seat and source of some of the most important diseases, as meningitis, meningeal apoplexy, etc.

The more complicated and delicate the structure of an organ, the more liable it is to errors of nutrition and growth. There is, therefore, no organ which is so liable to irregular development as the brain. It may be entirely wanting; or it may be partially developed, certain portions being absent; or, lastly, its growth may be excessive, constituting an hypertrophy.

CHAPTER I.

ACEPHALUS—ANENCEPHALUS.

Entire absence of the encephalon is not common, but there are many cases of this monstrosity on record. In extreme cases the head and part of the neck, as well as the brain and medulla oblongata, are absent. When there is great deficiency there is often a twin, the presence of which has interfered with the full development of the system. Sometimes the growth of other organs besides the brain is imperfect.

Anatomical Character.—In the ordinary form of anencephalus the brain and sometimes the medulla are absent, with the absence or imperfect development of their membranous and osseous covering. The vault of the cranium is absent. There is deficiency of the frontal, parietal, and occipital bones, except those portions which are near the base of the cranium. These portions are very thick and closely united, as if there were the usual amount of osseous substance, but instead of expanding into the arch, it had collected in an irregular mass at the base of the cranium.

The absence of the brain and the cranial arch gives a remarkable appearance. The eyes are prominent, the neck thick and short, while the body and limbs are ordinarily well developed. The physiognomy has been compared to that of some of the lower animals.

Fig. 17.

The base of the cranium is often occupied by a vascular tumor, not large, but of different size in different cases, and continuous below with the spinal pia mater. This vascular tumor is the representative of the cranial pia mater, and its smooth surface is the analogue of the arachnoid. The dura mater and the scalp being absent, the exposed mass resembles very much in appearance, as it does in structure, the placenta, and the sensation which it imparts to the finger pressed upon it is very similar. Sometimes small portions of cerebral matter are found among the vessels of this tumor, but they are so disconnected or isolated that they do not perform, in any way, the function of a brain. Occasionally the vascular tumor is absent, and the medulla or upper extremity of the spine is exposed, or it terminates in a little papilla at the back of the neck.

Those portions of the cranial nerves which lie external to the cranium are well developed, although the intracranial parts may be absent.

Symptoms.—The respiration in anencephalous monsters is irregular. They can be made to cry, but their cry is a sort of sob or hiccough, and occasionally they even nurse. The digestive function is well performed, and regular urinary and fecal evacuations occur. There is a tendency in anencephalous monsters to convulsions. Blowing upon them, and pressure upon the projecting medulla, if this is present, frequently produce this effect.

Prognosis.—Fortunately these monsters are short-lived. If the medulla oblongata, which is essential to the maintenance of respiration, is absent, extra-uterine life is impossible. Stillbirth is the result. If the medulla

oblongata is present, although respiration and circulation are established, death commonly takes place within two or three days, and almost always within the first week. Convulsions sooner or later occur, ending in fatal coma.

CHAPTER II.

IMPERFECT BRAIN.

Between the absent and complete brain there are various grades of deficiency. Parts of the brain may be perfect, while other portions are either absent or imperfectly formed. The deficiency is usually in the superior parts of the brain, especially in the hemispheres of the cerebrum, while the base of the organ is perfect. Both hemispheres may be absent, or one may be absent, while the other hemisphere is shrivelled or rudimentary. Occasionally the cranium preserves its normal shape and size, in consequence of an increase in the cerebro-spinal fluid proportionate to the lack of brain-substance. The imperfect development is not then apparent to the observer. The rudimentary hemispheres in these cases are spread out, forming the walls of a sac inclosing the liquid. The post-mortem examination of the following case was made in the Nursery and Child's Hospital, of this city, in 1862.

Case.—Female; parentage healthy; she was plump and well formed at birth, and nothing unusual was observed in her condition, as she nursed and throve like other children, till she reached the age when there is, usually, the first manifestation of intelligence. With her there was no evidence of an intellect, or, if any, it was very indistinct. She nursed, or took food when placed in her mouth, but apparently without relish, as if instinctively. She never reached her hands towards the nurse, or towards playthings. So indifferent and apparently unconscious was she of objects around her, that it was thought for some time that she was blind. She never smiled, except when her hands were gently rubbed or shaken; and then the smile seemed to be a movement more reflex than emotional. The smile was immediately succeeded by a fixed vacant look. She usually lay quietly, with her arms crossed; and during the last months of her life she sometimes uttered a scream, like children with cerebral diseases. Her evacuations were regular, and she was not subject to vomiting, before she was attacked with the acute disease of which she died. The size of her head was rather less than usual at her age, but not less than is often seen in well-formed children. The forehead was small in proportion to the rest of the head, but the difference was not such as to attract attention. Fortunately, the existence of this idiot was terminated by an attack of enterocolitis at the age of about ten months.

Sectio Cadav.—The head was measured, but the measurements were lost. They did not seem to differ materially from the normal standard. The sutures were united, and the fontanelles nearly, if not quite, closed.

The frontal bone lay a little lower than the plane of the parietal. The meninges of the brain presented nearly their normal appearance, but were distended with transparent serum. The quantity of fluid was estimated at about two-thirds of a pint, and when it was evacuated, the floor of the lateral ventricles was brought into view. There was almost an entire absence of that part of the brain which lies above the floor of the ventricles. On close inspection, rudimentary cerebral hemispheres were found in a thin layer forming a part of the walls of the sac. The whole amount of brain-substance above the ventricle did not exceed the size of a small egg. The cerebellum, the base of the brain, and cranial nerves presented their usual appearance. The entire brain, after being a few days in diluted alcohol, weighed six and a quarter ounces.

In this case, the fluid was only sufficient to compensate for the deficiency of the brain. In other, and probably the larger number of cases of incomplete brain, the cerebro-spinal fluid is not materially increased. There is then but slight elevation of the frontal bone, the forehead is low, or retreating, or even almost absent. This is that shape of head which is universally regarded as characteristic of idiocy.

Symptoms.—The symptoms in cases of deficient brain relate to the mind. If the cerebral hemispheres are absent, there is no intelligence. The individual, as regards mental endowments, does not arise above the instincts of the lower animals. If the hemispheres are partially developed, there is a degree of intelligence proportionate to the amount of cerebral substance present. If the deficiency is confined to one side, there is no apparent lack of intelligence or mental capacity, since, the brain being a double organ, one side performs the function of both.

Prognosis.—The prognosis as regards life, in cases of imperfect brain, depends not so much on the amount of deficiency as the exact seat of arrested growth. If only the cerebrum is partially, or even entirely absent, the infant may live and thrive. But if those portions lying at the base of the brain, which control the functions of animal life, are lacking, or are imperfectly formed, life is very uncertain, and probably short.

It is evident that no therapeutic treatment can remedy a congenital deficiency. The services of the physician are not required. The philanthropic and patient teacher may impart a degree of intelligence to the idiotic, and the instruction of these unfortunates has of late years been very successful.

Microcephalus—Atrophy of Brain.

An abnormally small brain has usually been attributed to premature closure of the sutures and fontanelles by too rapid ossification. But in certain cases which I have met, there was no evidence of exaggerated ossification, and the fault seemed to me to be a difficiency in the growth of the brain, while the ossifying process was not exaggerated or was even less than normal. A normal development of the cranial bones, with but

little brain-substance to keep them apart, would necessitate early obliteration of sutures and fontanelles. Thus in August, 1878, an infant was brought into the Bureau for the Relief of the Out-door Poor, with marked microcephalism. Its age was 19 months, and the bone formation was so slow that only two teeth had appeared; the circumference of its head was 14½ inches; it had had repeated convulsions since the age of five months, and the mother stated that its head had been round and hard from its birth. In microcephalus, death, sooner or later, is the common result; life ends in convulsions and coma.

Again, the brain of the child, when undergoing development, with the cranial bones sufficiently yielding, may not only cease to grow, but may even diminish in size, in consequence of protracted and exhausting diseases. Diminution in the size of the brain occurs especially after fevers and diarrhœal affections of long standing and attended with much emaciation. The waste of the brain corresponds with the general loss of flesh. If the cranial sutures are not united, the occipital and sometimes the frontal bones are depressed, according to the diminished size of the brain, and are overlaid by the parietal. In foundlings of two or three months, this loss of brain-substance is often very striking. In infants of this class who have died of protracted diarrhœa, it is not unusual to observe the occipital bone not only depressed, but extending one, two, or even three lines underneath the parietal.

If the child with shrunken brain, from protracted and exhaustive disease, is old enough to express its thoughts, it often seems foolish, talks but little, and perhaps says the same thing over and over again. In one case in my practice, a little girl, having passed through a long course of typhus, persistently repeated during her convalescence, with a silly smile, the questions addressed to her. This peculiarity continued two or three weeks, although her appetite was good, and her restoration to health rapid. In another case a little boy, during convalescence, was wont to laugh heartily at the appearance of the ordinary articles of furniture in the room. Both showed more impairment of mind during convalescence than in the midst of the fever. The friends of such children are in a state of great anxiety lest their minds are permanently enfeebled, but, as the appetite and strength return, the nutrition of the brain is re-established, and the mind regains its former vigor. In cases of wasted brain, with cranial bones united, the deficiency is supplied by serous effusion, which is gradually absorbed as the health of the patient is re-established, and the brain enlarges. This effusion occurs not only over the convexity of the brain, but also at its base, and sometimes in the ventricles. Dr. West states that in atrophy of the brain, from protracted disease, its texture is firmer than usual. I have not noticed this in infants, but my attention has not been directed particularly to this point. It is probable that there is some change in the anatomical character of the brain, aside from mere waste.

Partial atrophy of the brain sometimes, also, occurs from primary disease located in this organ; the affected portion wastes, while the rest retains its normal development.

CHAPTER III.

HYPERTROPHY OF BRAIN.

In contrast with atrophy of the brain is the opposite state, or hypertrophy. The size of this organ within the limits of health varies greatly in different individuals, but sometimes there is so great an increase in volume as properly to constitute a disease.

Pathological Anatomy.—The excess of growth which characterizes this disease has been ascertained to be confined to the white portion of the brain, and ordinarily to that part contained in the cerebral hemispheres. Hypertrophy of the brain is attended by induration, which exists in different degrees in different cases. It is in some so slight as to be scarcely appreciable; while in others it is apparent at once by pressure with the finger, or incision with the scalpel. Rilliet and Barthez state that the induration in some cases resembles in degree and appearance that produced by the action of alcohol. The white substance of the cerebrum is not only resisting and elastic, but its color is unusually pale; it presents even a brilliant or polished appearance. At the same time the gray substance is more or less faded, and its depth in the convolutions is less than in the normal state of the organ. Rokitansky says: "The cineritious matter is generally of a pale grayish-red color. The medullary is always dazzling white, and remarkably pale and anæmic." An unusual case is related by Burnet, in which the gray substance in the corpora striata retained its usual color, and was indurated like the white substance. In exceptional instances the cerebellum as well as cerebrum undergoes hypertrophy, becoming at the same time more or less indurated. In Burnet's case there was induration of the optic nerves. "The internal structure," he says, "of the optic nerves, especially in their bulbs, had the polish, homogeneous appearance, elasticity, and almost the hardness of cartilage." Rilliet and Barthez state that in two cases the spinal cord presented even more marked induration than the encephalon. Congestion is not a feature of hypertrophy. On the other hand, there is often less vascularity of the brain and its membranes than in the healthy state. If the cranial bones are completely ossified at the time when hypertrophy commences, and firmly united, enlargement of the brain is partially prevented. The convolutions are then thin, much flattened, the sulci more or less effaced, the

membranes pale and dry, and the ventricles are small and nearly destitute of serum. At the autopsy of such a case, when the dura mater is incised, the expansion of the brain prevents the proper refitting of the skull-cap. Occasionally hypertrophy causes more or less absorption of the cranium, and perhaps the sutures already united are pressed apart.

If hypertrophy commences in young infants with the fontanelles and sutures still open, they usually remain open, or are a long time in uniting. The interspaces continue, not only in consequence of the growth of the brain, which tends to separate the bones, but also in consequence of feeble ossification. The shape of the head arrests attention. Hypertrophy usually produces most enlargement between and above the ears, while the frontal portion of the head, though somewhat enlarged, is less developed.

The direction of the eyes is not changed, as is common in congenital hydrocephalus.

Rokitansky says (vol. iii, page 285): "With regard to the question to be decided by the theory and microscopic examination, as to the nature of the added material upon which the increase of volume depends, I have formed the following opinion from repeated investigations:—

"1. The disease is genuine hypertrophy.

"2. It consists, as such, not in an increase in the number of nerve-tubes in the brain, from new ones being formed, nor in an increase in the dimensions of those which already exist, either as thickening of their sheaths, or as augmentation of their contents, by either of which the nerve-tubes would become more bulky; but,

"3. It is an excessive accumulation of the intervening and connecting nucleated substance."

It is now generally admitted that the views of Rokitansky are correct; that hypertrophy of the brain is due to an augmentation in the amount of connective tissue, which lies between and unites the tubules.

Causes.—Hypertrophy of the brain results from an error in the nutritive process which sometimes seems to be associated with the rachitic state, or a condition analogous to rachitis. It is not common, is indeed rare, in this country, and is more common in countries like England, where rachitis is more prevalent than with us. Rilliet and Barthez consider frequent congestions of the brain as a common cause. The hypertrophy is most frequently met in hospitals for children, and among the poor of the cities, whose systems are rendered cachectic by residence in damp and dark localities, and by unwholesome diet. In the deep valleys of Switzerland, and in parts of South America and Asia, hypertrophy of the brain is common, under the name cretinism. It is associated with rachitis and stunted growth. The abnormal development which occurs in cretinism begins in infancy or early childhood, and the unfortunate subjects of it are short-lived. Cretinism has been attributed to a residence in localities wet and deprived in great measure of solar light, and to

general disregard of the laws of health on the part of those affected as well as their parents.

The observations of different physicians also establish a connection between some cases of hypertrophy and the saturation of the system by lead. In what way lead-poisoning leads to hypertrophy is obscure, but the concurrent testimony of different observers is so strong, that we cannot doubt that it does sometimes have that effect. But in a considerable proportion of cases, as in the two presently to be related, the cause is obscure.

Symptoms.—The symptoms, as is the case with most organic diseases of the brain, vary considerably in different cases. Sometimes there is, at first, more or less depression or languor. If the child is old enough to speak, he may complain of pain in the abdomen or limbs, evidently neuralgic, or of headache. After a variable time vomiting succeeds, and finally convulsions, affecting the muscles of the face, as well as extremities; the convulsions are usually clonic, but sometimes, as regards at least the extremities, of a tonic character. The pupils may be contracted or dilated; there is restlessness alternating with drowsiness, and finally coma succeeds.

Hypertrophy may continue a considerable time before serious symptoms arise; but when once developed, these symptoms ordinarily continue with more or less severity till death. Death commonly results within a week after their commencement, but sometimes not till several weeks have elapsed. When death occurs at an early period in the disease, there is usually firm ossification and union of the cranial bones, and, therefore, but moderate enlargement of the cranium.

If hypertrophy commences at a period not far removed from birth, the bones, of course, yield more readily to the pressure, and acute symptoms do not occur so soon. After a time, however, in all or nearly all cases, convulsions supervene. These indicate the gravity of the disease, and are prognostic of its fatal termination.

In a patient observed by Burnet, violent convulsions, followed by loss of consciousness, marked the commencement of acute symptoms. Five days subsequently, the following symptoms were recorded: mobility of the eyes, without expression; pupils contracted, and directed upwards; divergent strabismus of the left eye; the senses in their normal state, with the exception of sight; the limbs move by volition. For a month there was little change. Then occurred drowsiness, and increased prostration, and five weeks later the child succumbed with the symptoms of double pneumonia.

Such is the clinical history of hypertrophy. In cases of firm ossification of the cranial bones, and therefore, no marked enlargement of the skull, the symptoms are similar to those which occur if the dimensions of the head are increased, only compression and death result sooner.

The following case, in which the sutures were firmly united, I attended

in 1864. The head was large, but not so large as to attract attention from its disproportion :—

Case.—A boy, aged two years and two months, had, when about one year old, intermittent fever, and since then his countenance was uniformly pallid, and his flesh soft. Weaned at the usual time, he remained well till the 1st of January, 1864. In the beginning of this month he was observed to be feverish for some days, and his appetite poor. His health then gradually improved, and he was thought to be entirely well.

On the 26th of February he was suddenly seized with convulsions, general at first, but most severe and continuing longest on the left side. The convulsions lasted a little more than three hours. He recovered fully his consciousness by the following day, but his appetite remained poor; he was no longer amused by his playthings, and was very fretful. The surface was pallid; bowels constipated; pulse but little, perhaps not at all, accelerated. He continued in this state till the 6th of March, when he had another slight convulsive attack, and from this time he never fully recovered his consciousness. He was fretful if disturbed, his face generally pallid, while the pulse and respiration were not perceptibly altered.

On the following day, the 7th, the left pupil was somewhat larger than the right, but both were sensitive to light. The difference in size continued till near the close of life. Although vision was imperfect, if not altogether lost, the sense of hearing was not impaired.

When questioned, he uniformly answered, "No," with a drawling voice, evidently not understanding what he said.

As the disease advanced, the respiration became at times sighing; but the rhythm of the pulse was not materially altered. The temperature of the surface was changeable, sometimes cool, sometimes warm, and the congested spots or patches, so common in cerebral affections, were also observed at times on the face, ears, or forehead. Through most of his sickness he took drinks readily, and the urine was freely discharged, probably from the iodide of potassium, which he took in one and a half grain doses every two hours.

He became more and more drowsy, again had slight convulsive movements, and finally died, with much apparent suffering, on the 14th of March. The pulse became more accelerated during the last two or three days. On the day preceding his death, the pupils were contracted, and not affected by the light.

Sectio Cadav.—Body somewhat emaciated, and eyes sunken; occipito-frontal circumference of head nineteen and a half inches; distance from one auditory meatus to the other over the vertex, thirteen and a half inches; convolutions over the surface of the brain much flattened and compressed; brain generally deficient in blood; medullary substance firm, and of a pure white color; meninges healthy; no other abnormal appearances were observed; weight of brain forty-two ounces.

In the following interesting case, the diagnosis was for months doubtful, though it was evident that the disease had a cerebral origin :—

Harry R. L., of healthy parentage, was well till the summer of 1876, when he was nearly at the close of his third year. At this time he was observed to be feverish and fretful, and his features were flushed at times. He also complained almost daily of pain in the top of his head, which pain was intermittent, and these attacks of headache occurred for at least six

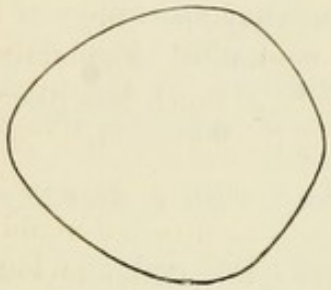
months, perhaps longer. There had been no backwardness in dentition, and no symptoms of rachitis or struma, and his nutrition was good, even after the commencement of the present malady.

In February or March, 1877, his stomach became irritable, so that he vomited often during the following months, and about the same time he began to lose the use of all his limbs—a progressive paralysis—and his bowels became constipated. Both urination and defecation were sluggishly performed.

In July, 1877, he ceased to walk, and he has not been able to stand since.

On March 29th, 1878, the following records were made: No improvement, but a gradual increase of most of the symptoms; lies constantly, and produces but little movement of his limbs, though sensation seems to remain in them; his eyes are clear, and pupils moderately dilated, but without vision; how long his sight is lost is not known; axis of eyes not depressed, or otherwise changed, and parallelism is retained; the cranium, which, during the first year of his sickness, underwent little change, has expanded rapidly during the last six months; the enlargement is most marked above the ears; the occipito-frontal circumference is represented in the accompanying diagram: this circumference measures $21\frac{1}{2}$ inches, of which $9\frac{3}{4}$ are in front of the ears, and $11\frac{1}{3}$ inches posterior to the ears; distance over vertex from one auditory meatus to the other $15\frac{1}{4}$ inches. The anterior fontanelle is observed to be open, though small, the diameter being about one-fourth or one-third of an inch: it is not elevated, and the surrounding edge of bone is flexible.

Fig. 18.



From the clinical history, the shape of the head and the unchanged axis of the eyes, it is believed that the above is a case of overgrowth of the brain, rather than of chronic hydrocephalus.

Diagnosis.—The diagnosis of hypertrophy is not always easy. The symptoms are, in the main, such as occur in other pathological states, especially congenital hydrocephalus. There is most danger of mistaking the overgrowth for this disease. Hypertrophy has, indeed, often been treated for hydrocephalus. There are, however, certain signs by which we may distinguish one from the other. In the ordinary form of congenital hydrocephalus, even when the amount of liquid is small, the orbital plates of the frontal bones are pressed in such a way that the axis of the eyes is changed so as to have a downward direction. The white of the eye can be seen between the iris and the upper eyelid. This gives a characteristic and striking expression to the face. The exception to this is in those rare cases in which the liquid is external to the brain. In hypertrophy this peculiar change in the axis of the eyes does not occur. Moreover, in hypertrophy there is not that uniform expansion of the head which is observed in hydrocephalus, as has been stated above. There are, commonly, greater enlargement, more prominence of the anterior fon-

tanelle, and wider separation of the cranial bones, in hydrocephalus than in hypertrophy.

Hypertrophy with consolidation of the cranial bones, and, therefore, little enlargement of the head, may be mistaken for meningitis. The history of the case, and the means by which we diagnosticate the latter affection, which will be described in their proper place, will usually enable the physician to make a correct diagnosis.

Prognosis.—In forming an opinion as to the probable termination of the disease, we must have regard to the age and general condition of the child, as well as to the degree of hypertrophy. If the disease commences at an early age, when the cranial bones are not firmly united, it is probable that there will be no compression of the brain, so as to endanger life, for a considerable period. We may then hope by proper measures to remove the constitutional state which gives rise to the hypertrophy, before the enlargement is such as to cause cerebral symptoms. If the bones have already united when the disease commences, even slight hypertrophy will produce symptoms, and a speedily fatal result is inevitable. Evidently, also, a child in a marked degree rachitic or scrofulous is much less likely to recover than one whose general health and constitution are less impaired.

Treatment.—The treatment in hypertrophy should be directed mainly to the constitution. Measures calculated to improve the nutritive process are those most likely to check the abnormal growth of the brain. As the disease is one of perverted nutrition, and usually coexists with a vitiated or impoverished state of the blood, tonic and alterative remedies are required. The syrupi ferri iodidi is, therefore, useful, as it is both tonic and alterative. This may be given in doses of three or four drops to a child one year old, three times daily. Cod-liver oil, with or without the iron, is beneficial in some cases. Another remedy is iodide of potassium in combination with a tonic, as the compound tincture of bark.

℞. Potas. iodid., ʒj;
Tinct. cinchon. comp.,
Syr. limon., āā ℥ij. Misce.
One teaspoonful, three times daily, to a child of three years.

The hygienic treatment is not less important than the medicinal. There is little hope of a favorable issue in any case, unless the regimen is such as will conduce to a more robust and healthy state of system. The diet should be plain and nutritious, the apartments clean and airy, and all undue excitement should be avoided.

CHAPTER IV.

THROMBOSIS IN THE CRANIAL SINUSES (PHLEBITIS).

The formation of fibrinous coagula within a vein or sinus is designated thrombosis (*thrombus*, clot). Coagulation of fibrin in the cranial sinuses occasionally occurs, constituting a very serious pathological state. This may result from local disease in the sinuses or in their vicinity, or from disease external to the cranium. The immediate cause of thrombosis, whatever its location, is sufficient arrest of the circulation to allow the fibrin to coagulate.

Tubercular and enlarged bronchial glands, compressing more or less the venæ innominatæ, or the descending vena cava, sometimes give rise to thrombosis in the cranial sinuses, the fibrin coagulating in consequence of retardation in the current of blood. I have known thrombosis, in the same situation, also to result from clonic convulsions, occurring in connection with severe spasmodic cough in pertussis, since both the cough and convulsions retard the flow of blood in the veins and sinuses within the cranium. At the post-mortem examination of at least four such cases I found whitish clots in the lateral sinuses.

Thrombosis, in the cranial sinuses, may also occur from inflammation, either in the walls of the sinuses or immediately exterior to them. This is the disease which writers have designated phlebitis of the cranial sinuses, and for a correct understanding of the morbid anatomy of which the profession are indebted to Virchow.

Anatomical Characters.—If a child die with the cranial sinuses and the veins of the brain and of the meninges in their normal state, the blood in these vessels is found at the autopsy dark but liquid, or there are small, dark, and soft clots in the larger sinuses. If there were congestion, but no coagulation, in these vessels in the last hours of life, the clots are more numerous, larger, and longer, sometimes extending from the sinuses into the larger veins which empty into them, but they are still dark and soft, readily falling to pieces when handled. If, again, there have been that degree of congestion and stasis which has resulted in ante-mortem coagulation, or in thrombosis, the clots are, in part at least, whitish, and of a fibrinous or gelatinous appearance; they were formed while the red corpuscles were still carried along in the circulation.

Most of the clots in thrombosis are free, while others are attached lightly to the internal surface of the sinus; occasionally they are so large

as to distend the vessel. They extend also in many cases into the cerebral veins which connect with the sinuses, producing prominence and firmness, so as to resemble (Rilliet and Barthez) an artificial injection. The clots do not present a uniform character. In parts of a sinus they consist of almost pure fibrin, of a yellowish-white color, while in other portions they present a gelatinous appearance from the large number of white corpuscles, while other portions are more or less tinged from the presence of red corpuscles. The central part of the clot, after a time, if the case is sufficiently protracted, softens, and presents a puriform appearance. This substance, which is only disintegrated fibrin, was supposed to be pus, till the microscope revealed its true character. It is obvious that small clots forming within a sinus, and having no attachment to its walls, are liable to be carried by the current of blood into the general circulation, unless there is complete obstruction. Virchow has also shown how a thrombus may extend, by gradual prolongation, nearer and nearer the heart, so that one commencing in a sinus may, after a time, reach into the jugular vein. Different observers, as M. Tonnelé, and also Rilliet and Barthez, have traced the fibrinous masses as far as the cava. The latter writers relate the case of a girl, four and a half years old, in whom the sinuses on the left side, especially those nearest the petrous portion of the temporal bone, were completely filled with clots of a yellowish-white color, intermixed with central dark spots. Similar coagula were also found in the left jugular vein as far as the brachio-cephalic trunk. Whether the walls of the sinus undergo any change depends on the nature of the disease which causes the thrombosis. If it be phlebitis, the coats are thickened from infiltration and injected, and the internal coat has lost its polish. If it be some obstructive disease in the course of the circulation, or a general cause, the coats of the vessel are unaltered, except that they may be stained by imbibition of the coloring matter of the blood. In an infant who died of this disease in the practice of Dr. West, "the sinuses on the left side were healthy, but the blood was almost entirely coagulated. The posterior half of the longitudinal sinus, the torcular, the left lateral, and the left occipital sinuses, were blocked up with fibrinous coagulum, precisely such as one sees in inflamed veins, and the clot extended into the internal jugular vein. The coats of the longitudinal, and of the inner half of the lateral sinus, were much thickened, and their lining membrane had lost its polish, was uneven, and presented a dirty appearance."

The mode in which congestion and coagulation occur within a sinus, in consequence of the pressure of a tumor upon this vessel, or upon a vein into which the blood from this sinus flows, is sufficiently obvious. The mode of the production of thrombosis, as a result of clonic convulsions, or of the spasmodic cough of pertussis, is also apparent. How it results from inflammation of the walls of a sinus, that is, from phlebitis, was not understood till explained by Virchow.

The fibrinous coagula which fill the sinus are not an exudative product, as was formerly supposed. Inflammation (in most cases otitis, with caries of the petrous portion of the temporal bone) approaches a sinus. The inflammatory products pressing against the walls of the sinus diminish its calibre at that point, and hence the retardation of the current of blood and the coagulation. Or the walls of the sinus may be thickened by inflammatory infiltration, or even by the formation of little abscesses within the coats in consequence of the inflammation, so as to produce bulging inwards, and the result, as regards the circulation, is the same. Whether, therefore, the inflammation occur without a sinus, or within its walls, thrombosis equally results, provided that the diameter of the vessel is sufficiently narrowed by the presence and pressure of inflammatory products.

There is no exudation on the internal surface of a sinus or vein when inflamed, as there is upon serous surfaces. "On the contrary" (*Cellular Pathology*, translation, p. 236), "when the wall is inflamed, the exuded matter (exsudatmasse) passes into the wall, which becomes thicker, cloudy, and subsequently begins to suppurate. Nay, even abscesses may form which cause the wall to bulge on both sides like a variolous pustule, without any coagulation of the blood ensuing in the cavity of the vessel. At other times, certainly, phlebitis, properly so called (and in like manner arteritis and endocarditis), is the cause of thrombosis, in consequence of the formation of inequalities, elevations, depressions, and even ulcerations upon the inner wall which favor the production of the thrombus. Still, whenever phlebitis, in the usual sense of the word, takes place, the alteration in the coat of the vessel is almost always a secondary one, and, indeed, occurs at a comparatively late period."

This view of the pathology of thrombosis comports with facts observed at autopsies, and which cannot be explained according to the old theory of phlebitis, namely, smoothness of the internal surface of the sinus; natural color of this sinus, or simple staining from blood; the non-attachment or slight attachment of the coagula, etc.

Causes.—Some of these have been already stated at the commencement of this article. It is evident from what has been said that this disease may be produced by any cause which obstructs the return circulation from the head. I have already alluded to tumors which press upon the sinus, or on the vein below the sinus, as a cause. Among the causes may be mentioned also abdominal tumors, narrowing of the chest from rachitis, or caries of the vertebræ, and, finally, compression of the jugular vein by a retropharyngeal abscess.

Sufficient allusion has already been made to inflammation of the internal ear as a not infrequent cause. Thrombosis is, indeed, one of the dangerous results of chronic otitis. Another cause is a reduced or cachectic state of system, apart from any local or obstructive disease. It is a noteworthy fact that a large proportion of those affected with thrombosis, even when it is

immediately due to obstructive disease, are cachectic. The explanation of this fact is not difficult. In reduced states of the system the action of the heart is feeble, and passive congestion of the vessels within the cranium is apt to occur. Passive congestion of the veins and sinuses in protracted diarrhœal maladies, which is described in our remarks upon another disease, is an example in point. In this state of feeble circulation very slight obstructive disease may be sufficient to cause thrombosis.

Symptoms.—The symptoms of this disease are often obscure. All of them may and do occur in other maladies of the encephalon. In cases related by M. Tonnelé, cerebral symptoms were well marked, such as faintness, dilation of the pupils, strabismus, grinding the teeth, convulsive movements. There may be an almost total absence of such symptoms as would direct attention to the state of the head. This is due to the sudden occurrence of death after the clots have formed in the sinuses. If the clots are large, death soon results in consequence of congestion of the brain and meninges, which is proportionate to the amount of obstruction. Extravasations of blood and transudation of serum not infrequently accompany the congestion and hasten the result.

Dr. West relates the case of a girl who had a mild attack of scarlet fever at the age of eight months, and did not fully recover her health. She continued restless and feverish, and had two violent convulsions two weeks after the scarlatina. In the following months she had anasarca, and when she was nearly a year old another attack of convulsions occurred. Fluctuation was now observed in the abdomen, and in a few days a sero-purulent fluid began to escape from the umbilicus. When this discharge had continued eleven days, symptoms of a liquid in the right pleural cavity were suddenly developed. She grew weak and emaciated, and finally was seized with extreme faintness, with which she died in forty-eight hours, at the age of thirteen and a half months.

At the post-mortem examination a large amount of pus was found in the abdominal and right pleural cavities. On the right side of the cranium, the sinuses were filled with coagula, and their coats seemed healthy. The left lateral and occipital sinuses, the torcular and part of the longitudinal sinus, also contained coagula, which extended into the jugular vein. The walls of the longitudinal sinus and the internal part of the lateral sinus were thickened, and their inner surface had lost its polish and was uneven. There was congestion of the brain, with points of extravasated blood. If, as is probable, the convulsions were due to some other cause, the only symptom which was clearly referable to the thrombosis was the sudden faintness. In the four cases of thrombosis occurring in pertussis, already alluded to, in which I was enabled to ascertain by post-mortem examination the presence and extent of the clots, the symptoms, which were apparently due to the thrombosis, were those of cerebral congestion. Among these symptoms, stupor, and finally coma were prominent. The

convulsions which occurred in both cases were apparently a cause, and not a result, of the thrombosis.

Diagnosis.—It is evident, from what has been said, that thrombosis of the cranial sinuses can rarely be diagnosticated with certainty. The pre-existence of otitis will sometimes lead us to suspect its presence, especially if the otitis has been accompanied by deep-seated pains. Symptoms of cerebral congestion, serous effusion, or apoplexy, occurring in connection with otitis, protracted convulsions, or glandular or other tumors situated so as to compress the vessels which return blood from the brain, indicate thrombosis.

Prognosis.—The prognosis, in any case, is obviously unfavorable. The cause is, ordinarily, permanent, or not readily removed, so that the clots gradually increase. If the cause is a local obstructive disease, death is almost certain, since, in nearly every instance, the obstruction is of such a nature that it cannot be removed by medical or surgical treatment. It is possible that recovery may take place if the clots are few and small, and the cause of the thrombosis is mainly feebleness of circulation in consequence of a state of debility. We know that clots may liquefy, and their elements re-enter the circulation; but such a result of thrombosis in a cranial sinus, if it ever occurs, is rare. The thrombus, by its presence, serves as a point of attachment around which more fibrin coagulates, so that the obstruction gradually increases till death occurs.

Treatment.—Thrombosis should be treated by cool applications to the head, in order to diminish the congestion, by stimulants and sustaining measures in case the systolic movement of the heart is feeble. Tonics, vegetable or ferruginous, are indicated if there is a cachectic state.

CHAPTER V.

CONGESTION OF THE BRAIN.

Congestion of the brain is not peculiar to infancy and childhood, but is much more common in these periods of life than subsequently. This is due, in a great measure, to the fact that in the young the circulation is more readily disturbed by moral as well as physical causes than in the adult.

Congestion of the brain is occasionally primary; more frequently it occurs as a concomitant or sequel of some other affection. Diseases, whether constitutional or local, which in the adult have no appreciable effect on

the vascularity of the brain, often cause in the child a decided increase of blood in this organ.

CAUSES.—Cerebral congestion is of two kinds, active and passive. The former results from a cause which directly affects the brain, and increases the flow of blood towards it, or from a cause operating primarily on the heart, and increasing the frequency and force of its systolic movement; the latter is due to some obstruction in the course of the circulation, or to feeble propelling power on the part of the heart.

Among the causes which most frequently produce ACTIVE congestion of the brain in the child, may be mentioned blows or falls on the head, excessive fatigue or excitement, heat, perhaps sometimes dentition, and also various inflammatory and febrile affections, especially in their first stages.

Cerebral symptoms occurring in the course of an essential fever are no doubt often due, in a great measure, to the irritating effect on the brain of the specific principle, whatever it may be, circulating in the blood. Occurring in inflammatory diseases which are located elsewhere than within the cranium, they are often attributed to functional disturbance of the brain. The brain, it is said, sympathizes with the affected part through the system of nerves which unite them. But observations show that symptoms referable to the brain, arising in the commencement of the essential fevers and of the phlegmasiæ, are in many instances preceded by, and are therefore, doubtless, in greater or less degree dependent on, hyperæmia of this organ.

Difficult as it is to ascertain the state of the brain in many diseases in which it is involved, we may determine whether or not there is congestion in the young child by observing the anterior fontanelle. If it be elevated and tense in an acute disease, hyperæmia is indicated. Now, it is often unusually prominent in fevers and inflammations, especially in their first stages, when cerebral symptoms are present. Its elevation, under such circumstances, is obviously coincident with cerebral congestion.

The acute inflammations which are most likely to be attended by cerebral congestion are those of the mucous surfaces and pneumonia. Severe coryza, tracheo-bronchitis, entero-colitis, and colitis, commencing suddenly with great febrile excitement, are frequently accompanied in their initial stage by active congestion of the cerebral vessels. Cases like the following, which I find in my note-book, are not infrequent. An infant four months old had been sick about two days with coryza and bronchitis, when I was called to see it; the pulse numbered 156; respiration 64; nursed, and was somewhat restless; cough frequent and dry; bowels moderately relaxed. The mucous membrane of the fauces was injected, and coarse mucous râles were present in the chest. The anterior fontanelle rose above the level of the cranium, and pulsated forcibly. Soon after convulsions occurred, which were relieved by appropriate measures, and on the follow-

ing day the fontanelle had subsided. The patient gradually recovered without any untoward symptom.

Cerebral congestion and convulsions often mark the initial stage of active intestinal phlegmasiæ. This is especially true of dysentery. The little patient, perhaps from the very inception of the colitis, is drowsy; its surface hot; pulse full and rapid. There is sudden and momentary starting or twitching of the limbs. The anterior fontanelle, if still open, is elevated, and it is not till the lapse of several hours that the cause of these symptoms is apparent from the occurrence of bloody stools.

The causes of passive congestion of the brain are very different from those of the active form. A common cause is obstruction in a sinus or vein by a fibrinous concretion, or by a tumor or abscess external to it.

I have occasionally met cases in which this form of cerebral congestion appeared to be plainly referable to obstruction to the return of blood from the brain by the pressure of bronchial glands, enlarged by hyperplasia in tubercular disease, these bodies diminishing by external pressure the calibre of the venæ innominatæ or the descending vena cava. Rilliet and Barthez have called attention to such cases in the clinical history of tuberculosis. The following case may be cited as an example; it occurred in the infant's service of Charity Hospital, in this city, in April, 1866.

An infant, about one year old, affected with tuberculosis, both bronchial and pulmonary, was observed, during the ten days preceding its death, to bore the pillow with its head almost constantly, so as to wear the hair from the occiput. This movement of the head was the only prominent cerebral symptom. Nothing abnormal was noticed in the appearance of the eyes, nor was the stomach irritable. A spasmodic cough and progressive emaciation attracted attention, but these were referable to the tubercular disease. At the autopsy we found the cerebral sinuses, veins, and capillaries greatly congested. On tracing the veins which return blood from the brain, an inflamed and enlarged bronchial gland was discovered in the angle formed by the convergence of the right and left venæ innominatæ. This gland, which contained but a single point of cheesy degeneration, had attained such a volume by proliferation of its cells that it pressed upon both vessels, so that it had obviously retarded the circulation in each, and given rise to cerebral congestion.

Passive congestion often occurs in the infant at birth, either from tediousness of the labor or delay in the expulsion of the body after the birth of the head. If it is simple congestion, and not congestion with hemorrhage, it soon passes off. Passive congestion of the brain also occurs in severe paroxysms of hooping-cough, in which return of blood from this organ is temporarily retarded. All are familiar with the congestion which occurs in parts external to the cranium, from the severity of the cough; producing epistaxis, extravasations under the conjunctiva, etc. The extracranial obviously indicates the presence and degree of cerebral congestion.

Those who practise in malarious regions sometimes meet cases of dangerous passive congestion of the brain, the result of malaria, occurring especially in the cold state of intermittent fever. In these cases the surface is pallid, its temperature reduced, and the pulse feeble. The blood, leaving the peripheral vessels, collects in undue quantity in the internal organs, producing congestion of the brain, as well as of the thoracic and abdominal viscera. In the child with malarial disease, in whom there is less vigor of constitution than in the adult, death not infrequently occurs in this passive congestion. Two such cases have occurred in my practice, although in this latitude the malarial maladies are mild in comparison with the type which they present in many parts of the United States.

Symptoms.—The symptoms of active congestion of the brain are stupor, great heat of head, throbbing of carotids, restlessness when aroused, twitching of the limbs, and perhaps convulsions. There is also sometimes intolerance of light, and the anterior fontanelle, if open, pulsates strongly. In passive congestion many of the symptoms are the same as in the active form. Stupor, twitching of the limbs, and fretfulness or irritability when the patient is disturbed, are common, ordinarily without increase of temperature; the surface may, indeed, be cool, and the face is not flushed nor the eyes injected. The strong pulsation and elevation of the anterior fontanelle, so conspicuous in active congestion, are—the former always, the latter often—lacking. In both forms there is tendency to constipation.

In many cases the symptoms of congestion of the brain are associated with others which proceed directly from the cause of the congestion, but it is not difficult, unless in exceptional instances, to determine which are due to the congestion, and which to the antecedent and coexisting pathological state.

Anatomical Characters.—In active congestion there is an excess of arterial blood in the brain and its membranes. The arteries, to their minutest branches, are seen to be full, presenting the bright hue of oxygenated blood. In passive congestion the sinuses and veins are distended. The pia mater, choroid plexus, and the vessels of the brain, have a darker appearance than in active congestion. In both forms of congestion, if they continue for a little time, other anatomical changes occur. If there is great distension of the capillaries, these vessels are apt to give way, and we find here and there little patches of extravasated blood. In other cases the over-distension is relieved by the transudation of the serous portion of the blood through the coats of the vessels. The cephalo-rachidian fluid is then found in excess external to the brain and in the ventricles.

Prognosis.—The duration and the result of congestion of the brain depend, in great measure, on the nature of the cause. If the cause is trivial, as mental excitement, fatigue, exposure to heat, there is usually prompt relief if the condition of the patient is understood and properly treated. If the cause is general or constitutional, as one of the essential fevers or

hooping-cough, or if it is local, but its seat external to the cranium, the prognosis, so far as the congestion is concerned, is not unfavorable, if there is a timely and judicious use of remedies. The most unfavorable cases are those in which the cause is seated in the encephalon, and those in which there is some obstructive disease in the course of the circulation. Congestion occurring from a structural change within the cranium is, from the nature of the cause, without remedy, and ordinarily fatal. Obstructive diseases of the circulatory system, wherever located, being for the most part permanent, give rise, as a rule, to incurable congestion.

Congestion of the brain, if it is not relieved in a few hours, becomes less and less amenable to treatment. It soon passes beyond the resources of our art, and ends in coma; it is seldom protracted beyond a few days. Extravasations of blood common in active congestion, and serous effusion common in the passive form, diminish the chances of a favorable result.

Treatment.—The indication for treatment in *active* congestion is plain. Measures should be employed which have a derivative effect from the brain. Unless there is an asthenic primary affection, in the course of which the congestion is developed, active purgation is required. A saline purgative is ordinarily preferable. If the stomach is irritable, there is no better purgative than calomel. In all cases of active congestion, whatever the cause, the bowels should be kept open. It is often better not to wait for the tardy action of a cathartic, but to give at once an enema of soap and water or salt and water. External derivative agents are also indicated. A warm mustard foot-bath, sinapisms to the back of the neck or chest, and to the feet, and cold applications to the head, are measures which should never be neglected.

This treatment, if employed early, will relieve the congestion in a large proportion of cases; but if there is no improvement, if the child is robust, and if the primary affection be such as does not contraindicate loss of blood, leeches should be applied to the temples or some part of the head. If after the lapse of some hours cerebral symptoms continue, apoplexy or serous effusion has probably occurred. Congestion is then no longer the prominent lesion, and it is proper to designate the disease by another name.

The treatment appropriate to *passive* congestion is somewhat different; cold applications to the head, and those of a derivative nature to the extremities, are useful. As this form of the disease is not primary, but is dependent on some antecedent pathological state, it is evident that it can only be treated successfully by removing or obviating as far as possible the cause. But the nature of the various obstructions to the intracranial circulation is such that our ability to accomplish this end is very limited.

If the cause is constitutional, or if it be some disease in the neck or chest, it may sometimes be partially or even wholly removed, but if seated

within the cranium it is beyond our control. In general, it may be said that depletion is not required or tolerated in passive congestion, and stimulants are often needed.

CHAPTER VI.

INTRACRANIAL HEMORRHAGE (MENINGEAL HEMORRHAGE. CEREBRAL HEMORRHAGE).

Hemorrhage within the cranium is not very infrequent in infancy and childhood; and there is no part of the encephalon, whether the meninges or brain, in which it does not sometimes occur. If the blood is extravasated upon the surface of the brain or between the meninges, the disease is designated by writers meningeal apoplexy; if in the substance of the brain, cerebral apoplexy. Extravasation may also occur in one of the lateral ventricles. This may, for convenience, be described as a form of meningeal apoplexy.

Causes.—Apoplexy is usually (there is an exception) preceded by congestion. If the congestion increases to a certain degree, the distended capillaries give way and extravasation of blood results. Therefore the causes of congestion which have been enumerated in the preceding article are, in great measure, those of apoplexy. Recent microscopic examinations have demonstrated that the corpuscular elements of the blood may escape from capillaries without rupture. While, therefore, it is probable that intracranial hemorrhage in early life commonly occurs from a rupture, its occasional occurrence through the walls of the capillaries must be admitted.

Intracranial hemorrhage is not infrequent in the new-born. It results in them from tediousness of the birth and severity of the labor-pains. At first there is extreme congestion of the meningeal and cerebral vessels corresponding with that of the scalp and face. This congestion, continuing, soon ends in extravasation of blood. In some of these cases forceps have been used to effect the delivery, but it is doubtful whether the use of instruments materially increases the congestion or the amount of extravasation. Certainly, in a large proportion of intracranial as well as supracranial hemorrhages of the new-born, instruments have not been used. An additional cause of the hemorrhage is, in some instances, the use of ergot, which, by producing strong and continuous pains, interrupts the placental circulation and increases the congestion of the fœtal veins and the capillaries.

In infants a few days old intracranial hemorrhage may result from that rapid and fatal disease, tetanus infantum. The hemorrhage is preceded by intense passive congestion, which the tetanic rigidity and spasms produce by obstructing respiration and circulation. Few cases of tetanus infantum occur without more or less extravation of blood, either meningeal or cerebral. Another cause of this disease is obstruction in the vessels which return the blood from the brain. The various structural changes which produce this obstruction, in different cases, have been sufficiently described in our remarks on cerebral congestion and thrombosis.

The congestion which precedes hemorrhage, when occurring under the conditions described above, is passive.

Among the causes which produce hemorrhage through the intermediate state of active congestion may be mentioned great mental excitement, of which M. Legendre relates a case, lengthened exposure to the sun's rays, an example of which Rilliet and Barthez have seen. It is also said that compression of the aorta by an enlarged liver or an abdominal tumor has sometimes produced meningeal or cerebral hemorrhage, by causing an increased afflux of blood to the head. A very important cause to which I have not alluded, is that general state of the circulatory system which is designated by the term purpura hemorrhagica. This sometimes results from the anti-hygienic conditions in which the child is placed. In other instances it results from some antecedent disease, protracted and debilitating, which has produced a profound alteration in the state of the blood and the vessels. The capillaries become less firm and elastic, and easily give way, so that in such patients ecchymotic points are ordinarily found in different parts of the system. The diseases which occasionally end in this hemorrhagic diathesis are numerous. I have known it to occur after measles, scarlet fever, and smallpox. It is also an occasional sequel of chronic diarrhœa, of intermittent and typhoid fevers, and of rachitis.

Anatomical Characters.—Hemorrhage in or upon the brain, in infancy and childhood, differs in important particulars from that occurring in adult life. In the adult, and more so as life advances, the arteries become less distensible and more brittle, so that when hemorrhage occurs it is usually from one of these vessels. In early life, on the other hand, the blood does not ordinarily escape from an artery, but, as has been stated, from the capillaries. The extravasation is not, therefore, so rapid and violent, and is not attended with such laceration and injury of surrounding parts, in infancy and childhood, as at a subsequent age. In the adult the hemorrhage commonly occurs in the substance of the brain. The flow of blood from the ruptured artery separates the brain-substance, producing a cavity in which a clot forms. This constitutes the usual form of apoplexy in the adult. In the first years of life, on the contrary, the extravasation is commonly from the meninges, and the symptoms to which

the effused fluid gives rise are for the most part due to its mechanical effect. Cases of hemorrhage in the substance of the brain constitute a small minority, unless during the days immediately succeeding birth. In early life, therefore, on account of its greater frequency, meningeal hemorrhage is a disease of more importance than cerebral, and its anatomical character should be carefully studied.

In *meningeal hemorrhage* the extravasation may be between the cranium and dura mater, upon the visceral layer of the arachnoid, in the meshes of the pia mater, or in a lateral ventricle, from rupture of the capillaries in the choroid plexus. Much the most common seat is external to the pia mater in the so-called cavity of the arachnoid; the blood escaping in this situation spreads uniformly in all directions. It soon separates in two portions, the solid and liquid. The solid portion, or the clot, is free or but slightly attached to the adjacent membrane. The meninges in the vicinity of the extravasated blood preserve their normal appearance, or are but slightly injected; the clot gradually becomes extended on all sides, so as to form a lamina at the seat of the extravasation, thinner at its circumference than centre, and at first of a dark-red color. The color gradually fades, and the lamina, becoming smooth and polished, and at the same time more and more attenuated, finally resembles the arachnoid in appearance. Its diameter varies in different cases from a few lines to two or three or more inches. M. Tonnelé relates two observations in which the adventitious membrane extended over the superior surface of both hemispheres, and in one of them, also, over the falx cerebri.

The extravasation may occur at any part of the surface of the brain, but its usual seat is the vertex. The next most frequent locality is the base of the brain. The subsequent history of the delicate membrane into which the clot is gradually transformed is interesting. It often extends so as to cover more space than was occupied by the extravasated blood, and its edges are then scarcely distinguishable, in consequence of their extreme tenuity, and their close resemblance to the arachnoid. The attachments of this membrane, so far as it forms any, are usually to the parietal surface of the arachnoid. Sometimes a portion of the membrane is attached, while the rest lies free, bathed on either side by the liquid portion of the blood which still remains from the extravasation. According to M. Legendre, in the most favorable cases, the serum is absorbed, and the membrane which has resulted from the clot, and which I have described, becomes intimately adherent to the internal surface of the dura mater. It forms an integral part of this membrane, and there only remain a little thickening and increased opacity, indicating the seat of the extravasation. The health is fully re-established.

But the result in other cases is as follows: The serum is not absorbed, and the newly formed membrane, uniting at points with the inner surface

of the dura mater, or its arachnoidal covering, incloses the fluid so as to produce a circumscribed hydrocephalus.

Sometimes there is only one cyst; in other instances the membrane, especially if large, unites in such a way as to give rise to more cysts than one. The size of the cyst varies, according to the quantity of fluid, which may be only a few drachms or several ounces. Rilliet and Barthez report a case in which there was a pint of fluid lying over each hemisphere, there being two cysts. If the cranial bones are not united, so that they yield to the pressure, the size of the cranium is increased, and if the extravasation is confined to one side, an inequality results, and the symmetry of the head is destroyed. The fluid which causes the enlargement of the head in such cases, is in part the serum of the extravasated blood, and in part a subsequent secretion.

Various writers relate cases of ventricular hemorrhage. Valleix met it in an infant that died at the age of two days. In the *Edin. Jour. of Med. and Surg.*, October, 1831, an interesting case is related. A boy, nine years old, died of hemorrhage in both ventricles, and also at the base of the brain and in the spinal canal. In the Nursery and Child's Hospital of this city, the post-mortem examination was made of an infant who died at the age of one month. In the posterior cornu of the left lateral ventricle were two clots, elongated and black, one larger than the other. In the corresponding cornu, on the opposite side, was a smaller clot. A similar post-mortem appearance was observed at the autopsy of a young infant in the infant service of Charity Hospital. A dark crescentic clot lay in each posterior cornu. The clot, if remaining a long time, undergoes degeneration. In the case of an adult, in which a year had elapsed after the extravasation, I found it to contain crystals of cholesterin and carbonate of lime.

Cerebral hemorrhage, or hemorrhage in the substance of the brain, may occur at any time in infancy and childhood. The blood is sometimes extravasated in points, here and there, over the entire organ, or a part of the organ; in other cases it is extravasated in one or perhaps two cavities, as in the ordinary form of apoplexy in the adult. In the first form of cerebral hemorrhage, or that in which the blood escapes from numerous points through the brain, there is evidently little laceration or injury of the organ. The brain-substance surrounding the hemorrhagic points sometimes preserves the usual appearance. It is white and firm. In other cases it presents a reddish or yellowish appearance, and is softened to the depth of a line or two. If the hemorrhage occur in a cavity, as in apoplexy of adults, the nerve-fibres are evidently torn and separated, and there is more or less compression of the surrounding brain-substance. Unless the disease is of long standing, the cavity contains a dark and soft clot bathed with serum, which has a reddish or a yellowish-red appearance. The brain in the immediate vicinity of the cavity is sometimes softened.

Rilliet and Barthez state that they have seen eight cases of cerebral hemorrhage of the capillary form; ten cases in which the hemorrhage was in cavities; and in two of the eighteen both forms were present. In five of those in which the form was capillary the disease was limited to portions of the brain, while in the remaining three the hemorrhagic points were found in nearly every part of the brain.

Apoplectic cavities are seldom seen in the cerebellum, and, whether the hemorrhage be capillary or in a cavity, there is, in most cases, as previously stated, more or less congestion of the vessels of the brain.

The proportion of cases of cerebral to other forms of hemorrhage is believed by some to be greater in the new-born than at any other period of life. Valleix relates four cases of intracranial hemorrhage occurring at this age, two of which were cerebral, one ventricular, and in the other the extravasation was in the cavity of the arachnoid. Mignot has published eight cases occurring in the new-born, in two of which the hemorrhage was in cavities in the cerebrum; in three, in the lateral ventricles; and in three, external to the brain. If the same proportion be observed in other statistics, one in three of the cases of intracranial hemorrhage occurring in the new-born is cerebral.

Symptoms.—The symptoms in intracranial hemorrhage are not uniform; they vary according to the seat as well as the quantity of the effused blood. In some cases the extravasation occurs without such symptoms as would direct attention to the brain. When the hemorrhage occurs at the time of birth, in consequence of the strong and long-continued labor-pains, the infant is often born apparently dead. This is due partly to the hemorrhage, partly to the great congestion of the brain which precedes and accompanies the hemorrhage. Resuscitation is gradual and difficult. The infant's features are livid, and perhaps swollen; its respiration is gasping, and both pulse and respiration are slow. Its cry is feeble, with but slight movement of the facial muscles, and the lungs are but partially inflated; the eyelids are closed, and the limbs almost motionless. By artificial respiration and by friction, the pulse and breathing may be rendered more frequent, but the latter remains irregular and gasping. Finally, the limbs grow cold, the surface, from a state of lividity, becomes pallid, and death occurs in profound coma. M. Cruveilhier made many observations at the "Maternity" in reference to the death of new-born infants, and he believes that one-third of those who die in birth, at the full period, die of apoplexy. I have made post-mortem examinations in a few cases, when death had occurred from this cause, and in all the hemorrhage was meningeal. One of these was born on the 30th of December, 1864. The birth was delayed by unusual projection of the promontory of the sacrum, so that finally the application of forceps was necessary. The infant was apparently still-born, but by persistent efforts on the part of the physician who assisted it was resuscitated so as to live several hours, though with constant embar-

rassment of respiration and with lividity. At the autopsy a large extravasation of blood was found in the cavity of the arachnoid, over a considerable part of the convexity of the brain, and the substance of the brain was deeply congested.

Apoplexy in the new-born does not always terminate fatally, or, when fatal, in the sudden manner which I have described. Valleix relates the case of an infant who died of pneumonia at the age of three and a half months. Its birth had been protracted and difficult, but was completed without the use of instruments. It had had during its entire life paralysis of the right side. At the autopsy a clot was found near the base of the right thalamus opticus, evidently existing from birth. Around the clot the brain was softened to the depth of some lines, and was of a bluish-red color. A very similar case is related by M. Vernois. An infant lived forty-nine days with paralysis of the left side, and died of pneumonia. At the autopsy a hemorrhagic excavation in the process of cicatrization was found behind the right corpus striatum and the thalamus opticus.

Intracranial hemorrhage occurring from accidents of birth is generally attended by marked symptoms, such as have been described. But when it occurs subsequently to birth, whether in infancy or childhood, the symptoms vary greatly in different cases, and are generally obscure. I will briefly state the symptoms which have been observed in both the cerebral and meningeal forms of this disease. First, the cerebral. Sédillot relates the case of a child seven and a half years old, whose bare head had been exposed several hours to the sun's rays. Suddenly, after a paroxysm of anger, it was seized with great pain, corresponding with the posterior and inferior fossæ of the cranium. It uttered piercing cries, and died in a quarter of an hour. A clot was found in the right lobe of the cerebellum. Richard Quinn (Rilliet and Barthez) gives the history of a boy nine years old, who in playing with a hoop suddenly stopped, carried his hands to his head, and fell backwards unconscious. Three or four hours afterwards, when examined, he was found pale, surface cool, respiration slow and at times stertorous, pulse 50 to 60 per minute; the left arm was flexed, the left leg paralyzed; the right leg and arm convulsed; right pupil strongly dilated, the left contracted. He died seven hours after the commencement of the attack, and a large clot was found in the centrum ovale on the right side.

Rilliet and Barthez relate the following case from Campbell. A boy with good previous health was suddenly seized about 7 A. M. with repeated vomiting, and in an hour and a half with violent convulsions; he rolled his eyes and uttered inarticulate cries; pulse frequent and hard; pupils contracted; trunk and lower extremities cool. In the afternoon he presented symptoms of compression of the brain, such as dilatation of the pupils, frequent and feeble pulse. Death occurred in the evening, and a hemorrhagic cavity was found occupying the right middle lobe of the cerebrum.

Guibert relates a case of extravasation in the superior part of the right hemispheres of the brain in a boy fourteen years old. The principal symptoms were feebleness of the limbs, inability to walk, cephalalgia, involuntary evacuations, fever, grinding of the teeth, rigors severe and prolonged, lividity, loss of intellectual faculties, dilatation of the pupils, insensibility, to light, stertorous respiration. Death occurred in about an hour.

Rilliet and Barthez narrate the history of a girl two years old, who, after an attack of measles, was taken with convulsions accompanied with fever and prostration. The convulsive movements affected especially the eyes and upper extremities; the right leg was immovable; the left pupil dilated. These symptoms resulted from hemorrhage in the corpus striatum and opticus thalamus. The same authors relate also the case of a girl, seven years old, who died with a large apoplectic cavity in the left thalamus opticus. The symptoms were headache, convulsive movements, loss of consciousness, delirium, vomiting and constipation, convergent strabismus. These symptoms nearly disappeared, but in a few days the headache returned, with strabismus and a slight drawing of the face towards the left; on the twenty-seventh day there were some convulsive movements of the right eye, with paralysis of the arm. Finally contractions of the arms occurred, with acceleration of pulse, irregular breathing, dilated pupils, paralysis, and retraction of the head, followed by death on the forty-eighth day.

These cases, and those from Valleix and Vernois, which have been related in our remarks on hemorrhage of the new-born, are sufficient to show the character of the symptoms in that form of cerebral hemorrhage in which the extravasated blood forms a cavity in the interior of the brain.

If the amount of extravasation is large, and the substance of the brain is much lacerated and compressed, death may occur almost immediately, and, therefore, without symptoms, or before it is possible to determine whether or not symptoms are present. If the disease is not so speedily fatal, the symptoms, as appears from the above cases, are headache, confusion of thought, or even insensibility, cries, sometimes piercing, cold extremities, pallor, slow and perhaps stertorous respiration, convulsive movements followed by paralysis, or convulsions affecting one or more limbs, with paralysis of others, pupils contracted or dilated, sometimes one contracted and the other dilated, strabismus, rolling of eyes, vomiting.

These symptoms have all been observed in different cases, but they are not all present in any one case. Those which are generally present, and on which we mainly rely for diagnosis, are headache, convulsive movements, paralysis, confusion of thought, irregularity in the pupils, and strabismus.

In the CAPILLARY form of cerebral hemorrhage there is usually some complication, so that it is not easy to determine how far symptoms are due to the hemorrhage, and how far to the coexisting pathological state.

There are, indeed, but few published observations of capillary hemorrhage in the substance of the brain uncomplicated with meningeal hemorrhage, hemorrhage into a ventricle, or some other and distinct disease, but so far as I have been able to ascertain the symptoms referable to this form of extravasation, they are as follows: The child is drowsy; fretful when disturbed; it perhaps moans. There are sometimes slight convulsive movements and partial paralysis. If there is considerable extravasation, the respiration is irregular and sighing. Death occurs in coma, occasionally preceded by convulsions. Taupin relates the case of a child nine years old, who died with this form of hemorrhage, accompanied by softening of the brain. The disease began at night, with delirium, agitation, and piercing cries. In the morning the patient lay in bed, drowsy, not complaining of pain, and not replying to questions; pupils dilated, and insensible to light; left eye half open during sleep, and its axis changed; eyebrows contracted; face pale; mouth open; had no convulsions, but transient stiffening of the limbs, during which the thumbs were firmly compressed by the fingers; senses unimpaired, but the face drawn to the right; deglutition difficult; pulse small, irregular, and feeble; respiration 32, sighing. In the evening he had rigidity of the limbs and back, and, finally, was taken with general convulsions, in which he died at eleven o'clock. The hemorrhagic points in this case were numerous. A boy five years old, whose case is described by Rilliet and Barthez, died of this disease, pneumonia, and white softening of the intestine. During the last five days there were cerebral symptoms, the chief of which were drowsiness, fretfulness when disturbed, and moaning without apparent cause. Another child, whose case is described by Rilliet and Barthez, died at the age of four years, with cerebral capillary hemorrhage, accompanied by yellow softening. Six months before death he had general convulsions, followed by spasmodic movements of the left side. These subsided, but the left side remained feeble.

In MENINGEAL HEMORRHAGE there are often convulsions, general or partial, in some patients tonic, in others clonic. When partial, the convulsive movements may only occur in the muscles of the face and eyes. With the spasmodic muscular action is a degree of drowsiness and irritability. Paralysis, so common in the apoplexy of the adult, and not infrequent, as we have seen, in the cerebral form of early life, is sometimes, but not ordinarily, present in meningeal hemorrhage. Instead of paralysis, there are vomiting, some febrile action, thirst, and loss of appetite. The symptoms are different, however, according to the exact seat of the hemorrhagic extravasation, and the duration of the disease. If the extravasation end in the formation of a cyst, the symptoms are those of hydrocephalus. The following condensed history of cases which I have selected as typical, will give us a clearer idea of the history and course of

the various forms of meningeal hemorrhage than can be imparted by a narration of symptoms :—

M. Tonnelé relates the case of a child who was taken with faintness and convulsive movements. On the following day the trunk and inferior extremities became rigid; deglutition was painful; the pupils were largely dilated, immovable; face pale; pulse feeble and intermittent. Death occurred the same day. The dura mater was distended. A layer of coagulated blood, of great thickness, extended over the convexity of each hemisphere. The veins ramifying in the superior part of each hemisphere were distended with coagulated blood. The hemorrhage was in the meshes of the pia mater. Drs. Lombard and Panchard, of Geneva, relate a somewhat similar case. A child, thirteen months old, was convalescing from inflammation of the bronchial and intestinal mucous surfaces, when it was seized with general convulsions; the mouth and eyes were open, and the eyes directed upwards; pupils contracted; pulse frequent and irregular. The convulsions abated somewhat, but soon reappeared with violence. The patient became insensible, and died nineteen hours after the commencement of cerebral symptoms. The extravasated blood covered the upper surface of both hemispheres. From the above cases we see the symptoms and the course of meningeal hemorrhage, when the extravasation is so large that death speedily results. In protracted cases of meningeal hemorrhage, there is either a gradual disappearance of symptoms and return to health, or, circumscribed hydrocephalus occurring, the symptoms of that disease arise.

Diagnosis.—It is evident, from what has been stated, that the diagnosis of intracranial hemorrhage is attended with unusual difficulty, since the symptoms of this disease occur also in other and distinct pathological states. The history of the case, and especially the character of the cause, if ascertained, will aid in diagnosis. If there has been an obvious determination of blood to the brain, or some known obstruction to the return of blood from that organ, the persistence of cerebral symptoms would justify us in concluding that either serous or sanguineous effusion had supervened on a state of congestion. The points of differential diagnosis between apoplexy and meningitis are the sudden and full development of symptoms in one case, the gradual commencement and gradual increase of symptoms in the other; differences also of symptoms in certain respects; for example, as regards febrile reaction, constipation, etc.

There is one symptom in cerebral hemorrhage which is of great diagnostic value, namely, paralysis. Its presence affords strong evidence that there is extravasation of blood, and probably in a cavity in the substance of the brain. If the extravasation end in the formation of a cyst, the symptoms and appearances of hydrocephalus, which, after a time, arise, throw light on the nature of the disease.

Prognosis.—There can be no doubt that many cases of intracranial hemorrhage occur and terminate favorably without the nature of the disease being suspected. In such cases the amount of extravasated blood is small or moderate. In several published cases in which the accuracy of the diagnosis was shown by post-mortem examinations, the patients were convalescing from the hemorrhage when they succumbed to intercurrent diseases. If, however, the amount of extravasated blood is such as to give rise to those symptoms which have been described, the prognosis is unfavorable. Recurring convulsions, and persistent stupor from which it is difficult to arouse the patient, are unfavorable symptoms. If the convulsions cease, and consciousness return, even if there is paralysis, the result may be favorable.

Treatment.—The proper treatment in intracranial hemorrhage depends on the state of the patient, the time which has elapsed since the extravasation, and the degree of it, as shown by the nature and severity of the symptoms. If, as is often the case, the patient is robust, and is visited soon after the commencement of the attack, cold applications should be made to the head, mustard to the back of the neck and perhaps chest, and derivation should be produced by mustard pediluvia. In many cases, especially in active congestion, it is advisable to apply leeches to the temples, and the bowels should be opened by a stimulating enema. In active congestion, also, prompt purgation by salines or other cathartics, is sometimes of great importance. The object of such treatment is to relieve congestion of the cerebral and meningeal vessels, and thereby prevent further extravasation of blood. If the congestion be active, the pulse continue full and frequent, and the face be flushed, it is proper in many cases to control the action of the heart by a sedative. For this purpose the tincture of aconite root may be given in doses of one drop to a child five years old, repeated in three hours if necessary, or veratrum viride may be used. If the stupor or convulsions continue after sufficient time has elapsed for the patient to receive the full benefit of the above remedies, more active counter-irritation is required. Cantharidal collodion should be applied behind each ear. If the hemorrhage occur from passive congestion, or in a cachectic state of system, active depressing remedies should not be employed. External derivatives are of service, as well as cool applications to the head, and we should attempt, so far as possible, to remove the cause of the congestion and hemorrhage. If it depend on a cachectic state, tonic or other remedies calculated to relieve this state are indicated. The hemorrhage from such a cause is apt to be in points in the substance of the brain, or in moderate quantity over the surface of this organ, and by a timely use of constitutional remedies possibly we may prevent further extravasation of blood and increase the chance of the patient's recovery.

If a cyst result from the hemorrhagic effusion, the treatment which is proper is that described in the chapter on Acquired Hydrocephalus.

CHAPTER VII.

CONGENITAL HYDROCEPHALUS.

Congenital hydrocephalus consists in an excess of the cerebro-spinal fluid, lying either external to the brain, or more frequently in its interior. It is due to some vice in the development of the brain or its membranes, or to a pathological state occurring in them during intra-uterine life. This disease is ordinarily apparent from the symptoms and appearances at birth, but not always. Occasionally nothing unusual is observed in the shape of the head or aspect of the infant till after the lapse of some weeks, when the characteristic physiognomy begins to appear. In these cases the disease is still congenital, as there is every reason to believe that the abnormal state to which the excessive production of fluid is due existed from birth. In cases of arrested or partial development of the brain, as, for example, when a considerable portion of the hemispheres is absent, there is often an unusually large quantity of fluid which serves merely as a compensation for the lack of brain. I do not regard such cases as examples of hydrocephalic disease, since the effect of the fluid is not injurious, but rather useful. I restrict the term congenital hyprocephalus to those cases in which the brain is complete, or, if incomplete, the quantity of fluid is more than sufficient to supply the deficiency.

Anatomical Characters.—According to M. Breschet, the fluid in congenital hydrocephalus may be—1st, between the dura mater and the cranium; 2d, between the dura mater and the parietal arachnoid; 3d, in the cavity of the arachnoid; 4th, in the ventricles; 5th, between the arachnoid and the brain.

In a large majority of hydrocephalic patients the seat of the effusion is the ventricles. As the quantity of fluid increases, the pressure from within gradually unfolds the convolutions of the brain, at the same time producing expansion of the cranial arch. When the amount of fluid is considerable, and it becomes so in the course of a few weeks or months, the hemispheres are spread out in a thin lamina on either side, gradually decreasing in thickness from the base of the cranium to the vertex, where the brain-substance is sometimes so thin as to be scarcely perceptible. Complete absence of brain in this situation, namely, at the vertex, even in extreme cases of expansion and flattening of the hemispheres from the pressure of the liquid, is rare, though the brain-substance at this point is sometimes almost as thin as either of the membranes, so that the wall of

the sac is translucent. The membranes which surround the brain do not usually undergo any alteration, except such as arises from the distension. The falx cerebri sometimes disappears, and sometimes the meninges present a whiter hue from maceration than in health. The distension also causes such an expansion of the pia mater that it becomes very thin, and in places scarcely visible, but its presence in every point can be demonstrated.

The accompanying woodcut represents congenital hydrocephalus as it ordinarily occurs. I saw this infant when it was a few days old, and examined it from time to time till its death. The parents are healthy and have other healthy children. This infant when nine days old began to have clonic convulsions of a mild form in the muscles of the face, neck, and limbs, which recurred almost daily till the age of six weeks, and

Fig. 19.

sometimes every five or ten minutes. When the convulsions ceased in the sixth week, the head was observed to enlarge, and its excessive growth continued till death, which occurred at the age of seven months and one week. While the volume of the head progressively increased, the trunk and limbs emaciated. At death the occipito-frontal circumference of the head was nineteen and a half inches; the vertical from auditory meatus to meatus thirteen and a half inches.

The changes which the cranial bones undergo, both in their chemical character and in their shape, in hydrocephalic patients, if the amount of fluid is considerable, are interesting and remarkable. The base of the cranium undergoes little change, but those portions of the frontal, parietal, and occipital bones which constitute the arch are expanded in all direc-

tions, while they become much thinner. There is deficiency of lime in their constitution, so that their organic elements are greatly in excess. This renders them flexible and semi-transparent. Notwithstanding the expansion of the bones, there are usually interspaces between them, of greater or less size, according to the amount of fluid.

The scalp, being stretched by the pressure underneath, becomes tense and thin, and is scantily covered with hair. The veins which ramify in it are unusually prominent and large, and the head is elastic on pressure, from the amount of liquid beneath. In the common form of congenital hydrocephalus, namely, that in which the liquid is in the interior of the brain, the shape of the orbital plates of the frontal bone is changed, so that the eyeballs have a downward direction. This change in the axis of the eyes occurs at an early period, and it continues through the entire disease, becoming more and more marked as the quantity of liquid increases. If the amount be large, the lower part of the cornea is buried under the under eyelid, while the conjunctiva is visible between the cornea and the upper eyelid. The persistent downward direction of the eyes is characteristic of this disease, and, in connection with enlargement of the head, is an important diagnostic sign.

If we examine the interior of the cavity after the fluid is evacuated, we will find at its base the parts which lie in the floor of the lateral ventricles, but changed in appearance in consequence of pressure. The cornua are enlarged, and the thalami optici and corpora striata are flattened. In the early stages of the disease, when the amount of fluid is small, there is probably no absorption or destruction of parts in the interior of the brain. The various portions of this organ retain nearly their normal relation to each other. As the quantity of fluid increases, the foramen of Monro, which unites the lateral ventricles, becomes enlarged, the septum lucidum which separates them disappears, and the two ventricles form a common cavity. In most fatal cases we find this single large cavity. The surface which surrounds the cavity occasionally presents a whitish or semi-opaque appearance, which has led to the belief, that at a period antecedent to birth there was subacute inflammation of this surface, and hence the effusion.

The bones of the face are ordinarily less developed than in healthy children of the same age, so that the disproportion between the head and face becomes a marked peculiarity. The shape of the forehead and face is nearly triangular.

The foregoing remarks in reference to the anatomical characters of congenital hydrocephalus refer in the main to cases which have continued for a considerale time, so that their characteristic features are well marked. In very young infants, in whom the disease is still recent, similar anatomical characters are present, but in less degree.

Congenital hydrocephalus is often associated with other vices of con-

formation, especially with spina bifida. The two, when coexisting, are only parts of the same disease; the large quantity of cerebro-spinal fluid preventing the spinal canal from closing during fœtal development.

The fluid in congenital hydrocephalus consists largely of water, in the proportion even of 99 parts in 100. In addition to this element, there are traces of albumen, chloride of sodium, phosphate and carbonate of soda, and osmazome.

I have had an opportunity to witness only one post-mortem examination in a case of congenital hydrocephalus in which the liquid was exterior to the brain. This case was under observation in the children's service of Charity Hospital, in 1866. Full notes and measurements of the head were taken, which, unfortunately, were mislaid or lost. The infant had congenital syphilis, and had a pallid, strumous appearance. The shape and relative size of the head are seen in the accompanying figure, from a photograph. While the whole head was enlarged, there was a relative excess of development in the part between and above the ears. The axis of the eyes was not at all changed, and the vision was good. The appearance corresponded so closely with descriptions of hypertrophy of the brain that this was supposed to be the anatomical state. Antisyphilitic treatment was employed, and the syphilitic eruptions had nearly disappeared, when diarrhœa supervened, followed by death. At the autopsy a quantity of transparent or light straw-colored liquid, estimated at six or seven ounces, was found exterior to the brain, in the great cavity of the arachnoid, lying mostly over the superior surface of the organ. There was no excess of liquid in the ventricles, and the brain, though of good size, was not abnormally large, nor did it possess the firmness which is present in true hypertrophy.

Fig. 20.

All cases of congenital hydrocephalus may be embraced in two groups, namely, that in which the liquid is in the interior of the brain, and that in which it lies exterior to the organ. Liquid primarily in the arachnoidean cavity permeates the meshes of the pia mater, and lies in part underneath it, or this delicate membrane may be ruptured. Four of the groups, therefore, described by Breschet, may properly be reduced to one, namely, those groups in which the liquid lies under, between, or external to the meninges. It is probable that some of the cases which led to Breschet's classification were examples of acquired circumscribed hydrocephalus, the result of extravasation of blood. In this form of hydrocephalus, as is stated elsewhere, an adventitious membrane forms external to the liquid, becoming in time thin and delicate, and often bearing a close resemblance

to the normal membrane (especially the arachnoid), for which it is sometimes mistaken.

Symptoms.—If there is a considerable amount of hydrocephalic fluid prior to the birth of the child, so that the head is abnormally large, parturition is seriously interfered with. The scalp and mininges may become ruptured by the severity of the pains so that the fluid escapes. If this does not occur, the labor is often necessarily instrumental. Whether the liquid is present before birth or accumulates subsequently to it, the tendency is to an increase of the quantity, and a corresponding enlargement of the head.

The digestive function in this disease is at first well performed. The infant nurses readily, and has its evacuations with the regularity of other children. Not many weeks, however, elapse, in the majority of cases, before defective nutrition is apparent.

While the volume of the head increases, other parts are imperfectly nourished and stunted in their growth. Emaciation is common of the neck, trunk, and limbs, associated with progressive feebleness. In the last stages of this disease there is more or less vomiting with constipation. If there were previously the ability to support the head, it is now lost, and the erect position is no longer possible. In marked cases, when there is great disproportion between the head and the rest of the system, there is frequently not even the ability to rotate the head on the pillow. As long as the cranial bones yield readily to the pressure from within, and there is no compression of the brain, the function of this organ is not seriously impaired. The child recognizes its mother or nurse, and it can be amused like other children, though easily fatigued. The state of the senses is different in different cases, and sometimes at different stages of the same case. The sight and hearing in some are perfect, in others impaired; while in others still they are good at first, but gradually become obscured and lost. It is said that the sense of smell may be perverted so that agreeable odors are unpleasant, and *vice versâ*. Many, reaching the age at which children begin to walk, cannot walk, or, if they do, it is with a tottering, unsteady gait.

When the liquid increases to that extent, and it usually does sooner or later, that the brain begins to be compressed, dangerous cerebral symptoms arise. The child becomes drowsy, and takes less notice of objects. Spasmodic muscular contractions and finally convulsions occur. The pupils act feebly or irregularly by light, or one is more dilated than the other. Strabismus also occurs. As death approaches, the eclampsia, partial or general, becomes more frequent, and is succeeded by stupor from which the patient cannot be aroused.

The following case, which I copy from my note-book, is an example of the common form of congenital hydrocephalus. It will give an idea of the ordinary course of this disease, and show the difficulty which we meet

with in its treatment. Female, born November 9th, 1859, with the aid of forceps. At birth the fontanelles were unusually large, the cranial bones separated, and the aspect in a marked degree hydrocephalic. She nursed at first, but, the mother's milk failing, she was afterwards bottle-fed. At the age of four months her head, which had increased faster than her general growth, measured from one auditory meatus to the other, over the vertex, seventeen inches; the occipito-frontal circumference, twenty-three inches. At this time she manifested considerable intelligence, being able to distinguish her mother from other persons, though the head was so large that it was necessary to support it constantly on a pillow. From the age of four to six months the operation of tapping was performed six times with a small hydrocele trocar, by Prof. Stephen Smith, at a point near the coronal suture, and from one inch to one inch and a half from the sagittal. At each operation an amount of fluid varying from twelve ounces to one pint was removed, and the head then covered with strips of adhesive plaster, so as to form a complete cap. It was necessary, however, within the twelve hours succeeding each operation, to loosen the dressing on account of either the occurrence of convulsions or symptoms premonitory of them. The head, within a week subsequently to each operation, regained its former size, and, as there was no permanent benefit, this treatment was discontinued. She finally died of entero-colitis at the age of ten months and five days.

At the autopsy the distance from one auditory meatus to the other was twenty and a quarter inches; the occipito-frontal circumference, twenty-six and a quarter inches. The anterior fontanelle measured antero-posteriorly four and three-fourths inches; transversely, seven and three-fourths inches. The parietal bones were separated from each other to the distance of two or three inches, and they measured in length nine and one-half inches.

On opening the cranial cavity, seven pints, by measurement, of transparent fluid escaped, exposing a vast open space, at the bottom of which were the parts which constitute the floor of the ventricles, somewhat changed in shape, and from them, on either side, the hemisphere was spread in a lamina, so as to cover the internal surface of the cranial bones. The laminæ near the base of the brain measured in thickness from half an inch to one inch, and they gradually became thinner on approaching the vertex, at which point the brain-substance was exceedingly thin, so as to be scarcely demonstrable.

The brain had its normal vascularity and consistence, and the cerebellum, medulla oblongata, the base of the brain, and cranial nerves presented their usual appearance. On folding the brain together, it had the size, shape, and aspect of this organ in its ordinary development. Nothing unusual was observed in the membranes except their great expansion. The above case corresponds in its general features with most cases met in practice.

Diagnosis.—The ordinary form of congenital hydrocephalus, that in which the liquid occupies the interior of the brain, can, in most cases, be readily diagnosticated. If there is only a moderate amount of liquid, it may be confounded with hypertrophy of the brain. In hydrocephalus there is commonly more rapid growth and greater expansion of the head; moreover, the enlargement occurs equally on all sides, while in hypertrophy, though all parts of the cranial vault are expanded, the enlargement is more at the vertex than elsewhere. The hydrocephalic head yields more readily to pressure than the hypertrophied, and often communicates a fluctuating sensation. Moreover, in the ordinary form of hydrocephalus, the change in the axis of the eyes described above is an important diagnostic sign. In rachitis the volume of the head is often considerably enlarged, due sometimes, in part at least, to a deposit of calcareous matter on the exterior of the cranial bones. The differential diagnosis is based on the shape of the head, round in one, square or with prominences in the other, on palpation, direction of the eyes, etc. The smaller the amount of liquid, the greater the liability to error of diagnosis; but if the amount is inconsiderable and not increasing, little treatment is required, except hygienic and tonic, which is also proper in both hypertrophy and rachitis. If the liquid is exterior to the brain, as in the case represented on page 376, diagnosis may be difficult, but such cases are infrequent.

Prognosis.—This is unfavorable. The amount of liquid in congenital hydrocephalus, as already stated, commonly increases. The most favorable result is no increase, or but slight, in the quantity, while the natural growth of the infant continues, and thus the disproportion between the head and the rest of the system gradually disappears. This result is exceptional. Ordinarily, while the quantity of fluid increases, the nutrition of the body and limbs is more and more deficient. The patient, if not cut off by some intercurrent disease, finally succumbs with cerebral symptoms produced by pressure of the fluid. The majority of those affected with congenital hydrocephalus die in infancy, but some enter childhood, and occasionally one reaches even adult life. Cases of recovery have been reported, but if they were genuine, the disease was evidently mild, and the amount of liquid small or moderate.

Treatment.—It is a proper question, in many cases, whether anything should be done to relieve the hydrocephalic infant besides attending to its general health. The anxiety of parents, however hopeless the nature of the case if left to itself, reported recoveries, and the fact that we have medicines which in many instances diminish the amount of liquid in the internal cavities, incline us to the use of therapeutic measures.

We may attempt to diminish the quantity of fluid by the use of diuretics. Digitalis, squills, nitrate and acetate of potash, have been used. Probably the most efficient diuretic in these cases is iodide of potassium. This may be given in doses of one to two grains every two hours to an infant of

six months. Constipation, if present, should be relieved by an occasional purgative. If it is tolerated, we may partially prevent the expansion of the head by a close-fitting cap. For this purpose strips of adhesive plaster about one-third of an inch in width, should be applied so as to cover the entire head. The proper way of applying these is as follows: First, one strip from each mastoid process to the outer part of the orbit on the opposite side; secondly, from the back of the neck, along the longitudinal sinus, to the root of the nose; thirdly, over the whole head, so that the different strips will cross each other at the vertex; and, lastly, a strip long enough to pass three times around the head should be applied, passing above the eyebrows, the ears, and below the occipital protuberance. Too tight an application should be avoided, as it may give rise to convulsions or other cerebral symptoms. If the cap can be tolerated, and the general health is good, the prospect is more favorable; but usually, from the increase in the quantity of fluid, it is necessary in a few days to remove or loosen the plasters in order to prevent convulsions. If this treatment is not successful, we may finally resort to tapping. The mode of performing this operation has already been indicated in the case which I have detailed. No appreciable good result has followed the use of irritating or sorbefacient applications to the head. Nutritious diet and attention to the general health are requisite.

CHAPTER VIII.

ACQUIRED HYDROCEPHALUS.

Hydrocephalus, or dropsy of the brain, may also occur in those who at birth are well formed and free from disease. Pathologists call this acquired hydrocephalus. It is in nearly all cases the result of disease, which is located sometimes within the cranium, but often in other parts of the system.

Causes.—The diseases within the cranium which most frequently produce serous effusion are the meningeal inflammations, both simple and tubercular, tumors or other causes which obstruct the venous circulation, and hemorrhagic effusion ending in the formation of cysts. Prolonged passive congestion often ends in transudation of serum through the coats of the capillaries. Therefore, all those causes of congestion, except such as have a transient or momentary effect, may be regarded as causes of serous effusion.

Among the diseases external to the cranium which produce serous effusion within or upon the brain, may be mentioned retropharyngeal abscess,

tuberculization or inflammation of the bronchial glands, scarlet fever, and certain affections of an exhausting nature, especially protracted diarrhœal maladies. In at least five cases which have fallen under my notice, and in which post-mortem examinations were made, the cause was enlarged tubercular bronchial glands, which, by pressure on the venæ innominatæ, so retarded the flow of blood from the brain as to cause congestion and effusion. The causative relation of these glands to cerebral congestion is more fully described in our remarks in reference to this disease.

Dropsy of the brain is common in protracted infantile diarrhœa, as in advanced cases of intestinal catarrh of the summer months in the cities. It is preceded and accompanied by passive congestion of the cerebral veins and sinuses, due in part to feebleness of circulation in consequence of the exhausted state of the patient, and in part to the wasting of the brain, which always gives rise to more or less passive congestion, unless in young infants, in whom the cranial bones become depressed and override each other. Dropsy of the brain resulting from scarlet fever, and that peculiar circumscribed dropsy which results from hemorrhagic effusions, are described elsewhere.

A few cases have been related by different observers, Abercrombie among others, in which dropsy of the brain seemed to be essential. Nothing abnormal was observed, with the exception of serous effusion. But the reports of such cases are, for the most part, meagre; and, as Barrier has well said, we are not to accept such cases as examples of essential dropsy of the brain, unless the post-mortem inspection is so complete as to render it certain that there was no pathological state which might cause the dropsy.

Anatomical Characters.—Acquired hydrocephalus usually occurs after the cranial bones are firmly united, and, therefore, the shape of the head is not materially altered. If it occur at an early age, before there is firm union, there may be expansion of the cranial arch, as we sometimes observe in the circumscribed hydrocephalus resulting from hemorrhage. The effusion in acquired hydrocephalus occurs over the surface of the brain, in the subarachnoid space, or in the lateral ventricles. In the dropsy of protracted diarrhœal maladies, I have rarely failed to find the liquid over the whole superior surface of the brain as well as at its base.

The quantity of fluid in this disease is not large. In the majority of cases it does not exceed four ounces, and is often much less. It is transparent, or it has a slightly yellowish tinge. The membranes of the brain sometimes present their normal appearance, but in other cases they are injected. The brain itself, in some instances, has an injected appearance from passive congestion of the veins and capillaries; but in others, when there has been more or less compression of the brain, there is no more than the ordinary, or even less than the ordinary vascularity, and the convolutions are somewhat flattened.

Symptoms.—The symptoms of the pathological state, which gives rise to the dropsy, precede and accompany those which are referable to the dropsy itself. The dropsy declares itself by symptoms which are alarming from the first.

In children old enough to speak, or manifest intelligence, there may be at first complaint of headache. The child is irritable, its mind confused or wandering at times, or there is actual delirium. After a time drowsiness occurs. The head seems too heavy for the body, and is buried in the pillow. In fatal cases the features become pallid, the pupils sluggish, and perception and consciousness are gradually lost. The child lies in profound sleep, which increases. There are now often convulsive movements partial or general, and these soon end in coma, in which the patient dies.

Prognosis.—Acquired hydrocephalus commonly ends unfavorably. The prognosis depends not only on the quantity of liquid, but on the nature of the cause. If the cause be venous obstruction within the cranium or thorax, as we have no means of removing it, death is inevitable. If it be an exhausting disease, as entero-colitis or scarlet fever, although the case is not absolutely hopeless, the prospect is still unfavorable. It is only favorable when the quantity of effused fluid is small, the system not much reduced, and the primary disease mild. When acquired hydrocephalus arises from meningeal apoplexy, the case is apt to be chronic. The symptoms and termination of this form of the disease are very similar to those in congenital hydrocephalus.

Treatment.—The treatment in acquired hydrocephalus must vary somewhat in different cases, according to the nature of the disease on which it depends. I shall indicate the treatment, in part at least, in the description of these diseases. Occasionally the condition of the patient is such that there is little to encourage us in the employment of any remedial measures. In vigorous children, if acquired hydrocephalus occur in connection with symptoms which indicate too active a circulation, moderate abstraction of blood from the temples at an early period may be useful, but cases requiring such depletory measures are rare. These cases require cold applications to the head; the bowels should be opened, and derivatives should be applied to the feet and back of the neck.

If the congestion be of a passive character, as when the circulation is obstructed by tumors or otherwise, benefit may still be derived from cold applications to the head, and derivatives to other parts. In most cases of suspected dropsy of the brain, unless the patient is in such a hopeless state that all treatment is obviously futile, vesication should be produced behind the ears. I prefer cantharidal collodion for this purpose. In addition to this treatment, diuretics should be employed, unless there is too great prostration, or the course of the disease is so rapid that no benefit can result in consequence of the tardy action of these agents. The best diuretics are the acetate of potash and iodide of potassium.

CHAPTER IX.

MENINGITIS, SIMPLE AND TUBERCULAR.

THE most interesting and important disease of the cerebro-spinal system in early life, is that which is now designated meningitis. It is not infrequent. The mortuary statistics of this city show that it is the cause of death in from one in twenty-five to one in fifty of the entire number of deaths, the proportion varying somewhat in different years.

In 1768, the attention of the profession was particularly called to this disease, by Dr. Whytt, of Edinburgh. This observer, and the pathologists succeeding him, forming their opinion of meningitis from its most prominent anatomical character, namely, serous effusion, believed it a dropsy. They accordingly designated it acute hydrocephalus. During the last thirty years the profession have come to regard the disease as inflammatory, and hence the name by which it is now known, and which is believed to express its true pathological character.

Sometimes meningeal inflammation in children is idiopathic. In other instances it occurs in those affected by tuberculosis, and in many, if not in all such patients, there are tubercles in or under the meninges, which excite the inflammation in the same manner as in the lungs they cause pneumonitis or pleuritis. Therefore two forms of meningitis are recognized, namely, simple and tubercular.

Prior to 1868 I had preserved records of forty-five fatal cases of meningitis, some occurring in my private practice, and the remainder in institutions of this city with which I have been connected. Post-mortem examinations were made and recorded in thirteen of them. Twenty-five were under the age of one year, of which fifteen were apparently well when the meningitis commenced, belonging for the most part to healthy families; three were feeble and cachectic, but apparently without tubercles; and five had miliary tubercles in various organs, as shown by post-mortem examination. The condition of the other two was not recorded.

Of the twenty who were over the age of one year, the majority, namely, thirteen, presented a decidedly cachectic or a strumous aspect before the meningitis occurred, and a considerable number had symptoms of pulmonary tubercles. These statistics, as far as they go, show that simple meningitis predominates under the age of one year, and I may add eighteen months, while over that age the tubercular cases are in excess.

The belief has prevailed in the profession, that tubercular meningitis

does not occur in young infants. This idea is therefore fallacious, although, as has been stated, meningitis under the age of one year is oftener independent of tubercles or the tubercular diathesis than associated with them. Bouchut, speaking in reference to tubercular meningitis, says: "Up to this period it was not believed that this disease existed in young children, for no mention is made of it in the works of Denis and Billard. Still its existence at this age is, nevertheless, incontestable. MM. de Blache, Guersant, Rilliet and Barthez, and Barrier have observed several examples of it, and I have collected six cases of this disease in the practice of M. Trousseau. The youngest child was only three months old, and the eldest had arrived at the end of his second year. No statistics can be based on so small a number of facts; the only value they have consists in their overruling an opinion falsely accredited in medical science." I have witnessed the post-mortem of five cases of tubercular meningitis occurring in children under the age of one year, as is seen from the above statistics, and the age of one of these was only four months. In two, perhaps I should say three, of the five the presence of tubercles in the meninges was not positively demonstrated; but in all of the five cases miliary tubercles were present in the lungs and other organs, so that I did not hesitate to consider the meningeal inflammation of a tubercular character.

In patients over the age of eighteen months, although the proportion of tubercular to simple cases is larger than under this age, the excess is not so great, according to my statistics, as the remarks of some observers would lead us to suppose. There can be no accurate statistics of tubercular meningitis without careful post-mortem examination of the state of the brain and other organs in each supposed case, and this examination sometimes shows the meningitis to be simple, when the symptoms and physical signs had indicated its tubercular character. As an example, may be mentioned a case which occurred in the children's service of Charity Hospital, in March, 1868. The infant died at the age of twenty months, having had a cough of moderate severity at least three weeks before death, and symptoms of meningitis about four days. It was considerably wasted, and was supposed to have tuberculosis. At the autopsy, no tubercles were found in any part of the body, but parts of both lungs were hepatized. A fibrinous deposit, varying in thickness, was found over the pons Varolii, the optic commissure, along the fissures of Sylvius, over the superior surface of the anterior half and also upon the superior lobe of each cerebral hemisphere. As a careful examination failed to discover any tubercles, the meningitis was considered simple. Those who make these examinations, failing to find tubercles in the lungs and other organs in which they usually occur, should examine the lymphatic glands, for cheesy glands may be the cause of the formation of tubercles in the meninges while the organs of the trunk remain unaffected. The presence of cheesy glands in the absence of visceral tubercles, and with granulations upon the meninges, small, covered

with fibrin, and of a doubtful character, goes far towards establishing the tubercular nature of the meningitis. Thus in one such case which I examined the meningitis seemed to be due to cheesy bronchial glands, and I therefore considered it tubercular.

AGE.—The following table gives the age in meningitis, simple and tubercular, in forty-two cases in my collection :—

Cases.	Age.
1	2½ weeks. (Autopsy.)
2	2 months.
20	From 3 to 12 months.
10	" 1 year to 2 years.
5	" 2 years to 5 "
4	Over 5 years.
42	

Rilliet and Barthez have also published statistics of the age in meningitis. Their cases were observed chiefly in hospital practice, and the result is somewhat different.

In thirty-two cases of simple meningitis observed by these authors, eight were under the age of one year, six from two years to five, and eighteen over the age of five years. In ninety-eight cases of tubercular meningitis, there were two under the age of one year, fifty-one between the ages of one year and five, thirty-eight between the ages of five years and ten, and seven between ten and fifteen years.

PATHOLOGICAL ANATOMY.—This differs considerably in different cases. The dura mater is usually unaffected or is affected secondarily. In many cases it retains its normal appearance, its internal surface remaining smooth and polished, while in others it is more or less injected, and its internal surface dim or lustreless. The free surface of the pia mater, formerly designated the visceral arachnoid, is in a great part of its extent unchanged, but is often hyperæmic, or dry and cloudy, or opaque, over the seat of the inflammation. Exudation does not occur upon the free surface of the pia mater, however intense the inflammation.

In both simple and tubercular meningitis the inflammatory action occurs in the pia mater. In its meshes, or underneath them, occur the lesions which characterize the disease, and to which other lesions are secondary. Tubercular meningitis is most frequently basilar, or is basilar chiefly and primarily, although the inflammation may extend along the sides of the hemispheres. The meningitis is ordinarily most intense around the pons Varolii in the subarachnoid space and along the fissures of Sylvius, for the tubercular neoplasm occurs chiefly at the base of the brain along the course of the vessels. In simple meningitis, the inflammation may also occur at the base. It may in young infants be quite diffuse, and of little intensity in any one place, producing, in addition to hyperæmia of the pia mater, slight cloudiness and a moderate or slight escape of leucocytes from the

blood, these (pus cells) being perhaps visible only under the microscope. In meningitis, due to extension of inflammation from an otitis media, the inflammation is intense, confined to the portion of the meninges nearest the ear, and is often attended by inflammation of adjoining brain-substance, with perhaps the formation of an abscess. If the cause is exposure to the sun's rays, the meningitis is apt to be at the summit of the brain.

The exudation of fibrin is greatest along the course of the vessels, and in the depressions between the convolutions, and the opacity is most marked in these situations. Pus, when present, is often semi-solid, from the small proportion of liquor puris which it contains, even in recent cases. If the disease have continued several days, the liquor puris may be mostly absorbed, and the pus-cells becoming shrivelled, irregular, and aggregated, may resemble closely the cheesy transformation of tubercle-cells.

The fibrinous exudation presents features of interest. It does not usually attain much thickness, but by its opacity it conceals from view the brain underneath. If it occur in the fissures of Sylvius, the anterior and middle lobes are united by it. It is usually infiltrated through the substance of the pia mater. Sometimes little masses of variable size, often not as large as a pin's head, appear at the point of inflammation. These masses are firm, of a whitish color, or a light yellow, and their number varies in different cases. They consist of a firm, homogeneous substance, containing granular matter, and cells which often bear a close resemblance to tubercle-corpuscles, but are distinct. These corpuscular bodies are plastic nuclei or plastic cells, often shrunken. It is seen, then, that there are two morbid products which may be mistaken for tubercle: one, pus which has been in great measure deprived of its liquid element, and which may resemble cheesy tubercular matter, the other, plastic neuclei collected in little bodies, so as to resemble the ordinary from of crude tubercle. I once carried to one of the best microscopists and pathologists of this city some of the exudation from a case of meningitis, the cellular element in which could not readily be distinguished from shrunken tubercle-corpuscles. The exudation was from a child two years and eight months old, with good health previously to the meningitis; without tubercles in any part of the body, with parents healthy, and with no predisposition to tubercular disease. This microscopist, not knowing the history of the case, or character of the family, and ignorant, like all of us at that time, of the true tubercle-cell, pronounced the exudation tubercular after a careful examination with the microscope. Bouchut says: "The whitish miliary granulations which are observed on the surface of the pia mater have a certain consistency and tenacity which render them difficult to tear with the needles used for the preparation for the microscope. These bodies are formed: 1. Of fibro-plastic elements, whether nuclei or fusiform fibres; oval-shaped cells are generally present, but not always. The nuclei are oval or spherical, generally very small—that is to say, they hardly exceed

in diameter 0.008 mm. to 0.009 mm. The presence of these little spherical nuclei must be insisted on, because, with a less power than 550 diameters, it would be sometimes impossible to establish the differences which separate them from the elements of tubercle; the fusiform fibres are small and rare. 2. There exists a considerable quantity of amorphous homogeneous matter, in which minute granulations are scattered; it is very dense, and keeps the other elements strongly united together, so that it is difficult to isolate them completely. 3. Vessels are very rarely observed; the fibres of cellular tissue are also rare, or altogether wanting."

There being two microscopic elements which are distinct from tubercular formations, but are liable to be mistaken for them, namely, shrivelled pus-cells and plastic nuclei, more or less altered, it is seen, in part at least, why the old writers, and some of a more recent date, either hold that all meningitis is tubercular, or that there are comparrtively few cases of the simple form.

On the other hand, there are cases of true tubercular meningitis which, even with a pretty careful microscopic examination, might be, and probably often have been, regarded as simple. In order to a better understanding of this subject, I may be permitted to repeat certain facts already stated in the article on tuberculosis. The views of pathologists in reference to what is the primary form of tubercle, and what is and what is not tubercular matter have recently undergone a great change. It is now believed that the tubercle-cell is a round, pale, slightly granular cell, identical in appearance with the normal cell of the lymphatic glands, being in the average somewhat smaller than the white corpuscle of the blood; that it is produced mainly from the nuclei of the connective tissue by proliferation; that it is vitalized like other cells, and, of course, has functional activity; that the true, the living cell, is found only in the so-called gray, semi-transparent tubercle. It is furthermore believed, that what has heretofore been considered the tubercle-cell, namely, the irregular, sometimes angular, sometimes oval cell—without, indeed, any typical form—may be a dead, shrivelled, and altered tubercle-cell, or a dead, shrivelled, and altered pus or other cell. If, therefore, such cells are found in the meshes of the pia mater, we cannot determine from the microscope their true character. We can only form our opinion in reference to their nature from concomitant circumstances, or from discovering in connection with them the true tubercle-cell. Those products which have been designated crude tubercle and tubercular infiltration, contain these shrivelled cells, or shrivelled nuclei; and they may have a tubercular origin, or, on the other hand, an inflammatory origin, without either the tubercular product or diathesis.

In the tuberculosis of young children I have found, in a large proportion of cases in which I have had an opportunity to make post-mortem examinations, miliary tubercles disseminated through the lungs, and per-

haps other organs, in small masses, many of them not larger than a pin's head, and some occurring as mere specks scarcely visible. These minute tubercular formations have ordinarily been semi-transparent, and sometimes even transparent like minute drops of water, and containing the true and unchanged tubercle-cell. Now if in such a case meningitis occur, we may find the tubercle-cell in or with the fibrin at the base of the brain. But failure to find it, even with protracted microscopic examination, does not prove its absence from this locality, for I consider it almost impossible to discover in the midst of the fibrinous exudation such minute points of tubercular matter as are seen in the lungs, liver, or elsewhere. In view of these facts, I know no better rule for the practitioner, who cannot command the time for thorough microscopic examinations, than to consider as tubercular all cases of meningitis in which tubercles or cheesy glands are observed, in whatever part of the system, and consider as examples of simple meningitis all those cases in which no tubercles are apparent in the meninges or in any other organ of the trunk.

The pia mater is often firmly adherent to the brain at the seat of inflammation, so that on raising it a portion of the brain may be detached and removed with it. The extent of the inflammation varies much in different cases. There may in extreme cases be pretty general inflammation of the pia mater. In cases of such extensive meningitis, the symptoms are apt to be severe and the course of the disease rapid. Thus, in the month of April, 1866, a girl eleven years of age, in the Protestant Episcopal Orphan Asylum of this city, had complained occasionally of dizziness, but was otherwise in good health, cheerful, and with excellent appetite, till Thursday, when she was affected with vertigo, more persistent than previously, and with headache. At 2 P. M. on the following day she was seized with general convulsions, and continued insensible or nearly so, with occasional convulsive movements, till Monday, when she died comatose. The pia mater at the vertex, sides, and base of the brain had a cloudy appearance, and underneath it, in places, was a thick creamy substance in small quantity, which, examined by the microscope, proved to be pus, the largest amount being near the pons Varolii. There was no tubercle under the meninges or elsewhere, and no appreciable fibrinous exudation. The inflammation in this case was obviously intense. The only additional lesions noticed were moderate congestion of the brain and an increase in the quantity of the cerebro-spinal fluid.

If the disease is protracted three or four weeks, which is rare, or even less time, the exuded substance may undergo further changes, such as occur in simple exudations in other parts of the system. Thus, on the 30th of April, 1860, we made the post-mortem examination of an infant at the Nursery and Child's Hospital, who had symptoms of cerebral disease, it was stated, for several weeks, but the exact time was not ascertained. Prominent among the symptoms referable to the cerebro-spinal

system towards the close of life were the hydrocephalic cry and rigidity of the neck. The appearance at the autopsy was remarkable. The anterior half of the brain was completely encased in a deposit which had nearly the appearance of lard. It filled the fissures of Sylvius, and appeared slightly on the anterior aspect of the cerebellum. Examined under the microscope, this substance was found to contain numerous cells, among which could be distinguished some resembling pus-cells, but nearly all had undergone more or less fatty degeneration. Here and there was seen a large cell containing numerous small oil-globules, the compound granular cell of pathologists.

The brain itself in meningitis is usually injected. On making an incision through it, red points are seen upon the cut surface, which indicate the seat of the congested vessels. The inflammation rarely extends to the walls of the ventricles, but the choroid plexus is injected. In exceptional instances pus or fibrin is found in the lateral ventricles. In the infant, two and a half weeks old, whose case has already been alluded to, about two ounces of purulent fluid escaped on opening the left ventricle. A small amount of liquid of a similar character was contained in the right ventricle. The distension of the lateral ventricles with serum is one of the common results of meningitis. This fluid is clear or straw-colored, or it is turbid in consequence of being mixed more or less with the softened brain-substance. The quantity does not exceed two, three, or four ounces, and is often not more than one ounce or an ounce and a half. The distension of the two ventricles is ordinarily uniform, as they are united by the foramen of Monro, but now and then one ventricle is found more distended than the other. If there is considerable effusion, the brain is compressed and the convolutions have a flattened appearance, unless the cranial bones are still separated so as to yield to the pressure. If the sutures and fontanelles are open the cranial arch is expanded, sometimes quite perceptibly to the eye. From the same cause the anterior fontanelle, if open, is elevated. The foramen of Monro is enlarged according to the amount of effusion, and the portions of the brain which separate the ventricles are sometimes lacerated. In many cases the cerebral substance surrounding the lateral ventricles is softened. The softening is found in all degrees, from the least appreciable deviation from the normal consistence to a state of diffluence so that the brain presents the appearance of cream. Hypotheses have been advanced to explain the cause of this change in consistence, which are not entirely satisfactory. Whatever the explanation, the fact is attested by all observers, though there are exceptional cases. Thus Dr. West has records of the condition of the brain in fifty-nine cases, in thirty-seven of which there was considerable softening, and in the remaining twenty-two the consistence was normal.

Since a majority of the cases of meningitis in children are basilar, and portions of all the cerebral nerves lie at the base of the brain, it is easy to

understand why the functions of these nerves are so seriously impaired in this disease. Compression of these nerves, or extension of inflammation to their sheaths, affords explanation of many of the symptoms, as the sighing respiration, abnormalities of the eye, etc.

Although the above remarks relating to the anatomical characters of meningitis are applicable to a large majority of the cases, I must confess that I have sometimes been disappointed at the autopsies of young infants who died with all the symptoms of simple meningitis in not finding more lesions. Moderate hyperæmia of the pia mater, its slight opacity or cloudiness at the base of the brain or elsewhere, with the presence of a few wandering white corpuscles, without any fibrinous exudation, with no increase of liquid external to the brain, but a considerable increase of it in the lateral ventricles, and hyperæmia of the choroid plexus, with nearly natural appearance and consistence of the brain, have in some instances been the only lesions when I had expected to find marked anatomical changes.

I am fully convinced from my own observations that, in some instances, physicians who supposed that they were treating tubercular meningitis, and at the autopsies discovered within the cranium tubercles, without any inflammatory lesion, but with a larger increase of the cerebro-spinal liquid, have been treating cases in which in addition to the meningeal tubercles, which were latent, the bronchial glands were tubercular and cheesy, so that by their increased size they compressed the venæ innominatæ within the thorax, thus preventing the free flow of blood from the brain, and causing, as I have elsewhere stated, cerebral and meningeal congestion, with more or less transudation of serum, but with no meningitis.

Causes.—The causes of simple meningitis are not fully ascertained. Active cerebral congestion frequently occurring, however produced, appears to be one of the most common causes in young infants. In at least three instances I have known meningitis occur in infants between the ages of four and eight months, after severe and protracted bronchitis, which had been attended with the usual heat of head. The disappearance of eruptions upon the scalp, at or immediately before the commencement of the meningitis, has often been observed. I have witnessed it at the commencement of simple meningitis, as well as of meningitis which, if not tubercular, occurred at least in a decidedly scrofulous state of system. The direct effect of the solar rays upon the head, and the prolonged action of a high atmospheric temperature, even without direct exposure of the head to the sun, are common causes during the summer months in New York city. I once attended a child with this disease who had been much exposed bareheaded to the direct rays of the sun in August and September, and at his death, which occurred towards the close of the hot weather, found hyperæmia, opacity, and fibrinous exudation in the pia mater at the summit of the brain, while the base of the brain seemed nearly or quite normal.

In the *Jahrbück f. Kinderkrank* for October, 1875, Dr. Soltmann, of Breslau, reports three cases, in which intense cerebral hyperæmia, and probably meningitis, occurred from solar heat. In all three children the attack was sudden, the febrile movement and heat of head intense, and the progress rapid. The first had convulsions, the second automatic movements, and the third, the oldest, aged four years, when able to speak, complained of violent headache.

The statistics of New York city show that congestive and inflammatory maladies of the brain and its covering are more common during July and August, which are the months of maximum atmospheric heat, than in other months of the year. For example, in July and August, 1875, one hundred and sixty-seven died of these maladies, or one in every nine and eight-tenths who died from local disease, while during the entire year only seven hundred and ten died from the same, or one in every fifteen who perished from local diseases.

July, 1876, in New York city, was characterized by excessive and long-continued atmospheric heat, the temperature in the Central Park Observatory in the shade never falling below 61°, though never above 98°, and having a mean of 82.9°. There was also unusual dryness of the atmosphere, since during the entire month prior to July 30th, there were only fourteen hours of rain, with a rain-fall of .77 of an inch, and the average atmospheric humidity was represented by 65, saturation being denoted by 100. During this month I treated in my private practice four fatal cases, all between the ages of two and seven years, which I diagnosticated meningitis, none of them presenting any symptoms of otitis or tuberculosis. It would seem that the atmospheric heat had much to do with the development of the disease in these cases. One died in two days, but in the others there was the usual duration.

A not infrequent cause, especially among the strumous families of the cities, is otitis media, and caries of the petrous portion of the temporal bone, the inflammation extending to the meninges. Meningeal tubercles as a cause of meningitis, have been sufficiently alluded to.

Premonitory Stage.—Meningitis is usually preceded by symptoms which, if rightly interpreted, are of the greatest value. In most cases of both the simple and tubercular forms, which I have seen, there was a prodromic period, varying from a few days to several weeks. The symptoms of this period are obscure, and are apt to be mistaken for those of other and distinct affections.

The child in whom meningitis is approaching loses his accustomed vivacity and cheerfulness. He has a melancholy and subdued appearance, being quiet for a few minutes, and then fretful, without apparent cause. He can sometimes be amused by his playthings or companions for a brief period, when he turns from them with evident displeasure. Unexpected and loud noises and bright lights are evidently painful. If old enough to

describe his sensations, he complains of transient dizziness, and at other times of headache. His ill-humor, if his wishes are not immediately gratified, or if they are denied, is often scarcely endurable on the part of friends who are ignorant of the cause. There is great difference, however, in different cases, as regards this symptom. Some are inclined to be taciturn and quiet, while others are almost constantly fretting. The appetite is capricious; at one time it is pretty good, at another it is poor or even entirely lost. The patient may take a few mouthfuls of food, or, if an infant, nurse for a moment, when his hunger appears satisfied, and he will take nothing more. The bowels are regular or inclined to constipation. The pulse is natural, or it has times of acceleration, especially in the latter part of the day and towards the close of the premonitory stage. The duration of this stage is very different in different cases. Upon an average it is perhaps about two weeks, but it is often longer. In tubercular meningitis the symptoms, both during the inflammation and previously, are apt to be complicated by those which arise from tubercles in other parts of the system.

Unless the prodromic period is of short duration, the effect of imperfect nutrition is obvious before it closes. The flesh becomes soft and flabby, or there is actual emaciation, though generally slight. The patient loses his strength, becoming less able to stand or to walk, and more easily fatigued. Occasionally, especially in the simple form, premonitory symptoms are absent, or are slight and of short duration.

Symptoms.—Dr. Whytt, living in the last century, when the tendency was towards refinement rather than simplicity in classification, divided meningitis into three stages, according to the symptoms, especially the pulse. Many subsequent writers, following Whytt's example, have recognized three stages, based not upon the anatomical characters of the disease, but upon the succession of symptoms. Such division of meningitis is in great measure arbitrary, since in one case the same symptom occurs at an earlier period than in another.

When the premonitory stage has passed, and inflammation is developed, some of the symptoms which were previously present remain and are intensified, and other new and more characteristic symptoms appear. There are now fewer intervals of apparent improvement. The child is quiet, often lying with its eyes shut. If aroused, he has a wild expression of the face, and is irritated by attempts to engage his attention or amuse him. He rarely smiles, or takes his playthings, or he notices them for a moment, when he turns away with disgust. During sleep there is often at first a placid expression of countenance, but when aroused he has the aspect of real sickness; the eyebrows are sometimes contracted, as if from headache; the features wear a melancholy look, and are turned away to avoid the gaze of the observer or to shun the light. If the anterior fontanelle is open, it is observed to be prominent and pulsating forcibly. If conscious-

ness is not lost, and the patient is of sufficient age, he complains of headache, or of pain in some part of the body. The tongue is moist, and covered with a light fur; the appetite is lost or poor; there is seldom much thirst; more or less nausea and constipation are present. As the inflammation continues, and usually within three or four days from its commencement, symptoms arise which dispel all doubts, if there were any, as to the nature of the disease. The vital powers are now evidently beginning to yield. The surface generally is more pallid, and there is the curious phenomenon of the sudden appearance, and, after some minutes, disappearance, of spots or patches, or even streaks of active congestion upon the face, forehead, or the ears. These, having a bright red color, contrast strongly with the general pallor. Ordinarily they are irregularly circular or oval, and from one inch to an inch and a half in diameter. A red spot or streak is also produced if the finger is pressed upon the surface or drawn forcibly across it. It continues a few minutes and then gradually fades. Trousseau calls attention to this fact as a diagnostic sign.

Another curious phenomenon is the variation in temperature. The face and limbs at one time feel quite cool, and after some minutes, without any excitement or other appreciable cause, the temperature rises, so that the surface is warm to the touch.

Consciousness, in severe cases, may be lost at an early period. On the other hand, I have known it in a case of moderate severity to remain, though partially obscured, till within twenty-four or thirty-six hours of death. The patient will usually open his mouth for drinks, which are placed to his lips, when there is no other evidence of intelligence, and when sight and hearing are evidently lost.

The loss of the senses constitutes an interesting but melancholy feature of the disease. Among the first unequivocal symptoms, and frequently the very first, are such as pertain to the eye. This organ should be watched from day to day when the diagnosis is uncertain. Deviation from its normal state affords evidence of meningitis. The pupils are seen to dilate or contract sluggishly by variations in the intensity of the light, or they are not of the same size with those of another individual to whom the same amount of light is admitted. Sometimes the first perceptible deviation from the normal state is an inequality in the size of the pupils; while in others oscillation of the iris is observed. At a later stage, not generally till convulsions have occurred, the parallelism of the eyes is lost, and in most patients they have an upward direction. After effusion has occurred, the pupils are commonly dilated. As death approaches, the eyes become bleared, and a puriform secretion collects in the inner angle of the eye and between the eyelids. This secretion is not abundant, but it is sometimes sufficient to unite the lids. The sense of hearing is probably lost as soon, or nearly as soon, as that of sight, but the sense of touch continues longer. The tongue is covered with a moist fur, unless near the close of life, when

it is sometimes dry. The appetite is gradually lost, but often drinks are taken with apparent relish, even when there is no other evidence of consciousness. There are two symptoms pertaining to the digestive system which are rarely absent, and which possess great diagnostic value; one is vomiting, the other constipation. In some patients, irritability of stomach begins at so early a period that it is really prodromic; it is rarely absent. Barrier collected the records of eighty patients with meningitis, and in seventy-five of these this symptom was present. It is due to the intimate relation existing between the stomach and brain, through the ganglionic system of nerves. The vomiting occurs without effort, and usually at intervals, for several days. It is a sudden ejection of the contents of the stomach, apparently without preceding or subsequent nausea. It contrasts, therefore, with the vomiting due to an emetic, which is attended by distressing symptoms. With some it occurs frequently, with others not more than two or three times daily. Commencing in the first stages of meningitis, or even prior to it, it occurs less often as the drowsiness becomes more profound, and finally ceases. Constipation is also present, usually from the commencement of the meningitis. It is one of the most constant and persistent symptoms, continuing through the entire sickness, unless relieved by medicine, or unless there is a coexisting diarrhœal affection. Often, when diarrhœa precedes the meningitis, it ceases the moment the latter commences. The constipation in this disease is easily overcome by purgatives. Several writers speak of retraction of the abdomen as a sign of meningitis. A hollow or sunken appearance of the abdomen, according to Gölis, aids in distinguishing meningitis from fever. The anterior abdominal wall approaches the spine, so that the pulsations of the abdominal aorta are distinctly felt. Rilliet and Barthez, who have rarely observed this retraction except in cerebral diseases, attribute it to the state of the intestines rather than to the action of the abdominal muscles.

The pulse in the first stages of meningitis is accelerated, or it is nearly natural during certain hours and afterwards accelerated. When the disease has continued a few days, often not more than three or four, the pulse undergoes a marked change. It becomes slower, and at the same time, irregular. The irregularity usually consists in an intermittence of the pulse after each six or eight beats. Sometimes the force of the pulse varies, so that a feeble pulsation is succeeded by one of greater volume and strength. The decrease in the frequency of the pulse cannot fail to arrest attention. From 110 or 120 beats per minute in the first stage of the inflammation it often descends to a frequency even less than the normal adult pulse. At an advanced period, as death approaches, the pulse again becomes accelerated and feeble.

The change in respiration is as decided as that of the pulse. In the beginning of the meningitis respiration is sometimes moderately accelerated, but in other cases it is natural. When the disease has continued a few

days, the time usually varying from three or four to more than a week, a marked alteration occurs in the respiratory movements. Their rhythm, like that of the pulse, is disturbed. The breathing is irregular, intermittent, and accompanied by sighs. This change in pulse and respiration corresponds with the loss of consciousness, and shows that the brain is becoming seriously involved.

When the pulse and respiration undergo the changes which have been described, another prominent and grave cerebral symptom is often present, namely, convulsions. Its occurrence diminishes greatly the prospect of a favorable issue. The severity and extent of the convulsive movements vary in different cases. They may be partial or general. Their duration is often brief, but they recur three or four times through the day. They are preceded by cephalalgia in those old enough to express their sensations, and often by drowsiness. Each convulsive attack ends in still greater drowsiness.

With this group of symptoms another should be mentioned. I refer to the hydrocephalic cry. At intervals the patient, without being disturbed, and without any change in symptoms, utters a scream or sharp cry, and immediately relapses into his former state. This cry is more common in the commencement of the meningitis than subsequently, and in many it is absent or is not a marked symptom. The glandular system participates in the general loss or derangement of function. Tears are seldom shed, even when the child is much irritated, and the urinary secretion is diminished. The small amount of urine passed sustains an important relation to the progress of the disease and the therapeutics.

The patient usually lingers several days after the pulse and respiration are changed in the manner stated. The drowsiness becomes more profound, the vomiting ceases, as well as the convulsive attacks, and sensation and consciousness are entirely lost. But even in this state, if nutriment and stimulants are administered with regularity, the child often lives several days longer than the friends believed to be possible. At length increasing feebleness and rapidity of pulse and coldness of the face and limbs indicate the near approach of death, which occurs while in a state of coma.

The symptoms described above are such as occur in ordinary cases of meningitis, and in the order which I have indicated. But he will be disappointed who expects that the above description will apply to all cases.

Meningitis may be so violent and rapid that both the character and succession of symptoms are different from those which have been stated. Thus, I have related the case of a girl, who, with no prodromic symptoms excepting occasional dizziness and slight headache, was taken sick on Thursday, had convulsions on Friday, and from this time continued either in convulsions or coma till her death on Monday. Again, even in cases of the usual duration and anatomical character, some of the most prominent symptoms upon which we rely for diagnosis may be lacking. The following was a case of this kind :—

Case.—On the 5th of April, 1862, I was asked to see a boy two years and eight months old, of healthy parentage, and who, during the preceding year, had been in uniform good health, but previously had had two or three severe attacks of sickness. His head was unusually large, and whenever much indisposed he often had symptoms premonitory of convulsions, which were always, however, prevented.

One night, in the latter part of March, his parents noticed that his sleep was restless, but on the following day he seemed entirely well, and the restlessness at night was attributed to a late and hearty supper. On succeeding nights, however, he was restless, and, when questioned, complained of pain in the abdomen. In a few days he was observed to be drooping in the daytime, and his appetite was not quite so good as previously. He had continued in this way about a week when my first visit was made.

The abdominal pain had at this time become more constant, but was never severe or accompanied by moaning. When asked where he felt sick, he placed his hand upon the epigastrium, pressure upon which was sometimes tolerated, but at other times painful. The following symptoms were noted: tongue slightly furred, anorexia, thirst, constipation, scantiness of urine, no headache or unusual heat of head during any part of his sickness. He vomited at intervals from about the 7th to the 10th of April, when the irritability of stomach ceased, and there was no return of this symptom.

About April 7th, the respiration was first observed to be irregular and sighing, and the pulse intermittent. These symptoms, so tardily developed, were the first which indicated cerebral disease. He now lay most of the time in bed, with eyes closed, surface commonly pale, with occasional rose-colored spots or patches upon the cheek or forehead. The pupils responded to light in the usual manner till near the close of life, but bright lights were painful; the last two or three days of his life the left pupil was more dilated than the right. He had no convulsions or any spasmodic movement, and was conscious till within a few hours of death; the mother states that there was unequivocal evidence of his recognition of her on the last day of his life. He died April 17th, nearly three weeks after the commencement of the disease, and ten days after the commencement of symptoms which were distinctly referable to the brain.

Autopsy.—Abdominal organs healthy, though epigastric pain had been so constant and prominent a symptom; brain and its membranes somewhat injected. The meninges covering the base of the brain from the most prominent part of the pons Varolii to the first pair of nerves presented evidences of inflammation. There was such opacity of the pia mater in places, as to conceal the brain from view. The anterior and middle lobes of each hemisphere were glued together by fibrinous exudation, and on the left side, along the fissure of Sylvius, was a thick deposit of the same character. The lateral ventricles contained about an ounce of clear serum, and about half an ounce escaped from the base of the brain. The foramen of Monro was considerably enlarged, and the brain-substance surrounding the lateral ventricles was somewhat softened, but not in a notable degree.

In this case it is seen that the prominent symptom, and, indeed, almost the only marked symptom in the first stages of the disease, was pain in the abdomen, and yet the abdominal organs were healthy. At the very moment when it was highly important that a correct diagnosis should be

made, the evidences of cerebral disease were lacking. This case is, therefore, interesting on account of the variation in symptoms from those in the usual form of meningitis. There were no convulsions, and consciousness was retained as well as vision till near the close of life, and yet the lesions are such as are commonly present in meningeal inflammation. It is in such cases that a wrong diagnosis is apt to be made, to the injury of the patient and the reputation of the physician.

Occasionally meningitis may continue so long as to almost justify its being called chronic, even when there is a large amount of exudation upon the pia mater. In the few cases which end favorably, the symptoms abate gradually. I shall describe more fully the termination in speaking of prognosis.

Diagnosis.—It is of the utmost importance to diagnosticate meningitis in its first stages, since treatment, to be successful, must be commenced early. Certain writers describe at length the means of diagnosticating the simple from the tubercular form of the inflammation. Differential diagnosis is often difficult, and sometimes impossible; but it matters little, practically, whether the form of the disease is ascertained. On the other hand, it is very important, in order that the treatment be appropriate, to diagnosticate the premonitory or initial stage of meningitis from certain other affections not located within the cranium. Sometimes remittent or continued fever, or constitutional disturbances arising from irritation in the digestive system, simulate closely incipient meningeal disease, so that the greatest care and discrimination are required in order to make a correct diagnosis. Within a comparatively recent period I have known, in three different instances, experienced physicians of this city mistake commencing meningitis for fevers, not aware of the serious error they had made till the inflammation had reached a stage from which recovery was impossible. In order to avoid error in the diagnosis in the premonitory or initial stage of meningitis, the physician should take time to observe the physiognomy, and note every symptom. More than one protracted visit is often required to remove doubt as to the exact pathological state.

Meningitis is usually preceded and in its commencement accompanied by greater restlessness, fretfulness, intolerance of light, and greater variation of symptoms than most other maladies. One familiar with the physiognomy of infancy and childhood, will discover in the features indication of greater suffering, of more serious sickness, than is commonly present in other maladies which simulate this.

Sometimes the sudden disappearance of a chronic eruption upon the scalp will aid in the diagnosis. This is a sign of importance, taken in connection with the symptoms. Headache and vomiting, symptoms of early occurrence, should especially arrest attention, or, in absence of headache, pain of a neuralgic character in some other part. But we may repeat that familiarity with the symptoms of meningitis will not protect from

error if the visits of the physician are hasty, and his examinations imperfect. When the eyes become affected, the respiration and circulation irregular, and especially when convulsive attacks begin, diagnosis is easy. In fact, an incorrect diagnosis would then be unpardonable; but, unfortunately, if proper treatment has not been commenced till this period, it will be of little service.

Prognosis.—Meningitis is one of the most fatal maladies of early life. Whether the form is simple or tubercular, if the initial stage has passed without proper treatment, death may be considered inevitable. Tubercular meningitis, however early recognized, is rarely amenable to treatment. M. Guersant (*Dic. Med.*, t. xix, p. 403) believes that recovery from the first stage of this form of meningitis is possible. "In the second stage," says he, "I have not seen one child recover out of a hundred, and even those who seemed to have recovered have either sunk afterwards under a return of the same disease in its acute form, or have died of phthisis. As to patients in whom the disease has reached its third stage, I have never seen them improve even for a moment." The very few reported cases which resulted favorably may have been, as M. Guersant has intimated in the context, cases of the simple form. Rilliet and Barthez believe that in a few instances tubercular meningitis has been cured in its first stage, but they state also that it is apt to return.

The prognosis in simple meningitis is not so unfavorable, provided treatment is commenced at a sufficiently early period. It is now generally admitted that the simple form may not infrequently be averted, when threatening, and even arrested in its incipiency. In many such cases we cannot, from the nature of the disease, be certain that the diagnosis is correct. But when we see children relieved, who present precisely those premonitory and even initial symptoms which occur in meningitis, we must believe that at least some of them would have had the genuine disease if not relieved by the measures employed. That recovery is possible from simple meningitis in its commencement, is also obvious from the fact that a few recover even in the second stage, when there can be no error of diagnosis.

Although a considerable proportion of patients with epidemic cerebro-spinal meningitis recover, even when the symptoms have been most grave, I have known only two recoveries from sporadic meningitis when it had reached that stage, in which the functions of the brain and cranial nerves were impaired. One of these recovered with the permanent loss of sight, the other with the loss of hearing. Both seem to have ordinary intelligence. Another case has been communicated to me, in which the patient, a little girl, recovered completely, but for several months after the attack seemed nearly idiotic.

Sometimes even in the second stage of meningitis, treatment properly employed is attended by amelioration of symptoms. Though such im-

provement may serve to encourage physician and friends, it should not be the basis of a favorable prognosis unless it continue three or four days.

Apparent improvement during a few hours or a considerable part of a day, is not unusual in those who finally die. Thus, in an infant whose bowels were previously confined, I have known the pulse and respiration to become more regular and the symptoms generally improve, though only for a brief period, by the action of a purgative. Dr. Watson says of the advanced stages of this disease, it is "often attended with remissions, sometimes sudden, and sometimes gradual, deceitful appearances of convalescence. The child regains the use of its senses, recognizes those about him again, appears to his anxious parents to be recovering, but in a day or two it relapses into a state of deeper coma than before. And these fallacious symptoms of improvement may occur more than once."

Most fatal cases of meningitis terminate between the third or fourth and the twentieth day, the duration varying according to the extent and intensity of the inflammation, and the vigor and age of the patient. But there are cases in which it may continue much longer. It is surprising sometimes how long the patient lives, when the symptoms are such that death seems impending. Sensation and consciousness may be extinguished, convulsions occur at intervals, and the surface have acquired almost a cadaveric aspect, and yet the patient lives on. Rilliet and Barthez say: "Often have we inscribed upon our notes *death imminent*, and been astonished the next day to find still alive children to whom we had scarcely allowed two hours of life." The symptom which I have found to be the most reliable prognostic of the near approach of death, has been a pulse gradually becoming more frequent and feeble, though other symptoms remain as before. This change in the pulse is usually very apparent during the last twenty-four hours of life.

Treatment.—Such remedial measures should be prescribed during the premonitory stage as are calculated to relieve the fretfulness or irritability of temper and quiet the action of the brain, and, at the same time, produce a derivative effect from this organ. To this end the patient should be kept from all causes of excitement, and the bowels should be opened daily, if not naturally, by the use of proper medicines. A mustard foot-bath at night and occasionally through the day is useful, as it produces both a derivative and soothing effect. It will commonly produce a few hours' undisturbed rest, while all other measures except medicine fail. If dentition is taking place, and the gums are swollen, it has been the practice to employ the gum lancet, and still is with some physicians, but I for one have discarded its use for this purpose. Restlessness from dentition or restlessness premonitory of meningitis, requires decided doses of bromide of potassium, which will relieve the symptoms more effectually than the lancet. Three grains should be given to a child of six months, and four grains to one of ten or twelve months, and repeated if necessary in

two to four hours. If symptoms indicate the near approach of meningitis, or its incipiency, the head should be kept cool by a cloth wrung out of cold water, and cantharidal collodion should be applied behind one or both ears, over a space one inch in diameter.

Many children who are threatened with meningitis are scrofulous. They have already shown symptoms of tubercular disease. They are, perhaps, to a certain extent, emaciated, and may have been affected with a cough. The premonitory symptoms in these children indicate the approach of the tubercular form of meningitis, and a more sustaining course of treatment is required than in those who are robust. To such children cod-liver oil may be profitably given, three times daily, together with the syrup of the iodide of iron, and perhaps the bromide. They should also be taken into the open air, with proper precautions, and every hygienic measure should be employed which will be likely to invigorate the system without exciting the brain.

Loss of blood is not, in general, required during the prodromic period nor in the disease. Those of a strumous cachexia, or those, whether strumous or not, who are under the age of two years, do not, unless in very rare instances, require depletion by leeches, much less by venesection. There is one class of patients in whom the early loss of blood may doubtless, be of service, namely, those who in a state of robust health are suddenly seized with the inflammation. Leeches should then be applied to the head of the patient, if he is seen at an early period.

Often, notwithstanding the measures employed, the patient grows worse, the symptoms become more continuous, others more alarming arise, and meningitis declares itself. Whatever the cause of the inflammation, and whatever modifications of treatment were required in the premonitory stage, on account of special indications, the purpose now is to subdue the inflammation by every resource in our art, which does not injure or too much prostrate the system. In former days calomel was largely employed as the main remedy in this disease, but when administered daily it has a very depressing effect, and it is to be borne in mind that in meningitis the vital powers progressively fail on account of the loss of appetite, vomiting, etc. In tubercular meningitis depressing treatment is, of course, strongly contraindicated, cases have occurred in which calomel was given at short intervals for several successive days, so as to produce a laxative effect, and though the meningitis seemed to be controlled, death occurred from exhaustion, or from some intercurrent affection, the result of the exhaustion. Thus in one case related to the class by a distinguished professor in New York city, fatal gangrene of the mouth supervened from the mercurial treatment, after the meningeal inflammation had apparently subsided. Although calomel, during these last years, has been properly discarded as the main remedy, and its daily use rejected, nevertheless it is very useful as an occasional laxative in the more robust cases, if not given too near

the iodide of potassium, and it is especially indicated as a derivative from the head in children of four or five years, who, previously hearty and strong, have become suddenly affected with meningitis, as from exposure to the sun's rays or from an injury. But I repeat, that in my opinion, in ordinary cases, calomel should never be employed, except as an occasional laxative.

The two remedies upon which we must chiefly rely are the iodide of potassium and the bromide of potassium, or sodium. While the bromide quiets the restlessness, prevents convulsions, and diminishes, there is reason to think, to a certain extent, the hyperæmia, the iodide is useful as a sorbifacient, and it probably has some control over the inflammation. The iodide or bromide can be given together or separately.

The iodide should, like the bromide, be given early. If by a careful examination, the absence of any other local disease, or constitutional disease, which might give rise to the symptoms is ascertained, and the symptoms indicate the meningeal disease, the iodide should be immediately prescribed. Obscurity often hangs over meningitis at this early stage, but it is better to give the iodide, even if the diagnosis is wrong, and no inflammation has commenced, than to err on the other side, and withhold it in the initial period of the true disease, for it is not an injurious remedy like calomel, and to exert any marked curative effect, it should be given in the commencement of the inflammation. An infant of the age of six to twelve months should take two grains every two hours, and older children a proportionate dose. At the same time the bromide should be given in doses twice as large as that of the iodide, if the indications for its use are present, namely, headache, restlessness, and symptoms which threaten eclampsia. The bromide is a harmless remedy given often for a limited time. With the regular and continued use of the iodide and bromide, the quantity of urine is in most cases largely increased, and if the patient's condition do not soon begin to improve there is no remedy.

If convulsions occur the bromide should be given every ten or fifteen minutes till they cease, or, if they are not controlled by the bromide, an injection, *per rectum*, of three to five grains of hydrate of chloral in a teaspoonful of water should be used in addition. Compresses wrung out of cold water frequently applied to the head, or a bladder containing pounded ice, and separated by two or three thicknesses of muslin from the head, materially aids in reducing the meningeal hyperæmia.

In the first stage of simple meningitis the diet should be mild and in moderate quantity, but in the tubercular form it should from the first be of the most nourishing kind, consisting of beef-tea, milk-porridge, etc. At a more advanced stage in both forms of the malady the most nutritious diet should be allowed, but alcoholic stimulants should not be given unless near the close of life when the vital powers are failing. The apartment should be cool and quiet.

CHAPTER X.

SPURIOUS HYDROCEPHALUS.

The disease known as spurious hydrocephalus might with more propriety be called spurious meningitis. It received its appellation at the time when meningitis of early life was believed to be essentially a hydrocephalus, and was so called. Attention was first directed to this malady by London physicians of the last generation, particularly by Drs. Gooch, Abercrombie, and Marshall Hall, and little can be added to their description of its symptoms.

Anatomical Characters.—This disease, though resembling meningitis in certain of its phenomena, is not in its nature inflammatory, nor is it primary. It is the result of some malady often chronic, but occasionally acute, which has produced exhaustion, especially of the nervous system. When it commences, there is usually more or less emaciation, and the symptoms of the primary disease are present. To this disease the lesions pertain which are found in other organs besides the brain.

The state of the brain in spurious hydrocephalus is not the same in all cases. In some there is no appreciable anatomical alteration in this organ. There is no apparent difference, either in the meninges or the brain itself; from the condition which we often observe in those who have died of diseases which do not affect the cerebro-spinal system. In such cases the pathological state is simply deficient innervation, or if there is a structural change in the minute anatomy of the brain, pathologists have not yet discovered it.

The following case, which occurred in the Child's Hospital of this city, is an example of this form of spurious hydrocephalus :—

Case.—A female infant, six months old, died on the 24th day of April, 1862, with the following history : It was wet-nursed, fleshy, and apparently well, till six days before death, when symptoms of gastro-intestinal inflammation were suddenly developed. The vomiting, especially, was severe, continuing forty-eight hours. When it ceased, drowsiness supervened, and continued till the close of life. The face during the four days of stupor was pallid and cool; eyes partly open, pupils sluggish, but of equal size; bowels rather torpid; anterior fontanelle depressed. When aroused, the infant noticed objects for a moment, and immediately relapsed into sleep; pulse accelerated and not intermittent, the day before death numbering one hundred and fifty; respiration accelerated, without sighing, numbering on the same day thirty. There were no convulsions, and death occurred quietly. The brain weighed twenty and a half ounces, and its appearance was perfectly healthy, both as regards consistence and vascularity. The

amount of cerebro-spinal fluid in the ventricles and at the base of the brain was not notably increased. The stomach, small and large intestines, were vascular in streaks and patches.

In this case the cerebral symptoms were obviously due to exhaustion occurring at an early period, in consequence of the severity of the gastro-intestinal affection.

In a majority of cases, however, of spurious hydrocephalus, according to my observation, there is an anatomical alteration in the state of the brain and meninges. This consists in passive congestion of the veins, often with transudation of serum. At the same time the cranial sinuses are congested, and are found at the post-mortem examination to contain larger and more numerous clots than are present in those who die of diseases which do not affect the encephalon. Cases might be cited as examples. The cause of this congestion and effusion is, in great measure, feebleness of the circulation due to the general exhaustion of the patient. But there is another cause. In protracted diseases, especially those of a diarrhœal character, there is more or less wasting of the brain as well as of other parts. This naturally, by way of compensation, gives rise to congestion of the cerebral and meningeal veins and capillaries and to transudation of serum.

The transudation commonly occurs in this malady over the superior surface of the brain and in the subarachnoidal space, perhaps also more or less in the lateral ventricles. So common is it in the last stage of infantile entero-colitis, the summer epidemic of the cities, that this stage, which is really spurious hydrocephalus, has been called the stage of effusion. I shall relate in another place examples which show the anatomical characters of this intestinal disease.

Symptoms.—Spurious hydrocephalus most frequently results from protracted diarrhœal complaints. It may, however, result from any disease which is attended by great prostration. As it ordinarily occurs, the patient has for days or weeks been gradually losing flesh and strength. Finally drowsiness supervenes, or before the drowsiness there is sometimes a period of irritability.

Marshall Hall describes two stages of spurious hydrocephalus. In the first he says: "The infant becomes irritable, restless, and feverish; the face flushed, the surface hot, and the pulse frequent; there is an undue sensitiveness of the nerves of feeling, and the little patient starts on being touched, or from any sudden noise; there are sighing and moaning during sleep, and screaming; the bowels are flatulent and loose, and the evacuations are mucous and disordered." The second stage he describes as that of torpor. The first stage often, however, does not present those prominent symptoms which have been described by Dr. Hall, and this stage may even be absent, or not appreciable, especially in young infants.

Whether or not commencing with the stage of irritability, the disease, if not checked, gradually increases. The child soon becomes drowsy. He

may be aroused for a moment, but, unless constantly disturbed, immediately relapses into sleep. He is sometimes fretful when aroused, but in other instances is quite indifferent, observing without apparent interest objects employed for the purpose of amusing him. Often there are indications of cerebral pain or distress, as contraction of the eyebrows, etc., but many of those affected are too young to make known their sensations. Convulsions sometimes occur towards the close of life, but they are not so common in this disease as in meningitis. When they do occur, they are generally partial and often slight. The pulse is accelerated in most patients prior to and in the commencement of spurious hydrocephalus. As the disease advances it becomes irregular and intermittent, and towards the close of life it is progressively more frequent and feeble. The respiration at first is not much disturbed, but at length it becomes irregular, like the pulse. It is feeble and accompanied by sighs. Occasionally there is slight cough. The eyelids are partly open, the pupils no longer respond to light, and in advanced cases they have a bleared appearance. The diarrhœa, which in most instances precedes and causes this malady, continues till the stage of stupor arrives, when the evacuations become less frequent or cease altogether. In infants the stools are frequently green, in older children brown and sometimes slimy. The febrile heat of surface, which preceded the disease and was present in its commencement, disappears; the face and hands become cool, the features pallid, and the anterior fontanelle, if open, is depressed. Death finally occurs in a state of coma, or, if the disease is recognized and proper remedial measures employed, the result may be favorable, even when the symptoms are such that if meningeal inflammation were the disease we would consider the case necessarily fatal.

The following case is an example of spurious meningitis as we often meet it in practice:—

Case.—On the 13th day of March, 1859, I was asked to see a male child twenty-two months old, the records of whose case are as follows:

"Was well till about three weeks ago, since which time he has had diarrhœa, with febrile symptoms; pulse 162, respiration 52; has a slight cough, with a few mucous räles; resonance on percussion of chest good; is somewhat emaciated, and appears languid; tongue moist and slightly furred. Has all the incisor and three anterior molar teeth, and the gum is swollen over the remaining anterior molar and two canine teeth."

From the 14th to the 18th there was no material alteration in his symptoms, with the exception that the diarrhœa was partially restrained by Dover's powder in one and a half grain doses. On these five days the stools numbered daily from one to six. The pulse was uniformly frequent, varying from 124 to 156, and the respiration on two days, when its frequency was ascertained, numbered 56 and 46.

"March 19th, pulse 124; has become drowsy since yesterday, and when aroused is fretful. Omit Dover's powder. Treatment, cold applications to the head, mustard pediluvia.

"Evening, pulse 136; eyes constantly closed and head reclining; surface generally warm; tongue dry and furred; vomited at first, but has not

in three or four days. Apply cantharidal collodion behind each ear, and continue the local treatment.

"20th, pulse 130; is constantly sleeping, and when aroused is very fretful and soon relapses into sleep; no unnatural heat of head, and no dejection since yesterday. Treatment, a dose of castor oil, nourishing diet.

"21st, drowsiness as before; cheeks sometimes flushed, sometimes pale; pupils sensitive to light; margins of eyelids covered with secretion. The bowels have been opened by the oil."

On the 22d and 23d there was no material change in the symptoms. He was constantly sleeping, except for a moment when shaken. More active stimulation was now employed. Brandy was prescribed, to be given every two hours; beef tea and milk porridge frequently.

On the following day, the 24th, he was more fretful, and less drowsy. Brandy and beef tea were continued.

On the 25th, with the same treatment, there was still further improvement; drowsiness nearly gone and less fretfulness than yesterday; rolls the head occasionally and does not appear to see distinctly; has a slight cough; stools nearly regular; pulse 100; respiration natural; surface warm, and no unnatural heat of head. The same treatment was continued, and he rapidly and fully recovered.

This case is intesting on account of the long duration of marked drowsiness, which continued five days, and yet the patient recovered entirely in the space of two or three days under the use of brandy and beef tea.

In May, 1860, I was called to treat a very similar case. A child, twenty months old, had diarrhœa for two weeks, the stools being of a dark-brown color, thin and offensive. He was at first very irritable. The pulse was constantly above 130, and the respiration was correspondingly increased. The stage of drowsiness finally supervened, and for two days he was constantly asleep unless aroused by being shaken. During the somnolent stage the pulse numbered 140, respiration 36. The face and extremities were cool and he finally had a slight convulsion. By stimulants and nutritious diet he began immediately to improve, and was soon out of danger.

In the following case the result was unfavorable. This case is interesting on account of the anatomical characters of the disease as disclosed by the post-mortem examination. It is an example of that large class of cases in which spurious hydrocephalus is associated with congestion of the cerebral vessels and serous effusion. It is exceptional, however, as regards the long duration of drowsiness. Ordinarily, protracted diarrhœal maladies which end in passive congestion and effusion, terminate fatally in three or four days after the drowsy period arrives.

Case.—"Dec. 13th, 1861, called to-day to a German infant eighteen months old. It has had diarrhœa four weeks without regular and proper medical attendance; stools from the first brown and thin; during the last eight or nine days he has been drowsy; when aroused, opens his eyes and is very fretful, but immediately the upper eyelids gradually droop, and, unless disturbed, he remains asleep with his eyes partially open; forehead warm, face cool and pallid, and limbs also rather cool; pulse 164, respiration 32;

has had a slight cough about one week, and slight dulness on percussion over the left infra-scapular region; depression of infra-mammary region on inspiration. Treatment: Ammon. carbonat. gr. 1 every two hours; nourishing diet.

"Dec. 20th, has continued drowsy since the last record; pupils moderately dilated; a thick secretion between eyelids; right pupil considerably larger than the left; vision apparently lost during the three last days; pulse over 140; respiration 44 per minute, accompanied by sighing since the 18th; moans much when awake; rolls the head frequently; during the last six days the surface back of the ears has been constantly sore by vesication; takes the most nutritious diet, with brandy. The dejections remain thin and brown, and number three or four daily.

"From this date the diarrhœa continued, except as it was restrained by vegetable astringents. The pulse continued frequent, and a slight cough remained. There was on the 21st and 22d partial abatement of the drowsiness, but on the 23d it was greater than ever. The body was somewhat reduced at the commencement of the cerebral symptoms, but it was now considerably emaciated. The prostration increased daily, and the hands were observed to tremble. The face and hands became more cold, while the head was warm. On the 24th partial convulsions occurred, followed by coma and death.

"The cerebral veins and sinuses were generally congested, except in the anterior portion of the brain, where the appearance was normal. Between the brain and its membranous covering, chiefly at the vertex and the base, was an effusion of clear serum. The whole amount of this fluid was estimated at two ounces. On slicing the brain, numerous 'puncta vasculosa' were seen, both in the gray and white portions. With the exception of the congestion, the substance of the brain presented its normal appearance. No inflammatory lesions were present. We were not permitted to examine the condition of the intestines."

Diagnosis.—The only disease with which spurious hydrocephalus is liable to be confounded is meningitis. The points of differential diagnosis are the history of the case, especially the antecedent diarrhœa or other exhausting ailment, evidence of prostration when the cerebral malady commenced, depression of the anterior fontanelle in young children, and the cool face and extremities.

Prognosis.—If the pathological state of the brain is simple exhaustion, the disease can often be arrested by judicious treatment. If an incorrect diagnosis be made, and the treatment employed is that appropriate for meningitis, which it so closely simulates, death is almost inevitable. If transudation of serum has occurred, unless slight, the result is apt to be unfavorable, whatever may be the treatment. This disease in childhood is more easily managed than in infancy, but is less frequent. The prognosis is better in the cool months than during the heat of summer. It is more favorable if the child is over than if under the age of one year. The occurrence of an irregular and intermittent pulse, of respiration accompanied by sighs, of inequality in the pupils or their sluggish movements, with increasing stupor, indicates an unfavorable issue. The cure of the primary disease, with the pulse and respiration still natural, or accelerated,

without change of rhythm, pupils sensitive to light, drowsiness from which the patient is easily aroused to a state of entire consciousness, render recovery probable, with proper medication and alimentation.

Treatment.—The indications of treatment are twofold: first, to remove the primary pathological state which is the cause of the spurious hydrocephalus; and, secondly, to cure the latter. The first is important, since the successful treatment of a disease requires the removal of the cause. The measures employed for this purpose are pointed out in our description of the diarrhœal and other maladies which produce spurious hydrocephalus.

We may here say that as spurious hydrocephalus is due in a very large proportion of cases to the exhausting effect of long-continued diarrhœa, astringents, especially of subnitrate of bismuth, and alkalies are required in a majority of cases in the stage of irritability, and sometimes also opiates.

Active sustaining measures are indicated. Exhausted nervous power, as well as passive cerebral congestion, requires this. The diet should be highly nutritious, comprising such substances as milk and animal broths, and should be given frequently. Brandy is required at short intervals. Dr. Gooch was in the habit of giving the aromatic spirits of ammonia, properly diluted, as a quick and active stimulant. Six or eight drops may be given in sweetened water to a child one year old, and repeated every hour in cases of urgency. If, by proper treatment of the cause, and by the use of stimulants and nutritious food, the patient does not within a few hours become less stupid and more conscious, there is that degree of nervous exhaustion or of serous transudation from the engorged cerebral veins which will render death probable. In some cases it is proper to produce moderate vesication behind the ears.

CHAPTER XI.

ECLAMPSIA.

The term eclampsia is used in a more restricted sense by some writers than by others. It is used in the following pages to designate those convulsive seizures, clonic in their character, sometimes general, sometimes partial, which affect the external muscles. Eclampsia is therefore synonymous with clonic convulsions. It consists in a rapid, forcible, and involuntary muscular contraction, alternating with relaxation. It is distinguished from chorea in the fact that the latter is a more permanent state, and is

characterized by muscular movements which are partially under the control of the will, and are not so violent.

Eclampsia occurs in a great variety of diseases, some of which are located in the cerebro-spinal system, some in other parts of the body, and some are constitutional. It may also be produced by temporary derangements of system, not sufficiently severe to be considered diseases, and by powerful mental impressions, those of an emotional nature, affecting the delicate and sensitive nervous system of the child. Pathologists recognize three distinct forms of eclampsia. The term essential or idiopathic is used when the convulsions have no appreciable anatomical character, that is, when there is no apparent pathological state in the brain or elsewhere, which gives rise to the attack. For example, if a child dies in convulsions from fright, and all the organs, including the brain, are found in their normal state, the eclampsia is called idiopathic or essential. If the cause is disease of the brain or spinal cord, it is termed symptomatic. If it arises from disease elsewhere, as from pneumonia, the term sympathetic is employed. This is in the main a good division, but eclampsia may be at the same time sympathetic and symptomatic, as when it occurs in consequence of congestion of brain, which is induced by severe and frequent paroxysms of hooping-cough.

Causes.—Eclampsia occurs at any period, of infancy and childhood, but it is much more rare after the period of six or seven years than previously. Some children are more liable to it than others. It is produced in one by an agency which in another has no appreciable effect. There are some, generally those of an impressible nervous system, who are seized with convulsions whenever there is any slight derangement in the digestive or other organs. Eclampsia is frequent in certain families. Thus, Bouchut mentions a family of ten persons, all of whom had convulsions in their infancy. One of them married, and had ten children, all of which, with one exception, had convulsions.

The exciting causes of eclampsia are too numerous to be mentioned in full. It is a symptom in nearly all cerebral diseases. It is produced in the nursling by changes in the milk with which it is nourished. These changes are usually due to violent emotions of the mother, as anger, fright, and grief, to the use of acescent or indigestible food, or to derangement, temporary or permanent, in her health. Thus, in a case related to me, the catamenia so affected the milk that the infant was seized with eclampsia at each monthly period. In childhood the most common cause of clonic convulsions is the presence of some irritant in the primæ viæ. All kinds of fruit, even the mildest, may produce eclampsia, especially when eaten unripe or taken in undue quantity. I have known an infant to be seized with convulsions from eating strawberries, which parents usually regard as harmless, and one of the most violent and protracted cases of eclampsia which I have witnessed, occurred in a child over the age of six years,

from swallowing, in considerable quantity, the parenchymatous portion of an orange. Constipation, worms, dysentery, intussusception, and painful dentition are also causes which are located in the digestive apparatus. Inflammation in some part of the respiratory apparatus is a not infrequent cause. Thus eclampsia occurs occasionally in severe coryza, in consequence, according to some, of the proximity of the inflamed surface to the brain, and the consequent afflux of blood to this organ. It is a common complication also of pertussis and pneumonia. It occurs often at the commencement of two of the eruptive fevers, namely, smallpox and scarlet fever, and in the course of the latter disease.

Violent emotions of the child may also cause eclampsia. Bouchut relates the case of a girl, five years old, who was corrected before her companions, and was so affected by anger that convulsions ensued. Residence in close and overheated apartments, or in streets where the air is loaded with offensive vapors and is stifling, is a predisposing cause, so that there is a larger proportion of deaths from convulsions in the cities than in the country.

In young children, burns, even when not very severe, are apt to terminate suddenly in eclampsia, succeeded by coma and death. Urinary calculi, both renal and vesical, frequently produce the same result.

Such are the more common causes of eclampsia. It is seen that they are of two kinds, predisposing and exciting. An excitable or impressible state of the nervous system constitutes the chief predisposition to the disease. Plethora, or its opposite state, anæmia, increases the liability to an attack.

Premonitory Stage.—In the majority of cases there are prodromic symptoms, which the experienced and careful physician can detect, so as to forewarn friends. The child is perhaps more or less drowsy, and, when disturbed, fretful. The eyes often have a wild or unnatural appearance; occasionally they are fixed for a moment on an object, and yet apparently without noticing it. The sleep is disturbed; in some there is unusual heat of head, and, if old enough, complaint of headache. At times, especially if the primary disease is febrile or inflammatory, there is incoherence of thought or expression, or even actual delirium. In some children, when eclampsia is threatening, the thumbs are seen to be carried often across the palms. I have observed this especially during the convulsive cough of pertussis. A very important prognostic symptom is sudden starting, or twitching of the limbs. This shows that the nervous system is profoundly impressed, and but slight additional excitation is required to develop eclampsia. This sudden starting not infrequently precedes the attack several hours, and gives sufficient forewarning.

The prodromic symptoms are often disregarded by friends who do not understand their significance. Even physicians, in the haste of their visits, in many instances do not notice them. The symptoms which pre-

cede symptomatic and sympathetic eclampsia are, moreover, blended with those of the primary affection, and hence another reason why they are apt to be overlooked. When the convulsions are about to commence, the child generally lies quiet; the eyes are open and fixed. If spoken to or shaken, he takes no notice, and does not speak. The direction of the eyes is then changed; often they are turned up; sometimes there is strabismus. The face may be pale or flushed, and sometimes, especially in cerebral diseases, the features present patches or streaks of a flushed appearance, while around them the natural color is preserved. Immediately before the spasmodic movements the child occasionally utters a piercing scream, which is probably involuntary, though it seems like a supplication for help. The duration of the prodromic stage is very different in different cases. It may last from a few minutes to several hours, or even more than a day.

Symptoms.—Eclampsia is general or partial. If *general*, the muscles of the face, eyes, eyelids, and of all the limbs, are in a state of rapid involuntary contraction, alternating with relaxation. The features lose their natural expression and are distorted; the mouth is drawn out of shape, often to one side, by the violent muscular action; the teeth are pressed together by tonic contraction of the masseters, and may be violently struck together, so as to lacerate the tongue, if it protrude, or are ground upon each other. Unless the attack is of short duration, frothy saliva, perhaps tinged with blood from the injured tongue, collects between the lips. The eyelids are usually open, and in severe cases the eyes are turned so that the pupils are lost under the upper eyelids, or the muscles of the eyes are involved in the spasmodic movements, so that the eyeballs are forcibly drawn from side to side. Occasionally strabismus occurs. While the features are thus distorted, the head is strongly retracted or is turned to one side; the forearms are alternately pronated and supinated; the thumbs and fingers are convulsively flexed, so that the thumbs lie across the palms and are covered by the fingers; the great toe is adducted, the other toes flexed; and the toes, as well as legs, participate more or less in the spasmodic movements.

In general convulsions, consciousness is usually lost. The head is hot previously to and during the attack—at least in the first part of it—and the face flushed. In exceptional cases, especially in sympathetic eclampsia, the head is cool and the face pale. The pulse is somewhat accelerated, as well as the respiration, and the latter is rendered irregular if the respiratory muscles, especially those of the larynx, are involved, as they generally are. The sphincters are relaxed during the convulsive attack, so that in many cases the urine and stools are passed involuntarily.

Partial eclampsia is more common than the general form; it occurs in the muscles of the face, including those of the eye, of the face and of one or both upper extremities, or of the face and the extremities on one side.

The spasmodic movements may be even limited to the muscles of the eye, and they often occur only in these muscles and those of the face. Rarely, if ever, does eclampsia affect the legs without affecting also the muscles of the arms and face. In partial convulsive attacks, sensation and consciousness are in some patients not entirely lost, but in others they are not manifested if present.

The duration of an attack of eclampsia varies in different cases from a few minutes to several hours, with an average of not not more than from five to fifteen minutes. The movements do not often continue longer than three or four hours in the severest cases. They are sometimes said to last a much longer time, even for days, but there are in these cases intermissions. Violent attacks are usually short.

When the convulsion ends favorably, the spasmodic movements become less and less strong, and finally cease. The child then takes a deep inspiration, after which it lies quiet, and the respiration remains regular or moderately accelerated. Some fully recover in a few minutes if the eclampsia has been light and the cause transient, and seem to experience no inconvenience except soreness of the muscles and fatigue. Others soon recover consciousness, and their temperature, respiration, and circulation become natural, but they remain dull for a time, their minds are bewildered, and they are perhaps unable to speak. In a few hours these untoward symptoms pass away. In essential, and in a large proportion of cases of sympathetic eclampsia, if properly treated, and if the cause is recognized and removed, there is no recurrence of the convulsion; with others it is different. In many cases, especially of symptomatic eclampsia and of sympathetic, in which the cause is grave and persistent, the convulsions return after a variable period of a few minutes or a few hours. Six or eight or more convulsions may occur within twenty-four hours. Rarely they occur several times daily for several consecutive days, but severe convulsions, repeated at short intervals for twenty-four or forty-eight hours, usually end in fatal congestion of the brain or serous effusion. I once attended an infant about six months old, who had from four to twelve convulsions daily for eleven days, caused probably by a vesical calculus, as there was dysuria, and, at times, bloody urine. Some days after the convulsions were controlled, while we were deferring exploration of the bladder, death occurred suddenly, and the autopsy was not permitted. This case will be detailed elsewhere. Bouchut has witnessed a case of hooping-cough in which there were daily convulsions for eighteen days.

In severe eclampsia, the respiration is so embarrassed and circulation so retarded that congestion of various organs results. This passive congestion in the respiratory organs is indicated by moist râles in the larynx and bronchial tubes; occurring in the brain, it is indicated by profound stupor. It has already been stated that death may occur from the cerebral congestion, which, continuing, is apt to end in effusion of serum or

extravasation of blood. In these cases the convulsive movements cease, but there is no return of consciousness. The child lies quiet, as if in sleep, with pupils not readily acted upon by light, and often somewhat dilated; gradually the limbs grow cool and the pulse feeble, and fatal coma supervenes.

Death does not ordinarily occur from one attack. There are several at intervals, during which the stupor is gradually becoming more and more profound, till, finally, there is total loss of consciousness and sensation. This is the most frequent mode of death, namely, from coma. Apnœa may occur in the first attack, ending life abruptly and unexpectedly, but in other instances it does not result till after several seizures, when, at length, one more violent than the others interrupts the respiratory function and causes death.

Occasionally, when life is preserved, there is some permanent ill effect of eclampsia. Bouchut says: "The origin of certain permanent contractions which bring on deviation of the head or of other parts, retraction of the limbs, paralysis, etc., must be referred to the convulsions of the muscles. I have seen several children in whom torticollis had no other cause. The drooping of the upper eyelid, strabismus, irregularity of the mouth, severe contractions of the limbs, often depend on this influence. These accidents are consequences of essential as well as of symptomatic convulsions."

Anatomical Characters. — The morbid anatomy pertaining to eclampsia is in most cases twofold: first, the pathological states which precede and cause the convulsive movements; secondly, those which result from them. We have seen that in sympathetic eclampsia the diseases which sustain a causative relation are very numerous; some are constitutional, others local, and the latter may have their seat in almost any part of the economy, distinct from the cerebro-spinal axis. In some cases of sympathetic eclampsia the immediate cause is too active a circulation, a state of hyperæmia of the cerebral vessels.

It has already been stated that this hyperæmia may be diagnosticated in young infants in whom the anterior fontanelle is open. Such infants, seized with acute inflammation of the mucous surfaces or of the lungs, often present a full and rapid pulse and a convex and forcibly pulsating fontanelle before the eclampsia begins. In other cases of sympathetic eclampsia the primary disease induces passive congestion of the brain, and this in turn gives rise to convulsions. Eclampsia occurring during the paroxysms of hooping-cough affords an example. In the contagious diseases, as smallpox and scarlet fever, eclampsia is doubtless often produced by the direct action of the specific virus on the cerebro-spinal system. Therefore, in a considerable proportion of cases of eclampsia due to diseases not located in the cerebro-spinal system—in other words, of sympathetic eclampsia—the primary disease induces a pathological state of the cerebral

vessels or of the blood which circulates through them, which state immediately precedes and accompanies the convulsions.

In other cases of sympathetic eclampsia the convulsive movements are produced by the primary disease, acting directly on the nervous system, through the medium of the nerves, without causing any appreciable alteration in the state of the cerebro-spinal axis. Thus Barrier relates three fatal cases of convulsions occurring in pneumonia, in none of which was there anything abnormal in the condition of the brain or its membranes.

The pathological state preceding SYMPTOMATIC eclampsia differs in different cases, since convulsions occur in almost every disease of the brain and its membranes. The immediate cause of this form of eclampsia may be active or passive cerebral congestion, with or without effusion; it may be compression of the brain from various causes; it may be a deficiency as well as excess of the cerebro-spinal fluid.

In essential eclampsia the cause sometimes produces congestion of the brain prior to the convulsive seizure. In other cases, as when convulsions occur immediately from the effect of anger or fright, there is no appreciable change in the state of the nervous centres previously to the attack.

Again, eclampsia, especially when severe and protracted, and when occurring in successive attacks, may be the cause of certain lesions. It produces congestion of the brain and membranes, and perhaps of the spinal cord. Sometimes, if the congestion is great, there is also escape of serum from the distended capillaries, and the fibrin in the larger vessels, as the sinuses may coagulate.

The congestion resulting from eclampsia may give rise to extravasation of blood and the formation of a clot. If this accident occur, there is often paralysis affecting more or less of one side, permanent or gradually disappearing.

It may be difficult to decide whether the cerebral congestion precedes the eclampsia or is its result; but in those cases in which it precedes and operates as a cause, it is no doubt increased during the convulsive period. The spasmodic muscular action, by rendering respiration irregular and imperfect, also leads to congestion of the lungs and sometimes of the abdominal organs.

DIAGNOSIS.—The only disease for which there is danger of mistaking eclampsia is epilepsy. M. Ozanam mentions the following means of distinguishing the two: "Eclampsia differs from epilepsy in the frequent occurrence of prodromic symptoms; the clonic form of the convulsions, the rare appearance of froth in the mouth, the absence of a hideous livid aspect of the countenance, the spasmodic and sobbing character of the respiration, frequency of the pulse, and a state of quiet without snoring which succeeds an attack." In the young child, however, the above points of distinction are not reliable as a means of differential diagnosis. Some patients, who seem to have genuine attacks of eclampsia in infancy and

childhood, prove to be epileptic in subsequent years. The usual period of eclampsia is prior to the age of five years. If convulsions occur after this age without apparent exciting cause, or from trifling causes, in those who have not before had eclampsia, the disease is probably epilepsy; if prior to the age of six years, and especially of three or four, they are in the vast majority of cases the convulsions of eclampsia.

It is often difficult to ascertain the form of eclampsia, whether essential, symptomatic, or sympathetic—in other words, to determine the cause—till after the convulsions cease. This is especially true when, as is frequently the case, the physician is not summoned till the convulsive movements begin, and it is necessary that he should act promptly, with but little knowledge of the child's previous history. If there is an obvious antecedent disease, as hooping-cough or meningitis, the cause is apparent; but if the previous health have been good, or but slightly disturbed, it may be necessary to make more than one visit or examination in order to ascertain the seat and character of the cause. In the majority of cases of convulsions occurring suddenly in a state of previous good health, the cause is seated in the intestines, but sudden and unexpected attacks may be due to the commencement of some inflammatory affection, as pneumonia, or of a febrile disease, as smallpox. Unless the eclampsia is speedily fatal, the physician, if he examine carefully, will, in most cases, soon be able to ascertain the nature of the cause, and diagnosticate the form of the disease.

Prognosis.—Symptomatic eclampsia is always serious. If it occurs in the course of a cerebral disease, it indicates the approach of death, but if at the commencement, some may recover. The recurrence of it, whatever the cerebral disease, is an almost certain prognostic of death.

In idiopathic or essential convulsions the prognosis depends on the severity of the attack, and on the age, strength, and previous condition of the child. If there are predisposing or co-operating causes, as a nervous or excitable temperament, or dentition, the prognosis is less favorable than when such causes are absent.

In sympathetic eclampsia the prognosis varies greatly, according to the nature of the primary disease, and often according to the stage of that disease. If convulsions occur at the commencement of an eruptive fever, they generally subside without untoward symptoms, and the fever pursues a favorable course. Eclampsia, after the appearance of the eruption, is premonitory of a fatal result. I have not yet known a patient with scarlet fever recover who had convulsions after the rash had covered the body, and experienced physicians of this city tell me that their observations correspond with mine. Dr. J. F. Meigs, however, relates one favorable case. If the cause of the eclampsia be located in or upon the mucous surfaces, a majority recover with judicious treatment. In convulsions consequent on pneumonia or a burn, more die than recover.

The prognosis in eclampsia is more favorable if the parallelism of the eyes is retained, the pupils remain sensitive to light, and consciousness soon returns. A fatal termination may be predicted, if, after the convulsion, the child remains stupid, without any evidence of returning consciousness, and the pupils do not respond to light.

Treatment.—Fortunately, inasmuch as the physician is often required to treat eclampsia in ignorance of the cause, the same measures are demanded, to a considerable extent, in all cases, whether the form be essential, symptomatic, or sympathetic. As early as possible in the attack the feet should be placed in hot water to which mustard is added, or, if it can be procured with little delay, a general warm bath may be used in place. This has a soothing effect upon the nervous system and promotes muscular relaxation, while it also produces derivation of blood from the cerebro-spinal axis. It is, therefore, useful, especially in those cases in which active or passive congestion precedes the eclampsia; it is also useful as a preventive of passive congestion and consequent œdema of the brain, lungs, and other organs, which are the most serious results of eclampsia. It should be continued from six to fifteen or twenty minutes, according to the severity and duration of the attack; at the same time cold applications should be made to the head, until its temperature, which is usually increased, is reduced. The application of a cloth, frequently wrung out of cold water, is the most convenient and ready mode of employing this agent. Cold thus employed acts promptly in contracting the vessels of the brain and meninges, and diminishing the cerebral congestion. It tends, therefore, to remove one of the chief dangers.

As a large proportion of convulsive attacks originate in the condition of the intestines, either solely or in part, it is advisable to prescribe an aperient unless there is previous diarrhœal.

The common enema of soap and water will usually produce a free and speedy evacuation, and will sometimes disclose the cause of the eclampsia in the expulsion of seeds or other indigestible substances or scybala. A cathartic is also often required, especially if the enema fail to produce sufficient evacuations. In those that are robust, and especially in those beyond the age of two or three years, calomel is an excellent purgative, is easily given, and is prompt in its action. If the symptoms indicate intestinal inflammation, the milder purgatives, as castor oil, are preferable, as they also are in young or feeble children. If the recent ingesta of the patient consisted of fruit or of substances of an indigestible character, an emetic is appropriate; a teaspoonful of the syrup of ipecacuanha, repeated if necessary in fifteen or twenty minutes, may be given to a young child, or this syrup with the syrup. scillæ compositus to one older and more robust. Aside from the ejection of the offending substance which it produces, an emetic has some effect in controlling the convulsive movements. But the cases are rare in which emetics are indicated.

In addition to the local measures mentioned above, and measures calculated to relieve the digestive canal of any offending substance, any safe medicinal agent which will act promptly in relieving the convulsions is urgently demanded, for eclampsia, if severe and protracted, involves great danger. Fortunately such agents have been lately introduced into therapeutics, namely, the bromide of potassium or sodium, and hydrate of chloral. These agents, while they are effectual, are safe, and, therefore, their use has surpassed that of the antispasmodics, assafœtida, valerian, lavender, and chloroform; no one of which, except the chloroform, exerts any direct controlling influence over the convulsions, and the chloroform is a dangerous remedy unless used sparingly.

The bromide of potassium, which I prefer, should be given every ten minutes, dissolved in cold water, till the convulsions cease, in doses of three grains to a child of one year, and of four or five grains to a child of two or three years. When the convulsions cease, the interval between the doses should be of course lengthened. In one instance an infant of eighteen months was suddenly affected by eclampsia, and the mother in her fright mistaking the directions, gave thirty grains of bromide at one dose. Two hours afterwards, when I was able to attend, I found that the convulsions had ceased at once, and that the patient was playful. Such cases show the innocuousness of a large dose of the bromide.

In severe cases the bromide does not always act with sufficient promptness and power. The hydrate of chloral should then be employed, dissolved in two or three drachms of water, and given with a small glass or gutta percha syringe per rectum. If used in sufficient quantity, and retained by pressure with a napkin, it is quickly absorbed, and will usually, in about fifteen or twenty minutes, control the movements. For a child of one year I employ about five grains, and for one of four years ten grains. With the employment of the measures indicated above, eclampsia is, in my practice, much more amenable to treatment than in former years. Unless the cause is such that recovery is impossible from the very nature of the case, the convulsions will soon cease with these measures.

But additional treatment may be required, according to the pathological state which has brought on the eclampsia. If it be an eruptive fever, as scarlatina, and the eruption has receded, active revulsive measures, as hot mustard baths, are required; if in dysentery, or other internal inflammation, the flax-seed and mustard poultice should be applied over the parts affected.

In those dangerous cases in which symptoms of cerebral congestion continue after the eclampsia ceases, additional treatment is required. The child remains drowsy, does not speak, or apparently suffer in any way, and the pupils act less readily than in health. If this condition remain after the lapse of a few hours, there is probably serous effusion. All attacks of eclampsia, unless the mildest, are followed by a period of

drowsiness, but the persistence of it, with symptoms which indicate hyperæmia, with perhaps effusion within the cranium, calls for the employment of additional measures. Vesication by cantharidal collodion should then be produced behind the ears, mild revulsives be applied to the extremities, the head kept cool, the bowels open, and, in certain cases, a diuretic like iodide of potassium may be advantageously employed. The utmost care should be enjoined in reference to the hygienic management of those who are subject to eclampsia. The diet should be nutritious, but bland, and all causes of excitement be studiously avoided.

CHAPTER XII.

TETANUS INFANTUM.

Tetanus or trismus is one of the most interesting diseases of infancy. It is first, in point of time, in the long catalogue of fatal maladies. It occurs suddenly and unexpectedly in the robust as well as feeble, almost certainly destroying life within a few hours under modes of treatment heretofore employed. It is more frequent in some localities and conditions of life than in others. In New York it is more common than tetanus at any other age, or, indeed, in all other ages, since the mortuary statistics of this city exhibit a larger number of deaths from this disease in the first year of life than subsequently. Infantile tetanus occurs, with very few exceptions, in the new-born.

Interesting and important as is tetanus infantum, it must be confessed that our knowledge of it is much more limited and imperfect than it should be, when we consider what great advancement has been made in pathological inquiries during the present century. Our information in reference to its causation, symptoms, and proper treatment is not much in advance of that of M. Dazille, or Dr. Joseph Clarke, who lived in the latter part of the last century.

Did we better understand the pathology of diseases in the new-born, or could we more accurately ascertain the condition of organs at this age, doubtless we should occasionally consider those phenomena which we now designate as a disease *per se*, under the title tetanus, as symptoms of some other affection. But as tetanic rigidity and spasms in the new-born occur so abruptly, masking all other symptoms, and ordinarily ending in death without our knowing certainly whether or not there is any antecedent disease, it seems entirely proper that we should recognize the state in which such muscular rigidity occurs with such a rapid result as an independent affection. This explanation is required from the fact that I have

added to the accompanying table one case from Billard, which this observer relates under the head of spinal meningitis. In this case, an infant three days old was attacked with convulsions. "His limbs were rigid and violently bent; the muscles of the face were in a continual state of contraction." On the following day "the convulsions continued; . . . the body remained rigid, and the vertebral column, which the weight of the trunk will cause to bend with the greatest ease in a young infant, remained straight and immovable whenever the child was raised." At the autopsy, in addition to meningeal apoplexy, which is often present in those who die of tetanus infantum, a thick pellicular exudation was found upon the spinal arachnoid. There is, therefore, a strict accordance of the symptoms and history of this case with those which other observers describe as examples of tetanus infantum; moreover, as a satisfactory reason for including this case in our statistics, certain eminent observers, as we will see, have reported epidemics of tetanus in which meningitis was the principal lesion.

Fatal Cases.

Case 1. Male; taken when three days old; lived sixty hours. Labatt, *Edin. Med. and Surg. Jour.*, April, 1819.

" 2. Female; taken when three days old; lived forty hours. *Ibid.*

" 3. Taken when five days old; lived fifty hours. *Ibid.*

" 4. Taken when three days old; lived one day. *Ibid.*

" 5. Male; taken when two days old; lived two days. Billard, *Treatise on Diseases of Children*, Stewart's trans., p. 477.

" 6. Male; taken when three days old; lived two days. Romberg.

" 7. Male; taken when six days old; lived ninety-three hours. Dr. Imlach; *Month. Jour. of Med. Sci.*, Aug. 1850.

" 8. Female; taken at five days; lived four days. Caleb Woodworth, M.D., *Boston Med. and Surg. Jour.*, Dec. 13th, 1831.

" 9. Negro; taken at seven days; lived twenty-four hours. P. C. Gaillard, M.D., *South. Jour. of Med. and Phar.*, Sept. 1846.

" 10. Male; taken when seven days old; lived one day. Augustus Eberle, M.D., *Missouri Med. and Surg. Jour.*, 1847.

" 11. Taken when seven days old. D. B. Nailer, *N. O. Med. Jour.*, Nov. 1846.

" 12. Male; taken when three days old; lived one day. *N. O. Med. and Surg. Jour.*, May, 1853.

" 13. Negro; taken when three days old; lived three days. Robert H. Chinn, M.D., *N. O. Med. and Surg. Jour.*

" 14. Taken when two days old; died in four hours after the doctor's visit. *Ibid.*

" 15. Taken when seven days old; lived one day. C. H. Cleaveland, *New Jersey Med. Rep.*, April, 1852.

" 16. Negro; taken when seven days old; death finally. Greenville Dowell, *Amer. Jour. of Med. Sci.*, Jan. 1863.

" 17. Taken when twelve days old; lived one day. Thomas C. Boswell, communicated to Dr. Sims, *Amer. Jour. of Med. Sci.*, 1846.

Case 18. Taken when about five days old; died at about the age of nine days. B. R. Jones. *Ibid.*

" 19. Taken at or soon after birth; lived two days. Dr. Sims, *Amer. Jour. of Med. Sci.*, April, 1846.

" 20. Taken at the age of six days; lived one day. *Ibid.*

" 21. Taken when three days old; lived two days. *Ibid.*

" 22. Male; taken at the age of eight days; died in three hours. Communicated to the writer.

" 23. Taken at the age of twelve hours; lived two days. Communicated to the writer.

" 24. Female; taken when seven days old; lived forty-five hours. The writer.

" 25. Male; taken at the age of seven days; lived about forty-eight hours. *Ibid.*

" 26. Female; taken at the age of eight days; lived three days. *Ibid.*

" 27. Female; taken at the age of five days; lived three days. *Ibid.*

" 28. Female; taken when four days old; lived two days. *Ibid.*

" 29. Taken when six days old; died next day. *Ibid.*

" 30. Taken when five days old; lived twenty-four hours. *Ibid.*

" 31. Taken when eight days old; lived two days. *Ibid.*

" 32. Male; taken when five days old; lived one day. *Ibid.*

Favorable Cases.

Case 1. Negro; female; taken when three days old; recovered in a few days. Robert S. Baily, *Charleston Med. Jour. and Rev.*, Nov. 1848.

" 2. Negro; taken at eleven days; recovered in fifteen days. W. B. Lindsay, *N. O. Med. Jour.*, Sept. 1846.

" 3. Negro; taken when ten days old; recovered in thirty-one days. P. C. Gaillard, *Charleston Med. Jour. and Rev.*, Nov. 1853.

" 4. Male; taken at the age of eight days; recovered in twenty-eight days. *Ibid.*

" 5. Negro; taken at seven days; recovered in fifteen days. Augustus Eberle, *Missouri Med. and Surg. Jour.*, 1847.

" 6. Taken when eight days old; recovered in four weeks. Furlong, *Edin. Med. and Surg. Jour.*, Jan. 1830.

" 7. Taken at the age of one week; recovered in two days. Dr. Sims, *Amer. Jour. of Med. Sci.*, April, 1846.

" 8. Female; taken at the age of three days; recovered in five weeks. The writer.

Period of Commencement.—Finckh, who saw cases of tetanus of the new-born in the Stuttgart Hospital, states (*Hecker's Annalen*, vol. iii, No. 3, p. 304) that it began in one case on the second day after birth, in eight on the fifth, and in seven on the seventh.

Professor Cederschjold, of Stockholm, treated forty-two cases in hospital practice in 1834, and in these cases it usually commenced between the ages of four and six days. Copland says (*Medical Dictionary*) that it generally commences in the first seven or nine days after birth, and rarely later than the fourteenth. Romberg states that it commences between the fifth and

ninth days. In two hundred cases observed by Reicke, in Stuttgart, in the course of forty-two years, it was never found to commence before the fifth, rarely after the ninth, and never after the eleventh day. Schneider says that the disease occurs oftenest between the second and seventh, and rarely after the ninth day. In six cases reported by Dr. C. Levy, of Copenhagen, it began in two on the third day, in two on the fifth, and in two on the sixth. Dr. Greenville Dowell (*Amer. Jour. of Med Sci.*, Jan. 1863), who has seen much of tetanus infantum among the negroes in Mississippi and Texas, says it is almost sure to come on between the fifth and twelfth days after birth. In the forty cases embraced in the above table, the disease began as follows:—

Age.	Cases.
One day or under,	2
Two days,	1
Three "	9
Four "	2
Five "	6
Six "	3
Seven "	8
Eight "	6
Ten "	1
Eleven "	1
Twelve "	1

Very rarely, as will be seen hereafter, tetanus begins at or so soon after birth, that it may properly be called congenital.

Frequency in Certain Localities.—Tetanus infantum occurs probably in all countries, but it does not greatly increase the mortality except in certain localities. Some of the British and Continental physicians, whose observations of disease have been ample, confess that they have seen so few cases that they have almost no personal knowledge of this malady. On the other hand, there are, or have been, places in every zone where it is or has been so prevalent as to sensibly check the increase of population. The attention of the profession, more than a half century since, was directed to the prevalence of tetanus in the Island of Heimacy, off the coast of Iceland. On this island scarcely an infant escaped, while on the mainland scarcely one was affected. Heimacy, the product of volcanic action, of small extent and almost destitute of vegetation, supports a scanty population. The inhabitants live chiefly on the flesh and eggs of the sea-fowl, and are filthy and degraded in their habits. About the year 1810, the Danish government deputed the *landphysicus* of Iceland to visit Heimacy, and ascertain the nature of the disease which was so destructive to the infants. Although this gentleman, from his brief stay, saw no case himself, he obtained interesting particulars in reference to the disease from the priests and parents. At this time scarcely an infant escaped. Again, according to Dr. Schleisner, whose report in reference to the same locality

was published forty years later, tetanus was still the most fatal of all infantile maladies.

Tetanus infantum is also represented as very fatal in the Island of St. Kilda, off the coast of Scotland. In the temperate regions of America and Europe cases are not frequent, except occasionally in the poor quarters of the cities, in foundling hospitals, and rarely in country towns where the conditions are favorable for its occurrence. The records of the Dublin, Stuttgart, and Stockholm lying-in asylums furnish many cases. In the town of Fulda, Germany, in 1802, Dr. Schneider saw six cases in fourteen days, while a midwife in the same place stated that she had seen more than sixty in nine years.

But the greatest mortality from tetanus infantum is in the warm climates, both of the Eastern and Western Hemispheres. In the West Indies, the southern portion of the United States, the equatorial regions of South America, and in the islands of Minorca and Bourbon, it has, in many localities, been the most frequent and fatal of infantile maladies.

It is an interesting fact that in the warm regions of the United States the victims are chiefly negro infants. L. S. Grier, M.D., of Mississippi, says, in the *N. O. Med. and Surg. Jour.*, May, 1854: "The first form of disease which assails the negro among us is trismus. The mortality from this disease alone is very great. No statistical record, we suppose, has even been attempted, but from our individual experience we are almost willing to affirm that it decimates the African race upon our plantations within the first week of independent existence. We have known more than one instance in which, of the births for one year, one-half became the victims of this disease, and that, too, in spite of the utmost watchfulness and care on the part of both planter and physician. Other places are more fortunate, but all suffer more or less; and the planter who escapes a year without having to record a case of trismus nascentium may congratulate himself on being more favored than his neighbors, and prepare himself for his own allotment, which is surely and speedily to arrive." Dr. Wooten (*N. O. Med. and Surg. Jour.*, May, 1846) says: "It is a disease of fatal frequency on the cotton plantations in this section of Alabama." He has, however, never seen a white child affected with it.

In New Orleans, according to the death statistics in our possession, which, however, relate to only one year, tetanus infantum is the most fatal of all diseases except phthisis. Mr. Maxwell says, in the *Jamaica Physical Journal* (copied in the *London Lancet*, April 11th, 1835): "From observations that I have made for a series of years, . . . I found that the depopulating influence of trismus neonatorum was not less than twenty-five per cent. It scarcely has a parallel within the bills of mortality." This gentleman's observations relate to the West Indies. Similar statements are made in reference to this malady as it occurs in Cayenne and Demerara in South America.

While tetanus infantum prevails in regions wide apart, and presenting very diverse climatic conditions, there is a similarity as regards the personal and domiciliary habits of the people who suffer most from its occurrence. It occurs chiefly among those who are filthy and degraded in their habits, who live, either from choice or necessity, in neglect of sanitary requirements. This fact aids us in an understanding of the—

Causes.—That uncleanliness and impure air are a cause of tetanus is as fully demonstrated as most facts in the etiology of diseases. The attention of the profession was forcibly directed to this cause by Dr. Joseph Clarke in a paper read before the Royal Irish Academy in 1789. This physician was in charge of the Dublin Lying-in Asylum, and had rightly concluded that the mortality among the new-born infants was due to imperfect ventilation. Through his advice, apertures, twenty-four inches by six, were made in the ceiling of each ward; three holes, an inch in diameter, were bored in each window-frame; the upper part of the doors leading into the gallery were also perforated with sixteen one-inch apertures, and the number of beds was reduced. The result of these simple sanitary regulations may be seen from Dr. Clarke's own statement. He says: "At the conclusion of the year 1782, of 17,650 infants born alive in the Lying-in Hospital of this city, 2944 had died within the first fortnight, that is, nearly every sixth child." The disease in nineteen cases out of twenty was tetanus. After the wards were better ventilated, namely, from 1782 till the time of the preparation of Dr. Clarke's paper, 8033 children were born in the hospital, and only 419 in all had died, or about one in nineteen. So impressed was Dr. Evory Kennedy, who at a later period had charge of the same asylum, with the belief that Dr. Clarke had discovered the true cause, and had been able in great measure to prevent it, that he writes in his enthusiastic way: "If we except Dr. Jenner, I know of no physician who has so far benefited his species, making the actual calculation of human life saved the criterion of his improvements." The cases occurring in my own practice have almost all been in tenement-houses, where habits of cleanliness are not observed, and I have not yet seen, in the practice of others, nor heard of a case which occurred in the better class of domicils. The statement of physicians in the Southern States, who speak from extensive observation among the negroes, are strongly corroborative of the idea that the disease is in great measure due to uncleanliness and impure air.

Dr. Greenville Dowell, of Texas, states that he has been able to trace tetanus infantum to the bedclothes, saturated with excrementitious matters, which are found in the negro cabins. In a paper published in the *Nashville Journ. of Med. and Surg.*, June, 1851, by Prof. John M. Watson, the frequency of this disease among the negroes is accounted for as follows:—

"When called to see their children, we find their clothes wet around

their hips, and often up to their armpits, with urine. . . . . The child is thus presented to us, when, on examination, we find the umbilical dressings not only wet with urine, but soiled, likewise, with feces, freely giving off an offensive urinous and fecal odor, combined at times with a gangrenous fetor arising from the decomposition, not desiccation, of the cord."

Another cause is believed to be some irritation in the intestines, as from retained meconium. Observers in the Southern States and elsewhere occasionally mention this as a cause. In one case treated by myself, there was obstinate constipation immediately before the attack, and in another diarrhœa preceded, and was the only apparent cause.

In certain cases the assignable cause is exposure to wet or cold, or to a variable temperature, which, it is known, occasionally causes tetanus in the adult. Prof. Cederschjold attributed the epidemic which he observed in Stockholm to a sudden change of temperature, from hot weather in May, to frosty in June. In a case related by Dr. P. C. Gaillard, in the *Southern Jour. of Med. and Pharmacy*, Sept. 1846, the disease commenced as follows: The nurse came in with wet apron and clothes, in the evening; a short time after she had taken the child into her lap, it sneezed violently two or three times. At 10 P. M. tetanus began. In certain localities on the continent, where there are no parish churches, the frequent occurrence of tetanus has been attributed by the physicians to the practice of carrying the infants to a distance to be christened, thus exposing them to the winds. In this city I have observed tetanus after a similar exposure. The influence of the weather in the production of tetanus of the new-born is also shown by facts observed in the Stuttgart Hospital. In an aggregate of twenty-five cases treated in that institution, all but three occurred in the cold months. In the Island of Cayenne, at a hamlet surrounded by mountains and dense forests, tetanus attacked only one in every twelve or fifteen of the infants. After a great part of the forests had been cut down, so as to allow access to the cold sea winds, almost all the new-born infants fell victims to tetanus. (*Insel, Cayenne.*)

Hein relates that a citizen of Berlin lost, successively, two children with tetanus soon after birth. When the second child fell ill he observed that its cradle was exposed to a current of air. At the third accouchement the position of the cradle was changed and the infant escaped. Exposure to wet and cold has been long recognized as a cause of the disease. According to Sauvages, "Hic morbus hieme et cum aurâ humidâ sæpius advenit quam sicca æstate." (*Nosol. Method*, vol. i, p. 531.)

The causes of infantile tetanus, enumerated above, may be proximate or remote, may produce the disease by their direct effect on the system or by producing a pathological state which in turn leads to the development of the disease. There are other direct causes, namely, organic affections. In the bodies of those who die of this disease lesions are observed which doubtless result from the spasms. Again, others are found which, from

their nature, could not be a result, and which, being observed in different cases, are to be regarded as direct causes. The most frequent of such lesions is inflammation of the umbilicus or umbilical vessels.

Moschion, who lived in the first century of the Christian era, stated in writings still extant that stagnant blood in the umbilical vessels sometimes produced dangerous disease in the new-born infant, and it is supposed, though this is doubtful, that he referred to tetanus. In modern times the attention of the profession was more particularly directed to this cause by a paper published by Dr. Colles, in the first volume of the *Dublin Hospital Reports*, in 1818. The observations published in this paper were made in the Dublin Lying-in Hospital during the period of five years. In each of these years he had witnessed from three to five post-mortem examinations in cases of infantile tetanus, and the lesions, he states, were in all much alike as follows: The floor of the umbilical fossa was lined by a membrane apparently formed by suppurative inflammation, and in the centre of this fossa was a large papilla. This papilla consisted of a soft yellow substance, apparently the product of inflammation, and in all the cases the umbilical vessels were in contact with this substance and were pervious. In a few instances superficial ulcerations were found near the mouth of the umbilical vein, and occasionally the skin surrounding the umbilicus was raised. The peritoneum covering the vein was highly vascular, often not to a greater distance than an inch above the umbilicus, but sometimes as far as the fissure of the liver. The peritoneum in the course of the umbilical arteries presented the inflammatory appearance in still greater degree, sometimes as far as the sides of the bladder. The connective tissue lying along the arteries and urachus anteriorly was loaded with a yellow watery fluid. The inner surface of the umbilical vein was not inflamed, but its coats, in general, were thickened. On slitting open the arteries, a thick yellow fluid, resembling coagulable lymph, was found within their coats, and in all cases these vessels were thickened and hardened as far as the fundus of the bladder.

Dr. Finckh, who observed twenty-five cases in the Stuttgart Hospital, believes that the most frequent cause was suppuration or ulceration of the umbilical cord. In ten of the twenty-five cases the navel was dry and cicatrized; in the remainder it was either wet or swollen, with a bluish-red inflamed edge at the margin of the navel; a dirty viscid pus covered the umbilical depression.

Dr. Levy, physician of the Foundling Hospital in Copenhagen, attended twenty-two cases in that institution in 1838 and 1839. Of these, twenty died, and fifteen were examined carefully after death. In fourteen there were decided marks of inflammation in the umbilical arteries, especially those portions lying along the urinary bladder; in several cases the peritoneum over the arteries was much injected, and in three adherent either to the omentum or intestine by coagulable lymph; the coats of the

arteries were thickened, their cavities dilated and containing dark reddish-brown or greenish puriform matter, always fetid. Sometimes the arterial tunica interna was found ulcerated and absent in places, and there was spongy thickening of the subjacent connective tissue. In two cases the ulcerative process had extended from the tunica interna to the peritoneum, and there was a deposit of thick ichorous matter around the ulcer; in one case both arteries were so softened that their coats were scarcely distinguishable, and in another these vessels had become gangrenous. The appearance of the umbilicus was unchanged in four cases; in ten the fundus was red and filled with puriform fluid, which quickly reappeared when removed, and, in general, shortly before death, the navel presented a greenish color.

According to Romberg, Dr. Schöller made post-mortem examinations in eighteen cases of tetanus infantum, and in fifteen found inflammation of the umbilical arteries. These vessels were swollen near the bladder, in one case to the diameter of four lines, and were found to contain pus. The lining membrane was eroded or covered with an albuminous exudation. Both arteries were not always equally inflamed, and in three cases only one was affected.

Schneeman found minute points of suppuration in the umbilical vein in eight cases (*Holscher's Annalen*, vol. v, p. 484, 1840), and pus throughout the course of this vessel in one.

The observations mentioned above were made, for the most part, in hospitals on the Continent; but similar observations have been made in private practice. M. Boiran, of the Isle of Bourbon, says that he has found in every case inflammation around the umbilicus (*Gazette Médicale*, Paris, July 11, 1841). Dr. John Furlonge (*Edin. Med. and Surg. Jour.*, Jan. 1830), who resided at St. John's, Antigua, attributes the disease to improper dressing of the umbilicus. The same opinion is expressed by Mr. Maxwell, who also saw the disease in the West Indies (*Jamaica Phys. Jour.*, copied into the *London Lancet*, April 11, 1855). Dr. Ransom states, in a communication to Prof. John M. Watson (*Nashville Jour. of Med. and Surg.*, June, 1851) that he has never seen a case of tetanus of the new-born in which the umbilicus was healthy. In a case related by Robert S. Bailey, in the *Charleston Med. Jour. and Rev.*, Nov. 1848, there was a hard scab on one side of the umbilicus, and this part was much distended. A discharge followed the removal of the scab, and the child recovered. In a favorable case, related by W. B. Lindsay, in the *N. O. Med. and Surg. Jour.*, Sept. 1846, the umbilicus was tumid, and not disposed to heal. Dr. H. O. Wooten (same journal, May, 1846) attributes the disease to the condition of the umbilicus and umbilical vessels, and states that he has found the umbilicus gangrenous. In a case related in the *N. O. Med. and Surg. Jour.*, May 1, 1853, the umbilical vessels were blocked up by purulent matter. Robert A. Chime, M.D., Brazoria, Texas

(*N. O. Med. and Surg. Jour.*, Sept. 1854), believes one cause of the disease to be improper tying and management of the umbilical cord, by which a diseased state is produced, which extends to the umbilicus, and thence to the viscera. At a meeting of the Obstetrical Society of Edinburgh, held April 24, 1850, Dr. Imlach related a case in which there was a dark and gangrenous appearance of the integument around the umbilicus, and the peritoneum underneath was also dark, but not inflamed; umbilical vein healthy; a little fibrin in the left umbilical artery; right umbilical artery much diseased; its two inner coats apparently destroyed, and in their place a yellow pultaceous slough, in which pus-globules were discovered with the microscope.

It is evident that the pathological state of the umbilicus and umbilical vessels described above, and which has been noticed by so many observers in different countries, cannot result from the tetanus. It is possible that the puriform substance noticed in the umbilical vessels was disintegrated fibrin, which had coagulated at the time of ligation of the cord, and the cells seen by Dr. Imlach and others may sometimes have been white corpuscles still remaining from the stagnated blood. (*Virchow's Cellul. Pathol.*) Still, the evidences of inflammation, in at least a part of the cases related above, were of a positive character.

The belief that umbilical lesions sometimes cause tetanus infantum comports with the well-known traumatic causation of tetanus in the adult. This belief is strengthened by the fact, which will appear further on in our remarks, that tetanus of the new-born, from being frequent in certain localities, has become infrequent through greater care in dressing and managing the umbilical cord.

But there are cases of tetanus infantum in which there is no disease in or about the umbilicus. Dr. Finckh, of Stuttgart, examined the umbilical vessels in eleven cases without discovering any pathological change. Dr. Samuel B. Labatt, master of the Dublin Lying-in Hospital, published in the *Edin. Med. and Surg. Jour.*, April, 1819, a paper entitled "An Inquiry into an Alleged Connection between Trismus Nascentium and certain Diseased Appearances in the Umbilicus." This paper was designed as a reply to the essay of Dr. Colles. Dr. Labatt relates several cases in which there was no disease of the umbilicus and umbilical vessels, and others in which the disease was so slight that it probably produced no injurious effect on the health of the child. Dr. James Thompson, who spent considerable time in the tropical regions, says (*Edin. Med. and Surg. Jour.*, Jan. 1822): "I have myself examined nearly forty cases of infants that have sunk under this complaint. In many I have looked at no other part but the navel, and have found it in all states; sometimes perfectly healed, especially if the infants had lived several days; at other times a simple clean wound. When death occurred on the fifth or sixth day, the wound was frequently in a raw state. I never yet saw it in a sphacelated condi-

tion." This writer concludes from his observations that there are cases in which the cause is located elsewhere than in the umbilicus or umbilical vessels. In the *Dub. Jour. of Med. and Chem. Sci.*, Jan. 1836, Dr. John Breen remarks: "From dissections . . . we have never been able to discover any peculiar morbid appearance which would justify us in offering any explanation of the pathology of the disease." In my own case there was no evidence of disease of the umbilicus or umbilical vessels so far as could be ascertained by external examination, and in one (No. 32) a careful post-mortem examination disclosed no lesion of these parts.

The inference from the above observations is that, although umbilical disease may be an occasional, probably not infrequent, cause of tetanus infantum, cases occur in which such disease is not present, and we must look for the cause elsewhere. From the nature of tetanus infantum, the cerebro-spinal axis has been from time to time examined in those who have died of this malady, and occasionally sufficient cause has been found in this part of the system.

I have alluded in another connection to a case from Billard, in which tetanic rigidity occurred in an infant three days old, as the result of spinal meningitis. That tonic spasms not infrequently occur in older children in consequence of meningeal inflammation is well known, and in some of the reported epidemics of infantile tetanus meningitis was really present, and was doubtless the cause of the tonic spasms. Such an epidemic was observed by Professor Cederschjold in Stockholm, in 1834. Within a few months he treated forty-two cases, and, in addition to the lesions which are known to result from tetanus, there was found in the bodies examined a plastic exudation at the base of the brain. Finckh, of Stuttgart, made twenty post-mortem examinations of those who had died of this disease, and in nine found spinal meningeal inflammation.

Meningitis in the new-born infant is, however, rare, and we must regard it as an exceptional cause of tetanus.

In 1846 there appeared from the pen of Dr. Sims, then practising at Montgomery, Alabama, a paper designed to show that tetanus of the new-born is produced by pressure exerted on the nervous centre, through depression of the occipital bone. In 1848 the same writer published a second paper, also, in the *Amer. Jour. of Med. Sci.*, fully enunciating his theory as follows: "That trismus neonatorum is a disease of centric origin depending on a mechanical pressure exerted on the medulla oblongata and its nerves; that this pressure is the result, most generally, of an inward displacement of the occipital bone, often very perceptible, but sometimes so slight as to be detected with difficulty; that this displaced condition of the occiput is one of the fixed physiological laws of the parturient state; that when it persists for any length of time after birth it becomes a pathological condition, capable of producing all the symptoms characterizing trismus neonatorum, which are instantly relieved simply by rectifying this abnormal

displacement, and thereby removing pressure from the base of the brain." In both papers cases are narrated in support of this theory, but there are serious objections to this mode of explaining the occurrence of the disease. In the first place, if this explanation were correct, tetanus ought ordinarily to occur sooner, for the occiput is as much depressed previously, and in the majority of cases more depressed than at the period when it does actually commence. Pressure on the medulla would certainly be followed by immediate and marked symptoms, instead of an immunity for four or five days.

Again, well-known facts in reference to the causation of tetanus infantum conflict with Dr. Sims's theory, as, for example, epidemics of the disease, its prevalence in one locality and absence in another, although no particular attention is given to the position of the infant, the diminution of the number of cases by greater attention to cleanliness, of which there is abundant proof. Moreover, there are many reported cases of this disease at the commencement of which there was no perceptible displacement of the occipital bone.

The inequality of the cranial bones often observed in tetanus infantum should, in my opinion, be explained as follows: When the new-born infant becomes emaciated the volume of the brain is diminished, like that of the trunk or limbs, and the sinking of the occipital bone simply corresponds with the amount of waste in the cerebral substance. Whatever the disease in the young infant, if there is much emaciation, the parietal bones will usually be found more prominent than the occipital. Now, in fatal tetanus infantum emaciation is very rapid; those fleshy and plump, if the disease do not speedily end, become pinched and wrinkled. Viewed in this light, the occipital depression should be regarded as a result, and not cause, of the tetanus.

Although we do not accept the theory which attributes tetanus infantum to occipital depression, there are a few cases on record in which it was apparently due to injury of the head received at birth. Dr. Sims has related one such case, that of a negro infant. The mistress, an observing lady, gave to Dr. Sims the following account of it: Its head was "mightily mashed. . . . . The bones seemed to be loose. I got it to take a little boiled milk on the first day; but it swallowed very little and very badly, for its jaws seemed to be locked. On the next day it took spasms and got stiff all over; its hands were shut up tight, and its arms were bent up so (she placed her forearms at right angles). Every time I touched it the spasm would get worse all over, screwing up its face till it was the ugliest thing in the world; and when the spasms wore off it looked as well as any other new-born baby. But then the stiffness never left it, and the spasms kept coming and going till it died." It lived two days.

It is evident, from the description given by the mistress, that this was a case of tetanus commencing at or so soon after birth that it seemed almost

congenital. The apparent cause was injury of the head, occurring in consequence of protracted birth, the infant being resuscitated with difficulty after several minutes.

Dr. W. C. Sutton published a similar case in the *Nashville Jour. of Med. and Surg.*, April, 1853. The infant at birth was apparently dead, but was resuscitated so as to live eighteen hours in a state of tetanic rigidity. In cases in which tetanus begins at birth, doubtless, the cerebro-spinal axis is in some way affected; but in the absence of post-mortem examinations, the exact nature of the lesion is uncertain.

It is evident, therefore, that in this disease, as in eclampsia, the cause in different cases may be entirely distinct. Dr. James Johnson, many years ago, expressed his belief in the multiplicity of causes, and he had been a careful and intelligent observer in the West Indies.

The causes may be arranged in two groups, one external, the other internal. In the first group should be placed imperfect ventilation, personal and domiciliary uncleanliness, and atmospheric vicissitudes; in the second group, so far as ascertained, inflammation of the umbilicus and umbilical vessels, meningitis, and, rarely, injury of the cerebro-spinal axis during birth.

The lesions resulting from tetanus infantum pertain chiefly to the circulatory system. In the cases examined by Professor Cederschjold, of Stockholm, already alluded to, the meningeal and cerebral vessels, and those of the spinal cord, the cavities of the heart, and the large vessels connected with the heart, were distended with blood.

Finckh made post-mortem inspection of twenty cases in the Stuttgart Hospital, the bodies, at death, having been placed on their faces, in order to prevent any deceptive appearance from the gravitation of blood. In four there was no appreciable alteration in the spinal cord or its membranes. In the remaining sixteen there was effusion of blood, in considerable quantity, the whole length of the spinal cord, between the bony walls and the dura mater. It should be stated, however, that there was spinal meningeal inflammation in nine of the sixteen, though the extravasation did not, probably, result from the inflammation, but from the tetanus. The blood in Finckh's cases was very dark, sometimes fluid, at other times coagulated. In one case there was no change in the appearance of the brain or its membranes. In the remaining nineteen, more or less extravasated blood was found on the surface of the brain, or in its interior. The substance of the brain was healthy, as also its membranes, except the congestion. The only abnormal appearance observed in the thoracic and abdominal viscera was strong contraction of some portion of the intestinal tube in five cases. Dr. West says: "The most frequent post-mortem appearances in these cases"—referring to tetanus infantum—"and that which I found in the bodies of all the four children whom I observed, consists of effusion of blood, either fluid or coagulated, into the

cellular tissue surrounding the theca of the cord. Conjoined with this there is generally a congested state of the vessels of the spinal arachnoid, and sometimes an effusion of blood or serum into its cavity. The signs of congestion about the head are less constant, though much oftener present than absent, and sometimes existing in an extreme degree; while in one instance I found not merely a highly congested state of the cerebral vessels, but also an effusion of blood, in considerable quantity, between the skull and dura mater, and also a slighter effusion into the arachnoid cavity." Dr. Weber, of Kiel, also placed infants who had died of tetanus on their faces, and, without exception, found injection of the capillaries of the cord and spinal meninges, and extravasation of blood. M. Matuszynski, according to Bouchut, "has observed effusions of blood of variable quantity, in the cerebral pia mater, in the ventricles, and in the choroid plexuses, with considerable injection of the membranes of the brain. He has also seen serous infiltration beneath the arachnoid, and serous effusion into the ventricles, accompanied by a diminution of the consistence of the cerebral substance." In two cases examined by myself there was intense injection of the cerebral meninges and of the meninges of the upper part of the spine, but no extravasation was noticed. The spinal canal was not opened. In a third case, in which the spinal canal was opened, there was extravasation in addition to the congestion; this was especially observed along the spinal theca.

Dr. H. O. Wooten (*N. O. Med. and Surg. Jour.*, May, 1846) states that he has made several post-mortem examinations, and has found the pathological appearances as uniform as in any other disease, as follows: "Engorgement of the substance of the brain, and of the meninges lining the base of the brain, the medulla oblongata, and spinal marrow; liver congested."

In a case related by Dr. Imlach before the Edin. Obst. Soc., April 24th, 1850, the upper part of the lungs was healthy, the posterior portion congested, and containing many dark points; heart and liver healthy; small intestines of a light-brown color; stomach and large intestines pale; there had been umbilical hemorrhage.

Romberg states that he found in a child, whose death occurred from this disease, such intense congestion of the veins and sinuses of the brain, that a slight touch, and the removal of the cranial bones, produced extravasation of the partly coagulated and partly fluid blood. Dr. Schöller, on the other hand, found actual extravasation of blood in the spinal canal in only one case in eighteen.

It is seen from the above observations, that tetanus of the infant is ordinarily accompanied by great passive congestion, which is especially marked in the cerebro-spinal axis, and that frequently extravasations occur from the distended capillaries. The embarrassment of respiration and the re-

tarded circulation of blood consequent on the tetanic rigidity, afford sufficient explanation of this state of the vessels.

Symptoms.—In many cases premonitory symptoms are absent, or are so slight as to escape notice. Sometimes there is a degree of fretfulness previously, but no more than is often observed in those who continue in good health. The first symptom which alarms the parents, and shows the grave nature of the commencing disease, is inability to nurse, or evident pain and hesitation in nursing. Commencing with rigidity of the masseters, the disease gradually extends to the other voluntary muscles, and in the course of a few hours the muscles of the limbs, as well as of the trunk, are involved. Persistent muscular contraction, which is the pathognomonic feature of infantile tetanus, is developed not fully in the beginning, but by degrees in each affected muscle, so that it is not till after the lapse of several hours, perhaps even a day, that the greatest amount of rigidity is attained. Therefore, in the commencement of the disease, the limbs can be bent, and the jaws pressed open, more readily than at a subsequent stage, though with manifest pain to the infant.

During the period of maximum rigidity, the jaws are fixed almost immovably, often with a little interspace between them, against which the tongue presses, and in which frothy saliva collects. The head is thrown backward and held in a fixed position by the stiffness of the cervical muscles. The forearms are flexed; the thumbs are thrown across the palms of the hands, and are firmly clenched by the fingers; the thighs are drawn towards the trunk; the great toes are adducted, and the other toes flexed. Occasionally opisthotonos results from the extreme contraction of the dorsal and posterior cervical muscles. The infant can sometimes be raised without any yielding of the muscles, by one hand under the occiput and the other under the heels.

The rigidity is liable to variation in its intensity, even after the full development of the disease. If the infant is quiet, especially if asleep, the muscles are partially relaxed to such an extent, sometimes in the first stages of the complaint, that the features have a placid and natural expression, though only for a short time. There are frequent exacerbations in the muscular contraction, sometimes occurring without any apparent cause, and sometimes produced by anything which excites or disturbs the child. Attempts to open the lips or jaws, or eyelids, or to bend the limbs, blowing on the face, or even the crawling of a fly upon it, occasions the paroxysm.

During the paroxysm the eyelids are forcibly compressed, as well as the lips, which are either drawn in or are pouting; the forehead and cheeks are thrown into wrinkles, and the physiognomy is indicative of great suffering. The unnatural positions of the trunk and limbs, which result from the muscular contraction, are increased for the moment; the head is more forcibly thrown back, and the limbs more strongly flexed.

The muscular movements which occur during the paroxysms are sometimes described as clonic spasms. There is indeed occasionally some quivering of the limbs, and yet, as I have on different occasions noticed, so far from the muscular action being a clonic spasm, it possesses a tonic character, which is at times intensified. In fatal cases the paroxysms occur more and more frequently until the period of collapse.

The crying of the child affected by tetanus is never loud, however great the suffering. It is variously described by writers as "whimpering" or "whining." It is of this suppressed character in consequence of the rigid state of the respiratory muscles and their imperfect movement.

During the exacerbation respiration is suspended, or so imperfect, and the circulation so retarded, that the surface becomes of a deep red, almost livid, color. Sometimes epistaxis occurs, affording partial relief to the congestion, and sometimes, though less frequently, the blood forces itself from the congested liver along the umbilical vein, and escapes from the umbilicus. I have already alluded to the occurrence of meningeal apoplexy.

The frequency of the pulse and respiration varies in different cases, and at different stages of the same case. They are often somewhat accelerated, but at other times are natural, or are even slower than in health.

While the appetite of the infant, to appearance, is not diminished, the pain which it experiences in nursing is such that alimentation is necessarily deficient. It can be fed with a spoon for a time after it ceases to take food in the natural way, but artificial feeding soon fails. The milk placed in its mouth is in great part pressed back through the violence of the spasm which is induced by the attempt to feed it.

In consequence of imperfect nutrition, the infant rapidly wastes away. There is no other disease except the diarrhœal affections in which emaciation is so rapid. In a case related by Dr. W. B. Lindsay in the *N. O. Med. Jour.*, Sept. 1846, the record states that "the infant was fat three days before, but was now emaciated." Romberg, who saw tetanus infantum in European hospitals, and Dr. Robert H. Chinn, of Texas (*N. O. Med. and Surg. Jour.*, Sept. 1854), both speak of the rapid emaciation. The trunk and extremities lose their fulness, and the features become pinched. Several observers have noticed the appearance of miliaria in this reduced state of system, especially around the shoulders, and sometimes a decidedly icteric hue appears on the skin.

The condition of the intestines is not uniform. They may be relaxed, particularly if the disease is due to some irritation in them; in other cases the stools are natural or constipated.

It is often difficult to ascertain the state of the eyes, since attempts to open the eyelids bring on spasms and cause firm compression of the lids against each other. According to Sir Henry Holland, one of the first symptoms which occurred in cases on the Island of Heimacy, was strabismus,

with rolling of the eyes. But this statement must be received with caution, since these cases were not seen by any physician, and the information was obtained from the parents and priests. If true, the proximate cause of the disease in Heimacy would seem to be located in the cerebro-spinal axis. Contraction of the pupils commonly occurs in the stage of collapse.

Mode of Death.—Death in infantile tetanus may occur from apnœa in the paroxysms, from extreme congestion of the cerebral vessels, or apoplexy; and, lastly, it may occur from exhaustion. The last mode is, probably, the most frequent.

Prognosis.—All writers till recently agree that tetanus of the infant rarely terminates favorably. Cullen attributes the ignorance of physicians in regard to this disease to the fact that it is so little amenable to treatment, that they are not usually summoned to attend those affected with it. In the island of Heimacy, of one hundred and eighty-five cases, occurring during a series of years about the commencement of the present century, not one survived; and in the same locality, at a more recent period, according to the report of Dr. Schleisner already alluded to, sixty-four per cent. died. Similar statements in regard to the mortality of tetanus infantum are given by physicians in the Southern States. Dr. H. O. Wooten, of Alabama, says (*N. O. Med. Journ.*, May, 1846) that he has "never seen a decided case of tetanus nascentium that did not prove fatal; . . . and that it is very generally deemed useless to call in medical aid after the initiatory symptoms are well declared." Mr. Maxwell, speaking in reference to the West Indies, says (*Jamaica Phys. Journ.*, copied into the *London Lancet*, April 11th, 1835): "From observations which I have made for a series of years, . . . I found that the depopulating influence of trismus nascentium was not less than twenty-five per cent. It scarcely has a parallel within the bills of mortality." Dr. D. B. Nailer (*N. O. Med. Journ.*, Nov. 1846) says: "About two-thirds of the deaths among the negro children are from this disease, and so uniformly fatal is it, that a physician is never sent for."

Yet death does not always result. Eight of the forty cases in my collection recovered; but a correct opinion cannot be formed from this of the actual ratio of favorable to unfavorable cases, since favorable cases are much more likely to be published. In the history of these eight cases, two interesting facts are noticed, which, when present, may serve as a ground for hope of a successful termination. These were, the age at which the disease began, and fluctuation in the symptoms. With two exceptions, the infants who recovered were about a week old when the initiatory symptoms appeared, and there were fluctuations in the gravity of the symptoms; whereas, fatal cases ordinarily grow progressively worse. Yet, in favorable cases, the symptoms are never so severe as they become in a few hours in those who succumb.

Duration in Fatal Cases.—Of eighteen cases observed by Finckh in the Stuttgart Hospital, fifteen died in two days, two in five days, and one in seven days. During the epidemic in the Stockholm hospitals, in 1834, where forty-two cases were treated, the disease seldom lasted more than two days. Romberg says: "It generally lasts from two to four days, but its duration is at times limited at from eight to twenty-four hours, and occasionally, though rarely, it extends from five to nine days."

In thirty-one fatal cases in my collection, in which the duration is mentioned—

One lived	3 hours.
Eleven others lived	1 day or less.
Twelve lived	2 days.
Four "	3 "
Three "	4 "

Both Underwood, who published a little treatise on diseases of children, in 1789, and Dr. Elsässer, at a more recent date, record fatal cases which were unusually protracted. The one described by Underwood was treated in the British Lying-in Hospital, and, although all the others treated in this institution died by the third day, this lived six weeks; but it is suggested by the author, that death was due in part to some other affection. The child treated by Elsässer lived thirty-one days.

Duration in Favorable Cases.—In the eight favorable cases in my collection, the duration of the disease, reckoned from the time when the infant ceased nursing till it began again, was as follows: In one case, two days; in one, a few days; in one, fourteen days; in two, fifteen days; in one, twenty-eight days; in one, twenty-one days; and in the remaining case, about five weeks.

Diagnosis.—To one who has seen this disease in the new-born, or is familiar with its symptoms, diagnosis is easy. The symptoms which possess diagnostic value are more manifest and reliable than in most other infantile affections. Permanent rigidity of the voluntary muscles, with temporary exacerbations, such as have been described above, which are induced by any cause which disturbs the infant—as attempts to open the mouth or eyelids—is pathognomonic.

Preventive Treatment.—While tetanus infantum, if fully developed, is ordinarily fatal, in spite of any remedial measures heretofore used, there is no doubt of the efficacy and value of preventive measures, when properly employed. This was shown by the great reduction in mortality in the Dublin Lying-in Hospital through the thorough ventilation introduced by Dr. Clarke. Dr. Meriwether, of Montgomery, Ala., says (*Amer. Journ. of Med. Sci.*, April, 1854): "When the disease appears endemically on a plantation, it may be arrested by having the negro houses whitewashed with lime, inside and out; by raising the floors above the ground; by removing all filth from under and about the houses; by particular atten-

tion to cleanliness in the bedding and clothes of the mother; and in the dressing of the child, so as to prevent any of the matter from the umbilicus lying long in contact with the skin." Many physicians, especially in the Southern States, speak confidently of care in dressing the cord, and attention to the umbilicus, as a means of prevention. In the *N. O. Med. and Surg. Journ.*, July, 1853, Dr. Grafton says that he has "never known the disease to occur in any child whose navel had the turpentine dressing." He uses turpentine as follows: "At the first time, a few drops of the undiluted turpentine are applied immediately to the umbilicus around the cord, and it is anointed at every succeeding dressing, the turpentine being diluted one-half or two-thirds with olive oil, lard, or fresh butter." This use of turpentine has also been recommended by other practitioners in the warm regions.

Dr. John Furlonge, of St. John's, Antigua, believes (*Edin. Med. and Surg. Jour.*, Jan. 1830) that no case would occur with the following treatment: "The cord, when divided, should be wrapped in clean linen. Every night, for two weeks, one or two drops of tinct. opii and spts. vini, equal parts, should be given, and castor oil, with a little magnesia, every morning. The child must be washed in tepid water every morning, and the funis dressed." If this treatment is attended by the success which is claimed for it by Dr. Furlonge, so great care in dressing the cord is certainly well repaid in localities, as at Antigua, where a large proportion of the infants die of tetanus.

Some experienced observers go so far as to assert that it is possible to ward off tetanus infantum after the occurrence of premonitory symptoms. Dr. Dowell says (*Amer. Jour. of the Med. Sci.*, January, 1863): "Some, with slight twitchings of the muscles, have recovered without any trouble by being put into a mustard-bath, washed clean, and put in a clean and well-ventilated cabin."

Treatment.—In considering the effect of medicinal agents which have been employed in the treatment of infantile tetanus, the great difficulty which the child experiences in swallowing should be borne in mind. Without care, a considerable part of the dose is lost by the spasm of the muscles of deglutition, which ordinarily occurs when the spoon is placed in the mouth, so that, unless special attention is given to this matter, it is uncertain whether the prescribed dose is fully administered.

The treatment employed by different physicians has been very diverse. Antiphlogistic remedies were prescribed by Finckh, but every case so treated was fatal. He states that whenever blood was abstracted, even in small quantities, the symptoms were aggravated. The same result has followed depletory measures in the practice of other physicians.

The internal remedies which have been most frequently prescribed are opiates and antispasmodics. Furlonge, in a favorable case, gave laudanum, in doses of one drop every three hours, alternately with two grains

of Dover's powder. Woodworth also gave one-drop doses of laudanum; Eberle, one-sixth of a drop hourly. The opiate has generally been given in combination with an antispasmodic. The Dover's powder, given every three hours by Furlonge, was combined with five grains of sulphate of zinc. The hourly doses of laudanum, by Eberle, were combined with six drops of tincture of assafœtida.

When anæsthetics began to be employed in the treatment of diseases it was believed that they would be especially useful in cases of tetanus. Accordingly chloroform has been used in tetanus in the infant, with the effect of controlling the spasm during the time of its use, but without curing the disease. In Case 7 in our first table it was employed several times, but apparently without delaying the fatal result. The editor of the *New Orleans Medical and Surgical Journal* states, in the May issue of that periodical for 1853, that he has used chloroform in tetanus infantum, with the effect, he believes, of prolonging life. Anæsthetics certainly relieve the suffering of the infant, and on this account, even if they do not prolong life, their judicious employment seems proper.

The remedy which, in my opinion, is far preferable to all others, is hydrate of chloral. Since the introduction of this agent into therapeutics, it has been employed by several physicians in the treatment of this disease with so good a result that it will probably supersede all other medicines for this purpose. Dr. Widerhofer, of Vienna, states that he has saved six out of ten or twelve by the use of chloral (*London Lancet*, March 18th, 1871). He prescribes it in doses of one to two grains by the mouth, or, if there is great difficulty in swallowing, two or four grains by the rectum. Dr. F. Auchenthales relates a case (*Jahrb. f. Kinderheil.*, N. S., IV.) in which he gave even six grain doses, and in nine days the disease had entirely disappeared. I have employed hydrate of chloral in only one case of tetanus infantum, giving it in half-grain doses, every two hours, except when there was profound sleep. The disease was fully developed, and the symptoms severe when I was called. I did not believe that the infant with the old remedies would live more than two days, but by the chloral life was prolonged nearly one week. Moreover, by the use of chloral the suffering of the infant is greatly diminished.

The administration of alcoholic stimulants is required at short intervals on account of the rapid emaciation and great prostration.

Local treatment directed to the umbilicus in those cases in which there is evidence of inflammation of the umbilicus or umbilical vessels should not be neglected. Vesication of the umbilicus, and the application of poultices to it, have been followed by unquestionable benefit, if we may believe the statement of some physicians who have made use of these measures. Dr. Merriwether, of Alabama, says, if there is no improvement from the medicine which he orders, he applies a blister, larger than

a dollar, to the umbilicus, and with this treatment the child generally improves; a remarkable statement, since so few improve at all.

A warm foot-bath, repeated at intervals of a few hours, and stimulating embrocations along the spine, are proper adjuvants to the treatment.

CHAPTER XIII.

INTERNAL CONVULSIONS.

Young children are liable to temporary suspension of respiration, induced by violent emotions, especially by anger. In the midst of their excitement, while they are crying or screaming, their breath is suddenly held, as if from tonic spasm of the respiratory muscles. In a few seconds respiration returns and is natural. There is no stridulous inspiration or other unusual sound, and there is no apparent ill effect, unless occasionally a degree of languor. External convulsions, which seem to be threatening, seldom occur, and when they do, are ordinarily mild. Some writers consider dentition the predisposing cause of this arrest of respiration, by inducing a sensitive state of the nervous system. Such an effect of dentition is possible, but certainly many infants are affected in this manner before the age of dentition.

A much more serious state, and one which is recognized as a true disease, is that variously designated by writers as internal convulsions, spasm of the glottis, child-crowing, laryngismus stridulus, etc. Manifest difficulties attend the investigation of the pathological state in this disease. There can be little doubt that it is not precisely the same in all cases. That there is, during the paroxysms, tonic or clonic spasm of more or fewer of the respiratory muscles is inferred not only from the symptoms pertaining to the respiratory apparatus, but from the fact that in severe cases there are often spasms of the external muscles, as those of the limbs and face. Usually, also, the movements of the eyeballs indicate spasmodic contractions of the motor muscles of the eyes. The occurrence of these contractions in parts that are visible justifies the belief that they occur in other parts which are concealed from view, especially as the characteristic symptoms cannot be readily explained except on this supposition. Trousseau says: "Internal convulsions consist, then, principally in a spasm of the diaphragm and of the respiratory muscles of the abdomen and chest; but it occurs, also, that the muscles pertaining to the larynx are affected with spasm at the same time with these." Rilliet and Barthez conclude from the symptoms that the "heart is not always a stranger to this internal convulsion, which, perhaps, prolongs itself even

to the intestines." The muscles of the pharynx appear to be involved, in some cases, as well as those of respiration, rendering deglutition difficult. In one form of internal convulsions, namely, that which is principally referred to by writers, there is not complete arrest of respiration, but the inspirations, during the paroxysms, are difficult and are attended by a stridulous noise. Again, the respiration may cease entirely, but when it commences it is stridulous, and difficult for a few inspirations. In still another form of the disease respiration ceases, but there is no symptom or sign indicative of glottic spasm or of an obstacle to the ingress of air; the inspirations which succeed the paroxysm are easy and noiseless. It has been suggested that, in these cases, there is paralysis rather than spasmodic contraction of the respiratory muscles, but the symptoms may be explained in accordance with the commonly accepted opinion, namely, that there is spasm of the diaphragm and, perhaps, of certain muscles of the chest and abdomen, while the laryngeal muscles are not affected. M. Herard, indeed, who has written one of the best monographs on internal convulsions, describes three forms of the disease, according to the supposed location of the spasm, namely, laryngeal, diaphragmatic, and another, which consists of a blending of the two.

Internal convulsions are not frequent in this country; they are rare in France, more frequent in Germany, and quite common in England. They occur, with few exceptions, before the age of two years. Dr. West observed thirty-one cases under the age of two years, and only six above that age.

Causes.—The causes of internal convulsions are not fully ascertained. Most observers have remarked the relative frequency of the disease during the period of dentition, and it is probable that dental evolution does operate as a cause, by rendering the nervous system more impressible.

Spasm of the glottis has been attributed to enlargement of the thymus gland, and also to enlargement of the cervical and bronchial glands. It is presumed that this effect is due to the pressure of these glands on the par vagum, or the recurrent laryngeal nerve. It is certain, however, that there is no such enlargement of the thymus gland which could possibly produce glottic spasm, or any other form of internal convulsions at the age at which these convulsions commonly occur. This gland is largest in the new-born, and having no function after birth, it gradually becomes atrophied. If enlarged thymus could produce glottic spasm, it would certainly occur most frequently in the new-born. Abnormal development of the thymus gland was the only assignable cause of atelectasis in two infants who died soon after birth, but I have never seen a case in which a convulsive attack was referable to this cause. M. Herard examined the thymus gland in six children who died of internal convulsions, and in sixty who died of other affections, and was not able to discover in its condition any causative relation to this disease. Indeed, cases have been

reported in which the thymus had undergone more than its usual atrophy at the time when the convulsions occurred (Hasse). Enlargements of the lymphatic glands in the vicinity of the pneumogastric or recurrent laryngeal nerve may possibly give rise to glottic spasm, but this is doubtless an infrequent cause, if it be a cause at all, since these glands are often greatly enlarged in strumous and tubercular diseases without such a result. According to Dr. Jacobi (*N. Y. Jour. of Med.*, Jan. 1860): "In some cases, described by Dr. Friedleben, a congenital hypertrophy of the thyroid gland has probably been the cause of laryngismus. The patients were new-born infants of normal development, and born by normal labors. There were no constitutional causes of the disease, but a remarkable vascular swelling of the thyroid gland. Whenever the swelling increased, the veins of the face and head increased in size also, the face grew livid, and the extremities and spinal column exhibited slight tonic convulsions. The recurrent nerves were entirely surrounded by the glandular tissue, their neurilemma looked unusually red, and their functions were probably injured during the occasional swelling taking place during lifetime."

The cause is occasionally located in the cerebro-spinal axis. Thus Dr. Coley relates a case in which an exostosis arising from the internal surface of the occipital bone pressed upon the cerebellum, while nothing abnormal was discovered in other organs. There are also striking examples in which the cause was located in the spinal cord. Thus Marshall Hall relates the following case communicated to him. A child with spina bifida was attacked with croup-like convulsions, whenever it lay so as to press on the tumor.

Internal convulsions also frequently occur in rachitic softening or deformity of the calvarium, since, when this is present, undue pressure occurs upon the brain, even by the weight of the head of the child upon the pillow.

In some patients there is evidently an hereditary predisposition to this disease; those affected belonging to families in which there is a tendency to convulsive maladies. Thus Toogood relates that five infants of the same family were affected with spasm of the glottis; and Reid relates, on the authority of Powel, that of thirteen infants of the same parents only one escaped internal convulsions.

The common predisposing cause is an excitable state of the nervous system, often associated with impaired general health. Hence the disease is more prevalent in cities, where anti-hygienic conditions abound, than in the country. Hence, too, the frequent improvement when the patient is removed to the pure and bracing air of the country. The use of insufficient food, or food of a bad quality, must for the same reason be considered a cause, as it leads to impoverishment of the blood, and renders the nervous system more impressible. Facts mentioned by Reid and

others show conclusively the influence of premature weaning, and of indigestible or otherwise improper aliment, in the production of this disease.

The causes enumerated above are for the most part predisposing; occasionally they are the only apparent causes, since this disease sometimes occurs when the child is perfectly tranquil, even in the midst of quiet sleep, or when it is at rest in its mother's arms. In other cases, and more frequently, there is an exciting cause, often trivial. Anything that requires exertion on the part of the infant, or that excites strong emotions, may be a direct cause, as anger, or any of the violent passions; so may even coughing, or, in rare instances, attempts to swallow. One author has known it to occur from excitement produced by examining the throat with a spoon. In a case in my practice, hereafter related, it occurred whenever the infant cried violently. It appears from the above facts that the etiology of internal convulsions is very similar to that of eclampsia. The same spasmodic muscular contraction may occur from a variety of causes.

Anatomical Characters.—While, therefore, structural changes in various parts of the system may give rise to internal convulsions, this disease, so far as ascertained, presents no anatomical characters, and must consequently be considered one of the neuroses. The lesions of the respiratory apparatus, observed at post-mortem examinations, are either due to the convulsions or are coincidences. Emphysema has sometimes been observed as a result, it is believed, of the spasmodic and irregular respiration. It was present in all of Herard's cases, and Rilliet and Barthez consider it common in those who die of this affection, although they did not observe it in any of their cases. Slight emphysema occurring in the upper lobes is, however, a common lesion in feeble infants, whatever the disease of which they die. Therefore its occurrence in internal convulsions is probably more due to molecular change in the lungs, since these patients are cachectic, than to the irregular breathing, which is only momentary.

In fatal cases of internal convulsions the blood is darker than usual, from an excess of carbonic acid; the cavities of the heart and large vessels are sometimes engorged with blood; but in other cases they contain no more than the normal amount. More or less passive congestion occurs in the internal organs; and congestion of the cerebral vessels is sometimes such that transudation of serum occurs.

Symptoms.—I have said that the symptoms vary according to the seat and function of the muscles which are affected. There is generally previous ill-health. The child is drooping, and is sometimes restless for days before the disease appears. Finally, if the muscles of the glottis become affected, the peculiar crowing sound is heard now and then during inspiration. It is observed especially when the child is crying or is agitated. It may be loud and well-defined from the first, but in most patients it comes

on gradually, so that several days elapse before its full stridulous character is developed. The attacks are more frequent and severe at night, in or after the first sleep, than in daytime.

Under favorable hygienic conditions, the malady may pass off without becoming more serious. In other cases the paroxysms gradually increase in frequency and severity. The dyspnœa in the attack is such that the features are livid, the head forcibly retracted, and death seems imminent from apnœa. In these severe paroxysms respiration often ceases entirely for a moment. When the spasm ends, a deep stridulous inspiration occurs, after which the breathing is natural. It has been stated that internal convulsions are often associated with those, usually tonic, but sometimes clonic, of the external muscles. In the tonic form, the thumbs are flexed across the palms of the hands, and sometimes are grasped by the fingers; the great toes are adducted, and the other toes flexed. In severe cases, the hands, forearms, feet, and legs are also somewhat flexed and rigid. At first, the contraction of the external muscles is temporary, either corresponding with the internal spasm, or it is most intense at the time of the spasm, though commencing sooner and subsiding later. After a while, however, if the disease continues, the external contraction becomes more persistent. In severe cases, nearly every inspiration is accompanied by the wheezing sound, and the paroxysms of dyspnœa are excited by trifling causes. Anything that suddenly disturbs the mind or body may bring on the attack, as anger, the impression of cold, or currents of air. Dr. West calls attention to the fact that an anasarcous condition is sometimes present, accompanied by albuminuria.

If the convulsions affect other muscles, as the diaphragm or the pectoral and abdominal muscles, which are concerned in the respiratory function, while those of the larynx escape, respiration is irregular, or even suspended for a moment, but the stridulous laryngeal sound is absent, as there is no obstacle in the larynx to the entrance of air. In this form of the disease, the infra-mammary region may be strongly retracted during the paroxysm from tonic contraction of the diaphragm. In severe paroxysms, whether the spasm be laryngeal or diaphragmatic, consciousness is nearly or quite lost, the features may be pallid, or, if respiration be suspended, may be more or less livid. There is no fever in simple cases. In the paroxysm there is often relaxation of the sphincters of the bowels and bladder, with involuntary evacuations.

The duration of the paroxysm may be a quarter, a half, or even a whole minute. Total suspension of respiration for even half a minute involves danger. In mild cases there may be but few paroxysms, and they slight. In other instances they occur in a severe form, almost daily for several weeks or even months. In the following case the muscles of the larynx were apparently not involved. The patient was scrofulous, and has since had scrofulous periostitis, with necrosis and exfoliation of the surface of

the tibia. At the time of the internal convulsions there was also a scorbutic or hemorrhagic cachexia.

Case.—On the 28th of August, 1858, a German female infant, fourteen months old, nursing, and having eight teeth, was suddenly seized with clonic convulsions. Uniformly delicate and pale, she had been in her usual health till the age of twelve months, when she had a single convulsive attack, and from that date had remained well till August 27th, when, without any premonitory symptom, she had a stool consisting of almost pure blood, black and offensive. On the morning of the 28th a similar evacuation occurred, and another in the afternoon immediately preceding the convulsion. Pulse 128, after the convulsion; surface cool and pallid; flesh soft, but no emaciation. Turpentine was prescribed in two-drop doses every two hours, and laudanum in one and a half drop doses, repeated sufficiently to insure quietude.

On the 29th the pulse was 152. At 1 P. M. she had a general convulsion, lasting about five minutes; in the evening she had an evacuation similar to those passed on the preceding day. The record for August 30th states: "Pulse from 150 to 160; up to this time has been playful, but is now drowsy, and, when disturbed, fretful; manifests no desire for solid food, as before her sickness, but still nurses; has taken up to this time thirty-two drops of turpentine. When she cries or frets, she has a spasmodic attack." This was the commencement of internal convulsions, with which this child was affected for several months. An opportunity was afforded of observing their character, for her excitement, when she was examined, was usually sufficient to produce them. After a succession of short expirations, respiration ceased; for a moment she was apparently insensible; eyes closed; face pale; no frothing at the mouth. The return of consciousness and respiration was without any laryngeal râle; and after the attack she seemed as well as before. No external convulsion and no evacuation of blood occurred after August 31st.

There was gradual improvement in her health, but she continued for many months pallid and irritable, and subject to attacks of internal convulsions. On the 11th of April, 1859, when twenty-two months old, she had another attack of general convulsions. The record made on that day is: "Has had internal convulsions (one or more paroxysms) almost every day since last August, brought on usually by crying when she is corrected in any way, or her wishes are refused." Again, on December 1, 1859, it is stated: "Has grown considerably since the last record, and appears to have recovered, except that at long intervals the spasms still occur." She took a preparation of iron, but her recovery seemed to be due more to the growth and development of the body, and to hygienic than therapeutic measures.

The general health in internal convulsions is more or less impaired, except in mild forms of the disease, in which the convulsive attacks soon cease. Pallor, or a sickly and cachectic aspect, irregular, usually constipated bowels, poor appetite, and moroseness or irritability of temper, are common symptoms of severe and protracted cases.

Diagnosis.—This disease is easily diagnosticated, unless when its symptoms are masked by those of external convulsions; it may then escape notice. Spasm of the glottis may be mistaken for spasmodic laryngitis, and

vice versâ. In some of the published cases this mistake appears to have been made. Spasmodic laryngitis is, however, so different not only in its nature, but in its clinical history, that a differential diagnosis is not difficult. It is an inflammatory disease, and is attended with febrile reaction and a sonorous cough; it commences at night after the first sleep, and from exposure to cold—particulars in regard to which it contrasts with true spasm of the glottis.

Prognosis—Modes of Death.—Statistics show great mortality in this disease. Dr. Reid, in a monograph on "Infantile Laryngismus," states that of 289 cases which he collated, 115 died. Rilliet and Barthez met with one favorable case in nine unfavorable: and Herard, one in seven. If the paroxysms are mild, infrequent, and dependent on a cause which can be easily removed, recovery is probable with proper treatment. The cause may, however, be such, even when the spasm is mild, that the case is necessarily unfavorable; as when it is due to disease of the cerebro-spinal axis. We should not, however, in any case consider the patient entirely safe, since grave symptoms may suddenly arise, so as to change entirely the prognosis. Long and severe paroxysms, with lividity of the face, and symptoms of suffocation, indicate an unfavorable result. The same should be predicted also if the infant gradually waste away, losing appetite and strength, especially if the face is pale and the pulse feeble.

There are three modes of death in internal convulsions. The first is apnœa. The infant dies suffocated in the attack. Respiration is first arrested, and then the pulse ceases, and at the autopsy the lungs and the cavities of the heart are found engorged with dark blood. Death may also result from the state of the brain. In such cases, passive congestion of the brain occurs from obstruction to the return of blood from this organ to the heart and lungs; and if this congestion is not soon relieved, serous effusion also occurs. Death results from the congestion, and consequent œdema or dropsy.

The third mode of death is from exhaustion. Repeated and severe attacks undermine the constitution; the infant gradually grows pale and thin, and dies of inanition, or of some disease which this state induces.

Treatment.—The treatment of internal convulsions has varied according to the theories which physicians have held in reference to its cause. Glandular enlargement is no longer regarded as a common cause, and therefore treatment directed to its removal is less frequently employed than formerly. The causes of internal convulsions are in part very similar to those of eclampsia, and the remedies employed in the one affection are, in a measure, appropriate in the other. That dentition is sometimes a cause, is usually admitted; and two cases, one of which occurred in my practice, and the other was reported to me, clearly show the truth of this belief. The effect of dentition is especially observed in weakly infants, when several dental follicles are undergoing active evolution. Thus, in

one of the cases to which I refer, five teeth pierced the gums in the course of two weeks; after which no convulsive attack occurred. If, therefore, the gums are swollen, the propriety of scarification should be considered.

In all cases of internal convulsions a careful examination should be made, in order to detect any appreciable cause of nervous excitation. The condition of the digestive organs should be ascertained, and evacuants or other remedies prescribed if there is evidence of their derangement.

Sometimes the alimentation of the infant is in fault. It is, perhaps, bottle-fed, and the stools have an unhealthy appearance. Attention should be given to the preparation of its food and the times of its feeding; or, if it nurse, the mother or wet-nurse who suckles it should have plain but nutritious diet, live with regularity, and give the breast to the infant at regular intervals. If there is a torpid state of the intestines, Dr. Meigs recommends "castor oil and aromatic syrup of rhubarb rubbed up together, three parts of the former and five of the latter." A simple enema answers well in such cases, and, in debilitated infants, this is preferable to medicine administered by the mouth. If there be diarrhœa, and it persist after the requisite changes are made in regard to the diet, remedies calculated to relieve it, and which are detailed elsewhere, should be employed. Marshall Hall states that he has ordinarily succeeded in curing the disease by attending to the condition of the gums and digestive organs.

Since rachitis is a not uncommon cause, the child should be examined in reference to the rachitic manifestations, and if they appear the treatment appropriate for rachitis is required.

In pallid and cachectic infants, tonics are indicated. The elixir of Calisaya bark in half-teaspoonful doses, three or four times daily, to an infant of one year, is an eligible preparation. The compound tincture of bark, or of gentian, or the two mixed, may be given instead of the Calisaya bark. The preparations of iron are sometimes to be preferred, as the citrate of iron and bismuth, citrate of iron and quinia, the syrup of iodide of iron, or the wine of iron. To an infant of one year the syrup may be given in doses of three drops, the citrates in one grain doses, and the wine in doses of one teaspoonful, three times daily. If the child is old enough, it may take iron in lozenges, as those of chocolate and iron.

Antispasmodics, as assafœtida, valerian, and oxide of zinc, are often prescribed in this malady, but they are less efficacious than the general tonic measures which I have indicated. The salutary effect of bromide of potassium in eclampsia, and certain epileptiform attacks, certainly justifies the trial of this agent in internal convulsions, if they persist after the employment of invigorating measures.

Hygienic measures are of the utmost importance. The infant should reside in dry and airy apartments, and should be kept much of the time through the day in the open air. Remarkable success sometimes attends

this simple expedient, when medicines have entirely failed. In the *London Med. Gazette*, Jan. 14, 1865, Mr. Robertson, of Manchester, relates five severe cases in which this malady was cured by exposure of the infants several hours daily to a cool atmosphere. These cases were treated in the winter months, and were kept out-door, even during strong winds. Mr. Robertson has records of forty cases, all occurring between December and April, while he has seen no case in the summer months. As the result of such extensive experience, this writer recommends "the free exposure of the infant out of doors, for many hours daily, to a dry, cold atmosphere, and if the air be dry, the colder the better." Dr. Marshall Hall's experience was similar. Says he: "The curative influence of change of air, and especially of the sea-breezes, is not less marked in this affection than in hooping-cough." Mr. Robertson recommends also, as part of the tonic treatment, "free sponging of the body every morning with cold water." In February, 1867, I attended a nursing infant, five months old, with internal convulsions, the paroxysms being attended with lividity of the face, and, at times, tonic convulsions of the limbs. Among the remedies employed was bromide of potassium, but more benefit obviously accrued from keeping the infant much of the time in the open air, than from the medicines employed. The disease passed off in six or eight weeks.

Unless the cause is of such nature that it cannot be removed, the above hygienic and therapeutic measures will, in a large proportion of cases, be followed by a satisfactory result.

The mother or nurse may abridge the paroxysm by raising the infant, blowing upon it, sprinkling water in the face, or gently stroking it. Dr. Hall recommends tickling the nostrils with a feather, to produce respiration, or the fauces, to occasion vomiting, and thereby interrupt the paroxysm. Anything which produces a sudden and profound effect upon the system may abridge the attack. This was effected in one case, in the practice of Dr. C. D. Meigs, by applying a cloth wrapped around ice over the epigastrium and the lower part of the sternum. The chief danger during the attack is from congestion of the brain, with effusion of serum or extravasation of blood. If the attack is severe, and the features congested, so that there is evident danger of such a result, cold applications should be made to the head, derivatives used for the extremities—as sinapisms, or mustard foot-baths—and the bowels should be speedily opened by enemata.

CHAPTER XIV.

CHOREA.

Chorea, or St. Vitus's or St. Guy's dance, is a neurosis, which is characterized by irregular and involuntary muscular movements, without loss of consciousness. The movements occur in the muscles of volition, and there is probably no one of them that may not be engaged, though some are more frequently affected than others. It is not known that any involuntary muscle is ever involved, though Sir William Jenner has expressed the opinion that occasionally the papillary muscles of the heart are, so that, by their spasmodic contractions, they produce insufficiency of the mitral valve. This, according to him, affords explanation of the fact that, in certain instances, a mitral regurgitant murmur is heard, which disappears about the time that the external movements cease. It is rare, however, that a mitral regurgitant murmur, heard during chorea, ceases when the latter terminates, and it is not improbable that in such cases there is, after all, a lesion of the valve, due to recent endocarditis, whether of a rheumatic or other origin. For a valve may be so thickened by recent inflammation as to cause a murmur, and after a few weeks or months the infiltrating substance be so absorbed that the murmur is no longer audible. If we admit the fact that cardiac bruits occasionally appear and disappear with chorea, this explanation seems to me more plausible than that of Jenner. Hillier says, in reference to this subject: "My own experience leads me to doubt the existence of dynamic apex murmurs in chorea, that is to say, murmurs produced in hearts entirely free from organic change. If such murmurs ever occur, they are certainly rare. Organic murmurs of the heart, on the other hand, are common in chorea, and I am inclined to believe that organic disease of the heart often exists in chorea when there is no murmur." We shall see that this opinion is correct, by a case presently to be related. Hillier also calls attention to the fact that choreic movements are irregular; but a cardiac bruit occurring regularly and uniformly, if not due to organic disease, would require rhythmical contractions of the papillary muscles to produce it.

In the class of children's diseases in the Bureau for the Relief of the Outdoor Poor in New York city, 6986 children were treated in the two years and three months, ending with March 31st, 1877. Of these cases 82, or one in every 207, had chorea. The patients were all under the age of fifteen years. Statistics published by observers in Europe show that the relative frequency of this disease is probably about the same in

the large European cities as in New York. Thus, according to Hillier, amongst 122,621 out-patients treated at the Hospital for Sick Children, in London, 406, or 1 in 322, had chorea; while of the in-patients 174 in 5585, or 1 in every 32, were choreic. In the Parisian Hospital for Sick Children, of 84,968 admitted in twenty-one years, 531 had chorea, or 1 in every 161.

Age.—Chorea may occur at any period of life, but a large majority of the cases are in childhood. It is rare in infancy, and it rarely begins after puberty. Under the age of five years the proportionate number diminishes, as we approach the time of birth. The youngest in the statistics of Hillier was three months. In 1870, in the Bureau for the Outdoor Poor, a child was presented for treatment, who the mother said had had chorea from birth, and in 1877 I treated a young woman with severe general chorea, who, repeatedly questioned, uniformly said that she had had the disease, without any assignable cause, from the first week of her life, and her friends corroborated the statement. The following table exhibits the relative frequency of chorea at different ages :—

	6 years and under.	6 to 10 years.	10 to 15 years.
Children's Hosp., Lond., Hillier, none over 12 years admitted	81	237	104
M. Rufz	10	61	118
Bureau for Outdoor Poor (prior to 1875)	2	26	16

	Under 3 years.	3 to 5 years.	5 to 10 years.	10 to 15 years.
Bureau for Outdoor Poor (since January 1, 1875) .	0	13	51	14

M. Sée collected the statistics of 531 cases occurring in the Children's Hospital, Paris, and from them concludes that the maximum frequency of chorea is between the sixth and tenth years. Only twenty-eight of his cases were under six years, the remainder, 503, occurring between the sixth year and puberty.

Causes.—The profession are nearly agreed in regard to certain causes of chorea, while there is a diversity of opinion in reference to others. It is admitted that in a large proportion of cases there is a neuropathic state, which antedates and predisposes to chorea. This state is often manifested in the family history by a proneness to affections of the nervous system, and in the individual by a highly excitable state of the emotions, so that he evinces joy, grief, or anger, from slight causes.

All writers admit that there is often an inherited predisposition to chorea. In 27 of 48 cases of chorea, Radcliffe found that father, mother, brother, or sister had been or was the subject of one or other of the following disorders: paralysis, epilepsy, apoplexy, hysteria, or insanity. The children of parents who when young had chorea, or who exhibit proneness to ailments of the nervous system, are more liable to chorea than other children. Hence the fact sometimes observed, of different children in the

same family becoming affected with chorea when they attain the age at which this disease ordinarily occurs. In one family in my practice, three girls at different times were affected.

Sex.—The emotions are strong in girls, since in them the nervous system predominates, while the muscular power is weaker than in boys. Hence a partial explanation of the fact which statistics fully establish, that the proportion of choreic boys to girls is about in the ratio of one to two and a fraction. I have remarked, in this city, the large proportion of cases in school-girls between the ages of six and twelve years; the severe discipline and confinement of the public schools no doubt increasing the strength of the emotions, and weakening the control of the will over the muscles.

Proportion of Males to Females.

27 to	73.	Hughes's Digest of Cases in Guy's Hosp., 1846.
138 to	393.	M. Sée.
50 to	94.	Outdoor Department, Bellevue.
276 to	499.	Children's Hosp., Lond. West (Lumleian Lect.).
481 to	1059	= 1 to 2.15.

Uterine Irritation.—The peculiar changes occurring in the female at puberty constitute an important cause. Hence another reason of the excess of female cases. Dysmenorrhœa and pregnancy are causes of a large proportion of cases in the first years of puberty. In the male, on the other hand, the changes of puberty do not appear to increase the liability to the disease, directly or indirectly, and male cases, after the age of twelve years, are comparatively rare. Radcliffe states (*Reynolds's System of Med.*) that after the ninth year, females are more liable to chorea than males, in the proportion of 5 to 2; while before the ninth year, the two sexes are equally liable to it. Carefully prepared statistics, however, notwithstanding the high authority of Radcliffe, show a preponderance of girls under the age of nine years, though not as great as over that age. In the Outdoor Department at Bellevue, of 35 patients under the age of ten years, 22 were girls, while of 20 from the age of ten years to sixteen, 15 were girls.

According to West (Lumleian Lect.), in 775 children with chorea, under the age of ten years, treated in the Lond. Children's Hosp., 64 per cent. were girls.

Anæmia.—Among the most common predisposing causes of chorea is anæmia. It is present in so large a proportion of cases, exhibiting itself by pallor of the countenance and other characteristic signs, that medicines designed to improve the quality of the blood are among the most valued remedies. The peculiar neuropathic state already alluded to, which needs only a slight additional cause for the development of chorea, is, no doubt, largely dependent on impoverishment of the blood, if it is not sometimes

due entirely to it. Among the poor of a large city like New York, or in hospital practice, the proportion of anæmic cases of chorea is, for obvious reasons, much larger than would appear from general statistics.

Rheumatism.—Dr. Copeland, M. Bouteille, and afterwards M. Germain Sée, in a more extended monograph, directed the attention of the profession to rheumatism as a cause of chorea. Subsequent observations have established the fact that rheumatism, or the rheumatic diathesis, is so frequently present that it obviously sustains an important relation to chorea, though in what manner is not fully ascertained. This relation between the two is more frequently observed in some countries than in others. In England and France, so large a proportion of choreic patients present the history of rheumatism either in themselves or family, that certain physicians of these countries believe that rheumatism is the most common cause of the disease. In Germany, on the other hand, according to Romberg, in the majority of cases no relation can be tracted between chorea and rheumatism, and the statistics of this city, and I think of this country, correspond with those in Germany.

Various theories have been promulgated in explanation of the relationship of the rheumatic and choreic diseases. It has been suggested that chorea is due to rheumatism of the brain or spinal cord. This is simply an hypothesis, the truth or falsity of which can only be ascertained by carefully conducted necropsies; but the theory appears improbable in view of all the facts. Another theory attributes chorea to the state of the blood which is present in those having rheumatism or the rheumatic diathesis, as well as in certain other conditions. This theory is enunciated by Dr. Ogle, as follows: "Recognizing the frequent existence of these fibrinous deposits or granulations on the heart's valves in chorea, I should be much inclined to look upon these post-mortem appearances rather as results of some antecedent general condition of the blood, common also to the choreic condition. It is very freely recognized that this affection is frequently, in some way or other, connected with that condition of blood which obtains in what we call anæmia, or that existing in rheumatic constitutions. In both of these states we know that the fibrin of the blood is much in excess (as also it is in pregnancy, another condition looked upon as obnoxious to chorea); and in these states we know that the fibrin with which the blood is surcharged is very prone to be readily precipitated, either owing to its superabundance, or from other obscure and acquired properties . . . upon the heart's walls or valves. May not this hyperinosis be the explanation of the coincidence alluded to?" (*British and Foreign Med.-Chir. Rev.*, January, 1868)—namely, the occurrence of chorea in those affected with rheumatism. Others still hold that chorea is the result of the heart disease, and not directly of rheumatism, occurring when the heart is affected from other causes, as well as when the lesion has a rheumatic origin. This theory is plausible, and probably to a certain extent

correct. Heart lesions, observed in children, result from scarlet fever in a considerable proportion of cases, though, it is true, the endocarditis and pericarditis of scarlet fever are believed often to have a rheumatic origin, occurring, in some instances, from scarlatinous rheumatism, but in other cases from scarlatinous uræmia. Occasionally, also, the heart disease appears to have occurred independently of both rheumatism and scarlet fever. Thus in a fatal case of chorea with valvular disease, related to the London Pathological Society, April 6th, 1869, the child was always healthy up to the present illness (chorea), and there was no history of rheumatism in the family. The more observations accumulate, the more important does heart disease in itself appear as a cause of chorea. In nearly all recorded cases of fatal chorea, which were supposed to be due to rheumatism, and in which post-mortem examinations were made, endocardial and usually valvular disease has been found. We shall see that certain eccentric causes of irritation aid in producing chorea, and may not the valvular disease, or the endocarditis which causes the valvular lesion, operate in a similar manner as a cause? We know that in the adult severe cardiac disease often profoundly affects the nervous system, perhaps in consequence of the irregular and embarrassed circulation; and certainly in the child a similar cause would be likely to produce a more decided effect.

But there is an ingenious theory which attributes chorea to minute emboli detached from vegetations on the valves, and arrested by capillaries in the corpora striata, or other portion of the cerebro-spinal axis. Since attention was directed to this matter, emboli have been found in one case in the medulla oblongata, although this portion of the spinal axis appeared healthy to the naked eye. Further observations are necessary in order to determine how much truth there is in this theory; but it seems probable, for reasons to be stated, that if capillary embolism does cause chorea, it is only in a limited number of cases, and that therefore those British observers who regard it as the common cause, have been led into error by the large proportion of choreic cases which are complicated by valvular lesions in their climate.

That embolism is not a common cause, if indeed a cause at all, appears probable from the following facts: First. In many cases of chorea there are no vegetations, or rather appreciable lesions, which could give rise to emboli. Secondly. Most patients recover, and some speedily, by treatment, which we would not expect if the cause were embolism. Thirdly. Embolism is not infrequent in the cerebral vessels of the adult, without the occurrence of chorea. Indeed, the conditions which produce embolism are much more common in adults than in children, while the reverse is true as regards the liability to chorea. Fourthly. Dogs sometimes have chorea, but the injection of minutely divided fibrin or other substance in the veins of the dogs is not followed by chorea as one of the phenomena.

Fifthly. Were capillary emboli the cause, we would expect to find an occasional embolus in the larger vessels of the brain, so as to be appreciable to the naked eye; but I find no examples of this in all the recorded autopsies which I have been able to consult. Moreover, it seems improbable that capillary embolism, when producing no lesion appreciable to the naked eye, would so arrest the circulation, and disturb the function of the brain or spinal cord, as to cause chorea, for the ill effects of such an obstruction would be likely to be obviated by the numerous anastomoses.

In 1877 the unusual opportunity occurred, in my asylum practice, of determining whether there are any fixed anatomical characters in the cerebro-spinal axis in chorea; in other words, whether chorea is a neurosis, as we have designated it in our definition, and the case is so interesting in other respects that I will relate it entire.

Charles, a foundling, born Oct. 15th, 1874, was received in the N. Y. Foundling Asylum soon after his birth. When two weeks old he was removed to a family in the city to be wet-nursed. His health continued good till the age of three months, when he had bronchitis and keratitis, the former mild, and lasting only a few days, but the latter continuing nearly two months, being attended by moderate injection of the conjunctiva, with some purulent discharge, which caused adhesion of the eyelids during sleep. From this time he remained well, with the exception of a slight attack of dysentery, till the age of about nine and a half months, when he began to have febrile symptoms. In the morning hours he seemed in tolerable heath, but at midday, or a little later than midday, of each day, he was observed to have slight irregularity or embarrassment of respiration, and lividity, with coolness of the extremities, which state, supposed at the time to be the algid stage of a somewhat irregular intermittent fever, lasted from one to two or three hours, and was succeeded by febrile movement, which continued during the remainder of the day; sometimes the fever abated in perspiration.

On August 4, 1875, a few days after the commencement of these irregular febrile symptoms, Charles was brought to the dispensary of the institution for treatment, and Dr. Reid, who was on duty that day, carefully examined the case, and prescribed the sulphate of quinia. This medicine continued a few days relieved the symptoms, but every four to six weeks, for more than a year, these febrile attacks returned, and were uniformly relieved by the same medicine. In other respects the patient had the usual health.

On or about February 1, 1878, the nurse noticed that Charles had what she designated "spells of trembling," in which he seemed excited and feverish, and which were sometimes attended by or followed by perspiration. In the course of another week the irregular muscular movements became more marked and constant, and they increased in severity till near the time of the admission of the patient into the asylum, about March 1st. The nurse had noticed in February slowness and some difficulty of micturition, and Dr. Reid examined him with a catheter for calculus, and also his prepuce for any source of irritation, but nothing abnormal was discovered, either in the condition of the bladder or the external organs. In the latter part of April, the chorea had become so severe, that irregular muscular action occurred in all the limbs, and in the muscles of the eyes, producing

such grimaces and contortions with strabismus, that the woman with whom he was boarding became alarmed, and returned him to the asylum stating that he had become crazy.

On March 12th my attention was first called to this child, when I made the following entry in my note-book: "Family history unknown; no history of rheumatism in patient's case, he may and may not have had it; heart sounds normal; pulse 104; all the limbs and the muscles of the face, eyes, and eyelids involved in choreic movements, which continue constantly except during sleep. The patient cannot walk or stand without support; appetite good, apparently better than in health, for he eats every kind of food handed to him, and carries the food with his own hands to his mouth, although these movements are very irregular and jerking. Three drops of Fowler's solution ordered after each meal.

March 17th.—Condition not much changed, but perhaps slight improvement; in addition to other choreic movements the eyes twitch spasmodically; pulse 84; temperature 98½°; bowels regular; no cough; appetite good. Increase medicine to five drops.

30th. The urine examined since the last record was found very pale and abundant; its specific gravity low, 104, without albumen. When an equal quantity of nitric acid was added to it, after twelve hours crystals of nitrate of urea occupied about one-half of the volume of the urine. The patient's sleep is quiet, but the choreic movements recommence as soon as he awakens, but in a milder form; is able to walk without support, but with unsteady gait. My term of service ended March 31st. On the following day, laryngo-tracheitis was suddenly developed, ending fatally in forty-eight hours, at the age of two years five and a half months.

Autopsy, April 4th. Slight œdema about the aperture of the glottis; general and intense redness of mucous membrane of larynx, trachea, and bronchial tubes, as far as they can be traced, posterior portions of lungs greatly congested. The heart, lungs, brain, with one eye attached to it by optic nerve, and the entire spinal cord were sent to Prof. Francis Delafield for microscopic examination. They were, as soon as removed, placed in a solution of bichromate of potash. The following is a brief statement of the examination, which was thoroughly made.

Microscopic Appearances. By Prof. Francis Delafield. *Brain*—presented no change apparent to the naked eye, except a considerable degree of congestion. It was hardened in bichromate of potassæ and chromic acid. Minute examination of the convolutions of the brain, the large ganglia, the cerebellum, the pons Varolii, and the medulla oblongata showed nothing except a uniform filling of the vessels with blood, as if they were injected. There were no apoplexies, no changes in the walls of the vessels.

Spinal cord—appeared to be entirely normal.

The Heart.—The auricles and ventricles were of normal size. The aortic valves were atheromatous, and somewhat rigid; the mitral valves were thickened and insufficient; the endocardium of the left ventricle was thickened.

The Lungs.—The capillaries in the walls of the air-vesicles were dilated, and there was an increase of epithelial cells within the air vesicles.

In this case there seemed to be no lesion associated with the chorea except the organic disease of the heart, and the changes in the lungs, secondary to this condition of the heart.

The above microscopic examination was made with sufficient minute-

ness, and it is seen that no emboli were discovered, and no lesion of the cerebro-spinal axis except congestion, which was attributable to the mode of death, namely, by obstructed respiration. Moreover it will be recollected that there were no cardiac *bruits*, and apparently not sufficient roughness of the edge or surface of the valves to cause precipitation of fibrin, which would be necessary in order that emboli should form.

Fright.—A not infrequent exciting cause of chorea is sudden and profound emotion, especially fright. All statistics give fright as the cause of a certain proportion of cases, though there are usually other potential co-operating causes, as anæmia or valvular disease. Fright was stated as the cause of chorea in 31 of the 100 cases occurring in Guy's Hospital, reported by Hughes, or in nearly one in three. But the statistics of other observers do not give so large a proportion of cases originating in this way. Chorea may commence within a few hours after the fright, or not till the lapse of several days (eight or ten). If several weeks have passed since the fright, as in some reported cases, the chorea is probably due to other causes. In rare instances, chorea is said to have been caused by sudden and excessive joy.

Imitation.—Under unusual circumstances, especially in a state of great mental excitement, imitation has been known to cause a form of chorea. Hecker describes an epidemic of it, occurring in the middle ages, and spreading through villages. In modern times it is rare that chorea originates from this cause, nevertheless occasional examples have been recorded.

But the disease which occurs from imitation differs from the ordinary form, and has been termed chorea major; while the chorea which is the subject of this article is sometimes designated, in contradistinction, chorea minor.

In chorea major the patient leaps, dances, or whirls like a top. It has its origin commonly in religious excitement, and spreads by imitation almost in the manner of an infectious disease. The epidemic of the middle ages was a chorea major. I have not been able to find any account of cases spreading by imitation, in modern times, which were not examples of the same form of chorea. Thus in the *Edin. Jour. of Med. and Surg.* for July, 1839, there is a clear description of chorea major, occurring successively in five children in the same family. Dr. Dewar, the attending physician, states that one of the children whom he was called to see was sitting near the fireplace, when her head dropped on her chest, and she appeared to doze some minutes. In the mean time the respiration became a little accelerated, the face altered and flushed, the eyes wild. In less than one minute she bounded from one extremity of the apartment to the other, leaping over chairs, a chest, and then throwing herself upon the floor; she attempted to stand upon her head, rolled upon the floor, and then, rising, ran with extreme swiftness in the room,

till she finally fell again on the floor, where she remained motionless some minutes. Then, recovering, she noticed those who surrounded her, and asked of her sister a toy, which she had allowed to fall. The whole paroxysm lasted twenty minutes.

Obviously, the symptoms of chorea major differ materially from those of chorea minor, and it is a question whether it should have the same generic name. It is a curious and interesting disease in its psychical and pathological aspects, but it is so rare in modern times that a knowledge of it is of little practical importance.

Intestinal Irritation.—In rare instances intestinal worms cause chorea, though in these cases there have usually been some co-operating causes. The following is an example, related by Mr. Ogle (*Lond. Medico-Chir. Rev.*, Jan. 1868): "Ellen L., 9 years old, had been under treatment about a month with chorea, rheumatism, and worms. She had not slept in four days, and there was constant spasmodic movement of the body and face. Her general condition was very unpromising. As she had passed portions of a tapeworm at intervals during the last three months, one drachm of the oleum filicis maris was administered in mucilage, which caused the expulsion of the entire worm. From that time she fully and rapidly recovered from the chorea, though a mitral murmur remained."

Lesions of Brain and Spinal Cord.—Although we reject the theory that cerebral emboli are the common cause of chorea, and believe that in a large majority of cases there are no cerebro-spinal lesions, nevertheless experiments, and also occasional cases, establish the fact that if not true chorea, at least choreiform movements now and then result from a structural affection of the nervous centres.

Experiments on certain of the lower animals demonstrate that irregular muscular movements may be produced by traumatic injury of certain portions of the cerebro-spinal axis, as the corpora quadrigemina, crura cerebri, pons Varolii, crura cerebelli, thalami optici, parts of the medulla oblongata, and the upper portion of the spinal cord. Pressure on the projecting part of the medulla oblongata of an acephalous monster also causes convulsive movements. At the meeting of the New York Academy of Medicine, April 20th, 1871, Professor Post related the case of a child who was struck with a billet of wood, over the occiput, and chorea followed, due, in all probability, to the injury of the brain which resulted.

If irregular muscular movements, choreic or choreiform, result from traumatic injury of certain portions of the nervous centres, may they not also occasionally occur from lesions of the same parts produced by disease? Sir Benjamin Brodie relates the case of a choreic girl, dying in St. George's Hospital (London *Lancet*, Dec. 19th, 1840), in whom, after a careful post-mortem examination, the only morbid appearance observed was a tumor the size of a hazelnut, connected with the pineal gland. Dr. Broadbent described another case before the London Pathological Society

(vol. xiii. page 246, *Transactions*), in which a tumor was found arising from the centre of the spinal cord; and Chambers one in which tubercles were imbedded in the cord. Romberg quotes from Frerichs a case in which the medulla oblongata was pressed upon by an enlarged odontoid process; and Dr. Aitken (*Glasgow Med. Jour.*, vol. i.) one in which the specific gravity of the thalamus opticus and corpus striatum was greater on one side than on the other. Rilliet and Barthez relate other similar cases, and add: "We may conclude, from these different cases, that there exist two species of chorea: the one essentially a simple neurosis, while the other depends on an alteration of the encephalo-rachidian system. In a word, it is of chorea as of convulsions, that it is sometimes idiopathic, sometimes symptomatic." Still, the cases in which it is symptomatic are so few, that it is proper to consider chorea, as it ordinarily occurs, one of the neuroses until the microscope detects some anatomical cause in the cerebro-spinal system of which we are now ignorant.

Anatomical Characters.—We have seen that chorea has no certain anatomical characters. Lesions are sometimes present, which probably sustain a causative relation to the disordered muscular action, and others are sometimes observed which are neither a cause nor result, their presence being a coincidence. But there are two lesions which, though often absent, have been observed in so large a proportion of fatal cases that they are justly regarded as an occasional result when chorea is severe. Dr. Hughes, of London, collected records of the post-mortem appearances of 14 cases, with the following result as regards the cerebro-spinal axis: Brain, 14 cases: healthy, 4 cases; only congested, 3 cases; softened in part or entirely, 6 cases (some of these also congested). In some of these cases those occasional results of congestion, namely, transudation of serum and extravasation of blood, in greater or less quantity, were also observed. Spinal cord: healthy, 3 cases; congested, 2 cases (one slightly, in the other the engorged vessels were large and numerous); softening in medulla oblongata, 1 case; softening opposite fourth and fifth vertebræ, 12 cases. In one there was soft, in another firm adhesion of the spinal meninges, and in one it is stated that the rachidian fluid was opaque. Of sixteen fatal cases of chorea occurring in St. George's Hospital, "congestion (more or less complete) of the nervous centres (brain or spinal cord, or both) was met with in six cases." There was softening of certain parts of the brain in one case, and of the spinal cord in another. (Ogle, *Brit. and For. Medico-Chir. Rev.*, Jan. 1868.) Other statistics of the anatomical character of fatal chorea correspond, in the main, with those of Hughes and Ogle. These lesions are probably not present in ordinary cases, occurring only when the choreic movements are so severe that the patient is deprived of needed repose, and the important functions of the economy, as the circulation and nutrition, are seriously disturbed.

The post-mortem examination of other parts besides the cerebro-spinal

axis furnishes a negative result, if we except such affections as have been acertained to act as causes of chorea. What portion of the nervous centre is chiefly involved in chorea is uncertain. Some, as Sir Benjamin C. Brodie (*London Lancet*, Dec. 19, 1840), consider chorea a disease of the nervous system generally, while others have attributed it to disease or disorder of a certain part, as the corpus striatum, cerebellum, etc. Finally, it is stated that, in late experiments on choreic dogs, the movements do not cease when the spinal cord is severed from the brain, nor also on division of the posterior roots of the spinal nerves. (Legros et Onimus, Rech. sur les mouvements choreiformes du chien, Acad. des Sci., 9 Mai, 1870, *Lyons Med. Jour.*, June 5, 1870.) In these cases, therefore, the part of the axis which is in fault would appear to be solely the spinal cord.

Symptoms.—Chorea is partial or general. It is partial when it affects a few muscles, or groups of muscles, as those of one arm, the face or neck, or of one eye. It is designated general, when all the limbs, and certain of the muscles of the face and trunk, are involved. Statistics show that partial chorea occurs more frequently on the left than on the right side, and in general chorea the movements on the left side are apt to predominate. The commencement is usually gradual. Even when finally chorea becomes general, certain muscles only are affected in the commencement in ordinary cases. The child in whom this disease is about to begin is observed to be fretful and impatient from slight causes, and the irregular muscular action at first is apt to be misunderstood by the parents, who reprimand him for his supposed fidgety habit. In exceptional instances, especially when the cause is a sudden and profound emotion, the commencement is abrupt, and the disease is severe and general from the first.

In a majority of cases the muscles which are primarily affected are those of the face, neck, fingers, or hand on the left side. Sydenham erred, unless the clinical history of chorea has changed during the last two centuries, when he stated as the common fact that a tottering gait is its first manifestation; but now and then such a case does occur. Wherever the choreic movements first appear, other muscles are soon involved, so that in the course of a few weeks, sometimes of a few days, all the muscles that participate are engaged.

A muscle affected by chorea alternately contracts and relaxes, but less forcibly and rapidly than in eclampsia, and the movement is partly controlled by volition. This produces an unsteady and tremulous action of the part, whether a limb, the neck, or face; which at once arrests attention, and indicates the nature of the disease. The result is similar, as regards the muscular action, whether the patient wills a movement, or attempts to control those which chorea produces.

If the case is of ordinary severity, the movements continue with but momentary intermissions, except during sleep, when they ordinarily cease. In

grave cases patients are often deprived of the proper amount of sleep, in consequence of the severity and persistence of the muscular action, and in exceptional instances, especially when the result is fatal, the movements continue in sleep, but the sleep is not sound, and is frequently interrupted. In profound sleep, the muscles are probably always in repose.

The older writers have left us graphic descriptions of those diseases which have striking external manifestations, though often with somewhat of exaggeration. Sydenham says of chorea: "The patient cannot keep it (his hand) a moment in the same place; whether he lay it upon his breast, or any other part of his body, do what he may, it will be jerked elsewhere convulsively. If any vessel filled with drink be put into his hand, before it reaches his mouth, he will exhibit a thousand gesticulations, like a mountebank. He holds the cup out straight, as if to move it to his mouth, but has his hand carried elsewhere by sudden jerks. Then, perhaps, he contrives to bring it to his mouth, and if so, he will drink the liquid off at a gulp, just as if he were trying to amuse the spectators by his antics!"

In severe general chorea a similar description is applicable to the movements of the legs and features. Grimaces and distortions of the features occur, while the gait is halting and unsteady, or it is impossible to walk, and the patient lies or sits. The speech is slow, thick, and indistinct, in consequence of the muscles of the tongue and larynx becoming engaged, and even mastication and deglutition are rendered difficult. The imperfect speech in chorea is attributed partly, however, to the impairment of the mental faculties. Chorea, except in mild cases, is accompanied by other symptoms referable to the nervous system. More or less impairment of the mental faculties occurs in severe and protracted chorea, exhibiting itself in dulness or apathy. The countenance sometimes presents in aggravated cases almost the appearance of idiocy. The muscles, instead of becoming hypertrophied, and more powerful by their frequent contraction, grow softer, more flabby, and weaker. Indeed, a partial paralysis sometimes results, so that a degree of numbness is experienced in the affected part, and the limb when raised cannot be sustained. Pain is not a symptom of chorea, but fugitive rheumatic or neuralgic pains are sometimes experienced. Derangement of the digestive function, exhibited by a poor or capricious appetite, constipation, etc., are common.

The urine of choreic patients has been examined by Drs. Walsh, Ford, Bence Jones, Handfield Jones, Radcliffe, and others, and its elements have been found in most cases to vary from their normal quantity. Dr. Handfield Jones read a paper before the Clinical Society of London, in 1871 (*London Lancet*, July, 1871), on two cases of chorea in which he had made careful chemical analyses of the urine, with the following result: During the height of the disease the amount of the urine was much in excess of what it was when the disease had ceased; the amount of

urea excreted during the choreic period was enormous; the amount of phosphoric acid excreted when the choreic symptoms were at their maximum was excessive, but the quantity was less than the average during convalescence; a moderate amount of uric acid during the disease, but none upon recovery.

Prognosis—Course.—Chorea, though obstinate and often incurable in adults, usually terminates favorably in children in three or four months. Bouchut considers its ordinary duration at from thirty to fifty days, which is certainly shorter than the average duration in this country, except as the disease is materially abridged by treatment. The same author states that it may continue only a few days, as he has observed in cases which occurred during convalescence from scarlet fever. But tremulousness of the muscles occurring in the state of weakness following a grave disease, and abating as the general health is restored, I should not consider as properly choreic, any more than that occurring from over-fatigue. As the choreic movements gradually increase in the initial period till a certain maximum is reached, so their decline is gradual. There are temporary variations also throughout the disease as regards the extent of the movements, which are aggravated by mental excitement, bodily fatigue, certain functional derangements, especially of digestion, and sometimes from causes which are not apparent.

Though, as a rule, chorea in children ordinarily terminates favorably under different, and even injurious, modes of treatment, there are exceptional cases. Romberg relates the history of a patient who died at the age of seventy-six years, having had chorea since the age of six years. In chorea limited to a few muscles, or a group of muscles, the prognosis is more doubtful than when it affects a large number, since in the former case the cause is more apt to be some lesion of the cerebro-spinal axis. Thus chorea involving only certain muscles of the neck or of the eyes is sometimes due to this cause, and is then very obstinate.

Again, observations demonstrate that chorea, when at first in all probability strictly a neurosis, but of a protracted and grave character, may give rise to a central organic disease. This is the course of most of the fatal cases, congestion, softening, or other lesion occurring over a greater or less extent of the nervous centres. Radcliffe has known cerebral meningitis to supervene in two instances. With the occurrence of a lesion of the cerebro-spinal axis new symptoms arise, such as headache, convulsions, delirium, and paralysis, and the choreic movements cease or continue, according to the nature of the lesion.

Chorea, like certain other diseases, either of a nervous character, or having a nervous element, is more or less modified by intercurrent inflammatory and febrile affections. The oft-quoted expression from Hippocrates, *febris accedens solvit spasmos*, observations show to be founded in fact, the most frequent example of which occurs in pertussis. In chorea

the movements, as a rule, are either rendered milder or they cease as long as the febrile excitement continues; but there are exceptions, and the subsequent course of the disease is not modified.

Diagnosis.—This is not difficult in ordinary cases. The irregular movements, with consciousness preserved, enable us to make a diagnosis at sight. In its commencement, and when it continues in an unusually mild form, chorea might be overlooked by the physician, as it often is by the parents, the movements being attributed to a fidgety habit; but medical advice is seldom sought till the movements are so pronounced that it is impossible to err, except through gross ignorance or carelessness.

It is important to determine when chorea merges in an organic disease, and also whether there is a local cause of the chorea. A careful and intelligent study of the symptoms and history of the case is requisite in order to a correct diagnosis in these particulars.

Treatment. *Regimenal.*—As chorea in a large proportion of cases occurs in a state of anæmia, and the vital forces are ordinarily more or less reduced, obviously the regimen should be such as invigorates the system. Fresh air and outdoor exercise, active or passive, according to circumstances, with the avoidance of undue excitement, are requisite; and the diet should be nutritious, but plain and unirritating. The various functions should be preserved so far as possible in their normal state. In exceptional instances, when the choreic movements are violent, the patient should lie in bed, and the muscular action, if so constant and excessive as to deprive him of the requisite sleep, should be restrained by light and well-padded splints.

Medicinal.—Sometimes among the co-operating causes is one of a local nature, which is susceptible of removal, as a carious and painful tooth, intestinal worms, etc., and measures calculated to effect this are obviously required. Allusion has already been made to a case in which the employment of the oleo-resina filicis, and the expulsion of a tapeworm, effected a speedy cure.

The remedy which has been most employed in chorea, and which in consequence of the anæmia is plainly indicated in a large proportion of cases, is iron. It does not interfere with the employment of other remedies which have a more specific effect. Nearly all the ferruginous preparations have been prescribed in different cases with benefit. Radcliffe, who justly ranks as one of the first authorities in nervous diseases, gives the preference to the iodide of iron, believing that iodine, as well as iron, exerts a curative influence. I have of late inclined to the use of the ammonio-citrate, as it is easy of administration in simple syrup, and is well tolerated.

Arsenic, highly extolled by Romberg and others, is a remedy of undoubted value. It is conveniently given in Fowler's solution. It should be administered in doses of three to five drops three times daily, after the meals, as in the treatment of cutaneous or other affections. Radcliffe has

administered by subcutaneous injection Fowler's solution, diluted with an equal quantity of water, in a few cases of obstinate local chorea, with a satisfactory result. An adult with choreic movements in one side of the neck of nine years' duration was nearly cured by fourteen injections employed at intervals of a few days, the quantity employed being increased gradually from three to fourteen minims of the solution. Strychnia is another remedy which has been found useful. Trousseau, who prescribed it in most cases, and highly extolled it, employed the following formula:—

℞. Strychniæ sulphat., gr. j ;
Syr. simplic., ℥ijss. Misce.

A child of the ordinary age, say ten years, takes at first a teaspoonful twice or three times daily, at uniform intervals, and the dose is gradually and cautiously increased until it begins to produce physiological effects. Strychnia, when employed to the extent of causing some rigidity, is more efficient as a remedy, but smaller doses have been found useful.

Professor Hammond (*Diseases of the Nervous System*, page 617) says: "My main reliance is on strychnia, which, I think, should be given in gradually increasing doses, somewhat after the manner recommended by Trousseau. . . . This plan of treatment certainly shortens the duration of the disease very materially, and causes great improvement in the general health of the patient. Sometimes the effect is so well marked, and is so immediate, that it is not necessary to increase the doses to the extent of causing muscular cramps, but generally the full therapeutical effect of the drug is not obtained till the calf of the leg or the nucha has slight tonic spasm. I have never seen the slightest ill-consequence follow this mode of treatment, and the doses are increased so gradually that, with careful watching, danger need not be apprehended." Dr. Hammond has treated thirty-two children with this agent without a single failure.

But as chorea terminates favorably with smaller and safe doses, even if the time required is longer, it does not seem proper to recommend its employment to the extent of producing physiological effects for general practice. Bouchut, speaking upon this point, says: "But, with these precautions, strychnia is extremely dangerous, for I have seen, at the Hôpital des Enfants Malades, a young girl of thirteen years die in tetanus," produced by an increased dose of this drug (article on Chorea). Dr. West, in his Lumleian Lectures, also says: "I have seen one instance in which its employment, while it failed to benefit a somewhat severe case of chorea, was followed by two attacks of violent tetanic convulsions, which nearly proved fatal;" and he adds, "The twitching of the limbs of itself prevents our becoming aware of the dose being excessive, and a child's inability to describe its sensations deprives us of another." For such reasons, Dr. West does not favor the employment of this agent. Still, any agent may be given in an overdose, and it is not difficult to prescribe strychnia in a dose

which will be efficient and yet safe for children at the age at which chorea ordinarily occurs. I have employed bromide of potassium in a few cases, but with so little benefit that I am not inclined to continue its use for this disease. Others have not been more successful. However efficacious the bromide may be in epilepsy, it does not appear to be a remedy for chorea.

Cimicifuga, first employed by Jesse Young of this country, is highly esteemed by Philadelphia physicians in the treatment of chorea. I have employed the fluid extract in doses of half a drachm, increased to one drachm, for a child from six to ten years of age, and though it benefits some cases, it has no appreciable effect either in moderating the movements or abridging the duration of others.

Ether, asafœtida, valerian, musk, the oxide and sulphate of zinc, turpentine, tartar emetic, opium, and numerous other remedies, have been recommended, and some of them have seemed useful in certain cases. In this city sulphate of zinc has been frequently employed as a remedy for chorea, and in gradually increasing doses till more than twenty grains were administered three times daily, but it has not appeared, so far as I have been able to ascertain, to exert any marked influence either on the severity or duration of the choreic movements. Justice, however, requires us to state that Dr. West, who has written recently on the nervous disorders of children, thinks that it has been beneficial in certain cases in which he has employed it, and regards it on the whole as the best remedy.

Radcliffe, who has had ample experience in the treatment of nervous affections, writes: "In an ordinary case of chorea the plan of treatment which I have now adopted as a rule for some time is to give cod-liver oil, in conjunction with hypophosphite of soda, making the draught containing the latter salt the vehicle for the administration of the cod-liver oil." Sometimes camphor or the sesquicarbonate of ammonia is added. Of more than thirty cases treated in this way, the average duration was under three weeks. Radcliffe began to prescribe these remedies on theoretical grounds, believing that phosphorus and cod-liver oil were required to restore "nerve tone," and the result of this treatment has certainly been such as to commend it to the profession. To children he gives from five to eight grains of the hypophosphite of soda three times daily.

Although strychnia and cod-liver oil are recommended by high authorities, the arsenical treatment, with iron as an adjuvant, has seemed to me the most useful. It is employed in the large class in the Bureau for the Out-door Poor, in preference to the strychnia and cod-liver oil, and we confidently expect that when the full dose is employed, the patient will begin to improve in a few days. Children tolerate arsenic better than adults, as I have stated elsewhere, and a child of five years can take five or six drops of Fowler's solution, after the meals, if smaller doses do not have the desired effect.

In those severe cases in which the choreic movements prevent the

proper amount of sleep, a moderate dose of hydrate of chloral may occasionally be advantageously administered.

Electricity has been many times employed in the treatment of chorea, and though some, chiefly electricians, believe that it has a curative effect, others, and the majority, fail to see any material benefit from its use.

Cold general baths, the shower-bath, frictions along the spine, etc., have been employed; but the local treatment which has so far been most successful, and which promises to supersede all others, consists in the application of ether spray over the spine. About two ounces of ether are employed at each sitting, the spray being applied from an atomizer up and down the whole length of the spine if the chorea is general. The operation, which occupies from ten to fifteen minutes, should be repeated daily or every second day. A considerable number of cases have been reported, in which the spray has apparently had a good effect in controlling the disease.

CHAPTER XV.

INFANTILE PARALYSIS.

Paralysis in young children, especially infants, is in most instances due to causes which seldom produce it in adults. The principal cause of it in the adult, namely, cerebral apoplexy, is indeed rare in children. Paralysis in children has the following recognized causes: 1st. A change in the blood, not fully understood, induced by certain grave diseases, as diphtheria, typhoid fever, measles, scarlet fever, etc. 2d. Reflex influence. The function of some part of the system is in some way disturbed, and paralysis occurs in certain muscles, maybe at a distance from the cause, and it disappears when that cause is removed, unless it has continued too long. The only rational explanation is found in the fact of a continuous connection between the local cause and the paralyzed muscles through the afferent and efferent nerves, and the nervous centres. 3d. Compression or injury of a nerve-trunk. These cases are rare. Pressing of the portio dura by the blades of forceps during birth, described in the next chapter, is an example. 4th. An anatomical alteration in the muscular fibres, the nerves and nervous centres remaining unaffected. This has been designated myogenic paralysis. This form of paralysis is probably often of a rheumatic nature. Paralysis of the face or other portions of the surface, which sometimes occurs in children and adults from prolonged exposure to cold winds, is of this nature. 5th. Some anatomical change in the nervous centres, as congestion, hemorrhage, inflammation, emboli, compression and laceration of brain, whether by tumors, inflammatory products,

or other causes, etc. If there is hemiplegia the presumption is that the disease causing it is cerebral; if paraplegia, that it is spinal. The following is an interesting example of hemiplegia. The case was related by me, and the specimen presented to the New York Pathological Society.

Maggie, aged 2 years 8 months, was admitted into the Catholic Foundling Asylum about the 1st of September, 1874. She seemed to be in good health and was plump and well developed, and her mother stated that she had had no serious sickness. After her admission she continued well, having the usual appetite, amusing herself through the day, and presenting no symptoms to attract attention till December 6th. On the evening of December 5th she ate her supper as usual, and was placed in her crib, *apparently in perfect health.* At 3 A. M., the sister who was in charge of the ward, found her in severe general eclampsia. Immediately, in addition to the usual local treatment, she administered five grains of bromide of potassium, and this was repeated at intervals till six or seven doses were administered. Nevertheless, the spasmodic movements continued, with more or less violence, till 1½ P. M., and in the muscles of the neck somewhat longer.

On my arrival at the asylum, at about 6 P. M., I found her lying quietly, rather stupid, but easily aroused. Her vision was evidently good, and she was conscious; the pupils responded to light, and the direction of the eyes was normal; pulse 104, no cough, and respiration natural; temperature, as ascertained by the thermometer in the axilla, also normal. There was no apparent paralysis of the muscles of the face, but the right arm and leg were paralyzed, though the paralysis was not complete. The great toe flexed on tickling the sole of the foot, but the foot itself had little or no motion, and on my attempting to flex the leg, which was extended, some rigidity of the muscles was observed. At times the patient produced slight movement of the thigh upon the trunk. The muscles of the right upper extremity were more flaccid than those of the leg, and below the elbow motion seemed to be totally lost, while a little movement remained of the arm on the trunk. I think that during the two or three days succeeding the convulsions sensation in the right limbs was not entirely lost, though greatly enfeebled. Subsequently paralysis in the right limbs, both of the nerves of sensation and motion, was nearly or quite total, and continued so till death. Nevertheless, tickling the sole of the foot caused some movement of the great toe. On the left side sensation and motion were perfect.

The record of December 9th runs: Has vomiting to-day for the first time; apparently sees well, and appearance of the eyes normal; has no retraction of head, or rigidity of muscles of neck, or along the spine; pulse 96, temperature in the axilla normal; lies quiet and with eyes shut; is stupid, but not particularly fretful, when aroused; the bowels move regularly.

December 11th, continues to vomit at intervals; pulse 68. Dec. 16th, pulse 80, temperature 100; vomited once yesterday, none to-day; lies in a constant doze; takes bromide of potassium gr. iv three times daily. Dec. 18th, moans at times, as if in pain; pulse 180, temperature 100; takes the bromide gr. iv every four hours.

Dec. 19th, pulse 180, temperature 103; there is convergent strabismus, and the eyes have a wild, almost insane, look, but she sees, grasping hurriedly a percussion hammer presented towards her; paralysis of nerves of motion and sensation in the right extremities nearly complete; slight move-

ment is still produced in the great toe by titillation; the vomiting has ceased; tongue covered with a thick fur; movements of the bowels pretty regular; has a slight cough, such as is common in cerebral disease.

Dec. 22d, lies quietly on her side in perpetual slumber, with eyes constantly shut; pulse 118, temperature 101½°; the bowels still move nearly normally; the pupils, exposed to the light, are seen to oscillate, but are constantly more dilated than in health; the urine passes freely; circumscribed flushing of the features at intervals; a rash like lichen over abdomen and chest, possibly due to the large quantity of bromide of potassium administered. 24th, pulse intermittent; pupils dilated.

Dec. 25th, died in profound stupor to-day, having lived nineteen days from the commencement of the malady.

Autopsy.—About thirty hours after death; weather cool. On removing the calvarium and dura mater, which presented no unusual appearance, the vessels of the pia mater were found rather more injected than usual, but not more so than we sometimes observe in those who die of diseases which do not involve the brain. The cerebro-spinal fluid was scanty, and the surface of the brain rather dry. The vertex of the left hemisphere was unusually prominent, rising perhaps half an inch higher than that on the opposite side. At the highest point, which was about one and a half inches from the median line, was a circular yellowish spot upon the surface of the brain about one and a half inches in diameter. Pressure upon this spot, made lightly, so as not to produce rupture, communicated the sensation of a large cavity underneath filled with liquid, and approaching to within two or three lines of the surface. There was no adhesion or exudation over this spot; and the surface of the brain appeared entirely normal, except a little cloudiness of the pia mater over a space which could be covered by a five-cent piece, a little posterior to the optic commissure. The incised surface of the brain, at a distance from the abscess, showed no increase of vascularity. The right hemisphere appeared in every way normal, except that its lateral ventricle was filled with pus, but not distended.

On the left side, occupying the centre of the hemisphere, was an abscess as large as the fist of a child of two years, extending from within two or three lines of the vertex, where its site corresponded with the yellow spot on the surface of the brain, to the roof of the lateral ventricle. Through this roof the abscess had burst, filling and distending the ventricle with pus, and thence making its way into the lateral ventricle of the opposite hemisphere. The whole amount of pus contained in the abscess and the two ventricles was, perhaps, two ounces. The walls of the left lateral ventricle were much softened, the upper part of the corpus striatum and thalamus opticus being nearly diffluent; the walls of the right lateral ventricle were slightly softened, but to less depth. The parietes of the abscess, which extended from the roof of the ventricle to the vertex, as already stated, were indurated to the depth of one and a half lines in consequence of proliferation of the connective tissue, except at the base of the abscess, which corresponded with the roof of the ventricle, where softening had occurred. The spinal cord, so far as it could be examined from the cranial cavity, had the usual vascularity, and seemed nearly or quite normal.

The cause of the encephalitis from which the abscess resulted was obscure. This inflammation, so far as can be ascertained, was idiopathic, which is known to be a rare disease. There was no history of otitis, which is one of the most frequent causes of cerebral abscess, nor of heart disease,

so as to produce embolism. It seems probable, since there was no fever till about the fourth day after the convulsions, that an abscess had primarily occurred in the hemisphere between the roof of the ventricle and the vertex, possibly weeks previously. The bursting of this into the lateral ventricle, and the constitutional disturbance, inflammation, and softening to which this would inevitably give rise afford sufficient explanation of the history of the case after the commencement of the convulsions.

Paralysis occurring as a symptom, or sequel of some obvious local or general disease, as diphtheria, lesion of the nervous centres, etc., and which may occur at any age, need not detain us. It is described in connection with the primary diseases on which it depends. But there is a form of paralysis which in the present state of our knowledge we must consider an idiopathic malady, and which is peculiar to the first years of life, or is so rare at other periods that it is proper to regard it as strictly a malady of infancy and early childhood. It occurs between the ages of six months and three years. The following description relates to it:—

Symptoms.—The previous health of the patient is usually good. The paralysis does not always commence in the same manner. In a few instances it begins suddenly in the daytime when the child is apparently in perfect health. In some it begins abruptly, after sound sleep. The child goes to bed well, sleeps through the night, and awakens in the morning paralyzed. I have known it to occur in one instance after sleep in the middle of the day. In these cases there has sometimes been an exposure, before the sleep, to wind or rain, or from sitting upon a cold stone. In other and the majority of cases the paralysis is preceded by a very decided febrile movement, which comes on suddenly, without appreciable cause, and after a few days the power of motion is found to be lost in one or more of the limbs. There is no symptom during the febrile movement to indicate any affection of the brain: consciousness is retained, and there is no more headache or apparent liability to convulsions than occurs in other pathological states accompanied by an equal amount of fever. Several other modes of commencement have been described by writers, but it is not improbable that they have embraced other forms of paralysis in their statistics, as for example those cases which are hemiplegic, or which occur in the course of a lingering disease, or a hemorrhagic disease, or with cerebral symptoms, as vomiting. Such cases should not in my opinion be included in the statistics of infantile paralysis, since their nature is uncertain, nor indeed should any cases in which there is doubt as to their genuineness. In whatever way the paralysis begins, it is at its maximum in the commencement. Occurring as by a stroke, the full extent of the paralytic state is exhibited at once, and so far as there is any subsequent change, it is an improvement, as regards the number of muscles affected, and the degree of the paralysis. Most frequently the muscles of one or both lower extremities are affected. Occasionally one of the upper

extremities is also paralyzed in addition to the lower, but paralysis of an upper extremity is less in degree, and disappears sooner, than that of the lower. The bladder and lower bowels remain unaffected, since only the muscles of volition are involved. Sensation is unimpaired in the affected limbs, and in the commencement there is even in some cases a state of hyperæsthesia (West). The febrile movement, which precedes and accompanies the paralysis in certain cases, gradually abates, and in a few days nothing abnormal remains except the loss of power in the affected muscles. These muscles are in a flaccid and relaxed state, so that the limb falls by its weight when unsupported, and they are usually free from pain. The number of muscles paralyzed varies greatly in different cases. Only one muscle or a single group of muscles may be affected, or, on the other hand, both the extensor and flexor muscles of two or more limbs. In the opinion of Mr. Adams, the following table exhibits the groups of muscles and single muscles most frequently involved, and in the order stated:—

Groups.

1. Extensors of toes, and flexors of the foot.
2. Extensors and supinators of the hand.
3. Extensors of leg, and with them usually the first group.

Single Muscles.

1. Extensor longus digitorum of toes.
2. Tibialis anticus.
3. Deltoid.
4. Sterno-mastoid.

The following is an example of infantile paralysis, as it not infrequently occurs when the result is favorable: A. K., German, female, aged 3 years 4 months, fleshy; had been in the habit of sitting on the ground near the house and on the door-sill. On July 2, 1871, she had a sound sleep in the afternoon, having been entirely well previously, and awoke trembling and with a high fever at 3½ P.M. At 8 P.M., the febrile excitement continuing, general clonic convulsions occurred, lasting about ten minutes. At this time I was called to see her, and found her face flushed, surface hot, and pulse about one hundred and thirty. Consciousness returned after the convulsion. Her intelligence was good, tongue moist and slightly furred, bowels rather constipated, and the urine freely passed. The febrile excitement continued two days, when it gradually and entirely abated, but before it ceased paralysis of the left lower extremity was observed. No weight at first could be sustained upon this limb, and it hung powerless when we endeavored to make her walk. The attempt caused her to cry, as if in pain, and pressing upon the thigh, or moving it, had the same effect. The thigh of this limb did appear slightly swollen on inspec-

tion, but measurement did not indicate any notable enlargement. The difference in circumference was certainly not more than one-eighth to one-fourth of an inch. There was no appreciable increase of heat in the thigh over the general temperature of the body. Sensibility remained in every part of the limb, and the loss of power was not complete, for on the first day, as soon as the paralysis was observed, slight and imperfect movements could be produced by pinching the limb. In three weeks the use of the limb was fully restored, by mildly stimulating liniments, and simple medicines to regulate the bowels. The tenderness which was observed in this case, is only occasionally present. It has been attributed to hyperæsthesia, but those who hold to the peripheral origin of the paralysis, would probably attribute it to the anatomical change occurring in the terminal nerve-fibres.

Prognosis—Progress.—The paralysis in nearly all cases soon begins to abate. The power of motion returns little by little, and whatever improvement occurs is permanent. There is no retrogression in the convalescence. The sooner improvement commences, the more favorable is the prognosis. In the most favorable cases there is complete restoration in from three to four weeks. In other patients, while certain of the muscles regain the power of motion, other muscles, oftener those of the lower extremity than upper, do not recover their function, and, unless proper remedial measures are employed, and even with them in certain instances, atrophy soon commences. The temperature of the paralyzed limb falls three, five, or even eight degrees, and the amount of blood which circulates in it is diminished so that the pulse of the limb is feebler and its vessels smaller than in health. With the atrophy the contractility of the muscular fibres by the electric current diminishes, and in unfavorable cases after a time powerful induced and even primary currents have no appreciable effect. The nutrition of a paralyzed limb is always imperfect, and if the paralysis occur in a child, its growth is retarded. Therefore in cases of protracted or permanent infantile paralysis of one limb a disproportion occurs both in diameter and length between it and that on the opposite side. If the paralysis continue, the ligaments of the paralyzed limb become relaxed and lengthened. West mentions a case of paralysis of the deltoid in which the humero-scapular ligaments were so extended that the humerus dropped from the glenoid cavity, so as to increase the length of the limb three-fourths of an inch. In the paralysis of certain muscles of the lower extremity, and continuance of the contractile power in others, we have the conditions which give rise to club-feet, and accordingly this deformity is the common result of the paralysis when it is not cured.

Etiology.—As infantile paralysis is not a fatal malady, opportunity for a post-mortem examination in a recent case seldom occurs. Hence the difficulty in determining the exact anatomical change in the nervous system which produces the paralysis. There are now in medical literature

records of a considerable number of cases in which autopsies have been made, but death occurred so long after the commencement of the paralysis, usually months or years, that it is difficult to determine whether lesions which have been observed were a cause or consequence. In a majority of these autopsies a spinal lesion of some sort was detected, but none could be discovered in a few instances, the most important of which were the following :—

Mr. Adams, in his treatise on club-foot, relates a case in which the spinal cord, carefully examined, probably only with the naked eye, seemed normal. Robin examined the spinal cord microscopically in one case, but discovered nothing abnormal, and Elischer made two autopsies in cases of this paralysis which had succumbed in variola, but with a negative result as regards any lesion in the nervous system (*Jahrbuch für Kinderk.*, 1873). The examinations by Robin and Elischer, since they were microscopic, have been justly regarded as important, and they have been related by certain writers in order to sustain the theory that infantile paralysis is peripheral, and not centric. But may there not have been a spinal lesion which caused the paralysis, and abated, leaving no trace, although its effects as regards the muscles continued?

Very little was effected, prior to 1863, in determining the cause or causes of infantile paralysis by post-mortem examinations, because the microscope was so little used, and because in most of the cases reported the clinical history or microscopic lesions were such as to show or to render it highly probable that the paralysis was not such as is designated and understood by the term infantile. Thus Beraud reported a case in which tubercles were found in the spinal cord. Hutin, a case in which there was atrophy of the lower part of the spinal cord, but the paralysis commenced at the age of seven years. Hammond, a case in which a clot was found in the spinal cord; and Jaccoud, one of spinal arachnitis, with thickening of the meninges. Since 1863, seventeen autopsies have been recorded in which the spinal cord was carefully examined, and upon these we must chiefly rely for our data by which to determine what are the anatomical changes in the nervous system which probably cause this paralysis. The reader will find these cases tabulated in a lecture by E. C. Seguin, M.D., published in the *N. Y. Med. Record*, January 15th, 1874, and the most important of them narrated in a paper on infantile paralysis, showing great research, published by Dr. Mary Putnam Jacobi, in the *N. Y. Obst. Journ.* for May, 1874. It is true that all but three of these post-mortem examinations were made many years after the occurrence of the paralysis; but in the three cases which were reported by Roger and Damaschino, only two, six, and thirteen months had elapsed. The following were the chief lesions observed in these cases as regards the spinal cord :—

	Cases.
1. Atrophy of motor-cells in anterior cornua	10
2. Nerve-cells, normal	2
3. Atrophy (variously recorded) of anterior columns, or cornua, or part of cord, or roots of anterior nerves	8
4. Sclerosis	9
5. Myelitis, recorded as diffused, central, or slight	7
6. Central softening (the three most recent cases)	3
7. Small clot in cord (Hammond's case)	1
8. Sciatic neuritis	1

It is seen that the most common lesions in these cases were those of inflammation of the spinal cord, or such as are known to result from this inflammation, to wit, atrophy of the nervous substances and sclerosis.

With the data furnished by these post-mortem examinations and the clinical histories of cases, we are the better prepared to consider the theories regarding the etiology of this malady. The views of MM. Roger and Damaschino are entitled to great consideration, since the autopsies which they made were in cases of shorter duration, and therefore nearer the date of the commencement of the paralysis than those which have been reported by other observers. Roger and Damaschino published a series of papers on this malady in the *Gaz. Méd. de Paris* in 1871, which they conclude with the following propositions: "1. The alteration peculiar to infantile paralysis is a lesion of the spinal marrow, which causes the atrophy of muscles and nerves. 2. The seat of this lesion is the anterior part of the gray substance of the medulla, where softened portions of spinal substance are seen. 3. This softening is of an inflammatory nature—in fact, a simple myelitis. 4. Infantile paralysis should, therefore, be called spinal paralysis of children, and be classed among the affections of the spinal marrow, as depending on myelitis."

To determine the exact character and limitations of the cause of infantile paralysis is difficult; but the views of Roger and Damaschino, as expressed in the above propositions, seem to harmonize more closely with, and to afford a more satisfactory explanation of, the symptoms, history, and lesions, thus far observed in ordinary or typical cases, than does any other theory. Suddenly occurring, active congestion of the anterior cornua, many neuropathists regard as the cause of infantile paralysis; but there is that close affinity between active congestion and inflammation that they may be regarded as having the same pathological effect in this instance, and therefore the two theories of a spinal congestion and spinal inflammation may be considered as one. It is not improbable that in some of the cases which more speedily recover there is simple congestion; while in the more obstinate cases, and those with inflammatory symptoms, the congestion has passed into an inflammation, or inflammation was present from the first. According to this theory, the atrophy so generally observed in the twelve cases in which autopsies were made, must be con-

sidered a degenerative change resulting from the inflammation or from the paralysis. That so accurate an observer and so excellent a microscopist as Robin could detect nothing abnormal in the case which he examined, was probably due to the fact that the inflammation or congestion abated without producing any degenerative changes in the nervous substance.

Professor Charcot considers atrophy of the motor cells as the cause of the paralysis, but it is much more in consonance with the facts to consider the cellular atrophy a result than a cause. For how could atrophy, which always occurs gradually, and by progressive increase, be the cause of a disease which begins abruptly, and is most intense in the very commencement? Besides, atrophy does not occur without some antecedent disease to cause it.

It would be a waste of time to consider in full the various theories regarding the cause of infantile paralysis. No one at the present time of those who are competent to express an opinion, believes it to be a reflex paralysis, and the expression dental paralysis once applied to it is no longer heard. There is one theory, however, which should receive more than a passing notice, and which was earnestly and ably advocated by Barwell, of London, in lectures published by him in 1872, in the London *Lancet*, to wit: "That this paralysis is purely peripheral; a malady affecting the ultimate fibrillæ of distribution of the nerves among the muscular elements. . . . Its essence," says he, "lies probably in some subtile derangement in relationship between the ultimate muscular and terminal nerve-fibres, perhaps from some inflammatory, perhaps from some chemical or nutrient change." This theory has much to commend it. Those who advocate it believe that the atrophy of the nerves which supply the paralyzed limbs and of the motor nerve-cells which connect with the roots of these nerves in the anterior cornua occurs in consequence of the paralysis, just as atrophy of the optic nerve can be traced even into the brain when the eye is destroyed. Nor does it dispose of this theory to state, as has been stated, that in order that paralysis occur in this manner, it is necessary that there should be the action of a poison, analogous to the woorari, for we observe something similar to this supposed peripheral cause in facial paralysis from exposure to cold, in which there can be no poisonous influence. This theory therefore rises up most strongly in conflict with that which attributes the paralysis to a congestion or inflammation of the anterior cornua, and it is necessary to decide between them, or to admit that the paralysis may sometimes have one and sometimes the other cause. But the fact that there is in many cases of infantile paralysis a decided febrile movement, and much constitutional disturbance, when there is no evidence of any morbid action going forward in the affected limbs sufficient to cause these symptoms, and the fact that only one set of nerves is affected, namely, the motor, which have a distinct origin in the spine from the sensitive nerves, but are intimately associated with them in their dis-

tribution, comport best with the theory of a central lesion. Therefore, the theory of spinal congestion or inflammation appears the best established. Nevertheless, all past experience shows that medical theorizers are apt to be too exclusive, and that in many diseases there is not a simple uniform cause, but that the cause may vary, especially when, as in the present instance, the symptoms also vary; possibly, therefore, we may yet find that there are cases, especially those in which there is little constitutional disturbance and a known exposure to cold, in which the cause is peripheral instead of centric. The brain and cerebral meninges may be excluded as sustaining any causative relation to the paralysis. There is no symptom which indicates that they are involved. The mind remains clear, and convulsions are no more frequent than in any other disease which is attended by an equal degree of febrile reaction.

Anatomical Characters.—All muscular fibres which are in a state of disuse, begin in a few weeks to atrophy, and undergo fatty degeneration. The transverse striæ in the primitive muscular fasciculus gradually disappear and are replaced by granules of fat, and later still by small oil-globules. If we examine with the microscope the fibres from a muscle which has been a considerable time paralyzed, but which has still some electric contractility, we will find in places the striæ remaining, but numerous opaque granules of a fatty nature within the sarcolemma wherever the striæ are absent, and in other places, where the degeneration is most advanced, oil-globules occur, always small. If the paralysis is more profound, the striæ have all disappeared. At a later stage, usually after some years in cases of complete and incurable paralysis, the fatty matter may be to a considerable extent absorbed, and the fibrous network of the muscle which remains presents a tendinous appearance. There is a great difference, however, in different cases, as regards the rapidity with which these changes occur. Hammond states that he found the striæ remaining in two cases after the lapse of more than four years of decided paralysis. The nerves of the paralyzed part also undergo atrophy.

Diagnosis.—This is easy as soon as the attention of the physician is directed to the state of the limbs. In a large proportion of cases the mother or nurse first observes the paralysis, and calls the attention of the physician to it. A knowledge and recollection of the facts in relation to infantile paralysis should lead the physician to examine the state of the limbs in all cases of marked febrile excitement in young children, occurring without apparent cause.

Prognosis.—It may be confidently predicted, if the child is seen early, and correctly treated, that the paralysis will diminish, if it cannot be entirely cured. If the paralysis have continued a considerable time, and there is no electric contractility of the muscles, there is poor prospect of any improvement. The induced current will fail, sometimes, to cause muscular contraction, when the direct current may produce it; but if there is no

response to the direct current, there is no therapeutic agent which can restore the use of the limb.

In cases seen soon after the paralysis commences, and before the stage of atrophy, the prognosis is most favorable, when there is still slight voluntary motion, and improvement commences early. In most instances, even when the paralysis has been mild, and of comparatively short duration, the limb, although its motion is fully restored, is for a long time weaker than the limb on the opposite side.

Treatment.—A physician called at the commencement of the paralysis should endeavor to remove every cause which might increase the irritability of the nervous system. It is proper to scarify the gums, if much swollen and tender from dentition, the bowels should be kept regular, worms, if present, expelled by appropriate medicines, and the diet be plain and unirritating. As the cause of the paralysis is, in the commencement, still operative, measures are appropriate which are calculated to remove it.

Local treatment is very important at all periods of the paralysis. In the first days a tepid hip-bath employed daily, with brisk friction of the surface, has a salutary effect. Stimulating embrocations along the spine, and upon the paralyzed limb, are appropriate also at an early date. Possibly, if there is a strong probability of spinal congestion, cold applied along the spine, by ether spray or otherwise, might be useful, but I am not aware that it has been employed in this disease. If the paralysis appear to have a central origin, ergot, the bromide and iodide of potassium, which may be administered variously combined, or singly, are the appropriate remedies for the first twelve or fourteen days. Administered every three or four hours in proper dose, they are the most effectual of all internal remedies for diminishing spinal congestion, and preventing effusion, and permanent structural change in the cord.

If the paralysis continue, or if it do not progressively diminish, we should not delay more than two weeks from the commencement of the disease before employing appropriate measures to restore the use of the limbs, and prevent atrophy of the muscles. The expectant plan of treatment which is proper in many diseases of children is unsuited to this. Muscular atrophy may commence in three weeks, and the further it has advanced, the more difficult and tedious will be the cure. Therefore, by the close of the second week if the paralysis continue, or is not rapidly disappearing, iron as a tonic with strychnia should be prescribed. There is probably no better formula for the exhibition of these agents than the following from Professor Hammond :—

℞. Strych. sulphat., gr. j ;
Ferri pyrophosphat., ʒss ;
Acidi phosphorici dilut., ʒss ;
Syr. zingib., ʒiijss. Misce.

One-third of a teaspoonful, or one-ninetieth of a grain of strychnia, is sufficient for a child of two years, administered three times daily. Hillier, Barwell, and others have employed subcutaneous injections of strychnia, with, it is stated, a good result. While in the first and second weeks the child has been allowed to remain quiet, he should now be encouraged to use his limbs. Frequent muscular contraction must, if possible, be produced, and the voluntary movements, when not totally lost, aid greatly in promoting the nutrition of the muscles and restoring their function. Immersing the limb for half an hour in water at a temperature of 110 or 115 degrees, rubbing the limb with a coarse towel, and kneading the muscles, aid also in restoring nutrition and tone to them.

But, fortunately, we have an invaluable agent in the subtle electrical fluid, which can be made to penetrate the muscles and cause their contraction when every other measure has failed. The induced current should be employed upon the limb every day, or second day, if it cause the muscles to act, but if the loss of power is of long standing, or complete, so that the induced current is not sufficiently powerful, the direct current should be used instead. It is not regarded as important which way the current passes, provided the muscles contract.

In a large proportion of cases a cure cannot be effected until the lapse of several months, so that the patience of the physician and friends may be put to the test; but if muscular atrophy can be prevented, and the limb kept at near the normal temperature, this mode of treatment will ordinarily in the end be successful. The primary affection which caused the paralysis will, with some exceptions, abate of itself, so that the state of the muscles and their nervous supply demand the whole attention. Observations show that by treatment perseveringly employed, fatty degeneration of the muscular fibres can be not only arrested, but the fat which has already been deposited within the sarcolemma may be absorbed, and the muscular striæ restored. In those cases in which it has been necessary to employ the direct current, the induced should be employed, whenever by the improvement of the case it is found sufficiently powerful.

CHAPTER XVI.

FACIAL PARALYSIS.

Causes.—Facial paralysis, in the newborn, commonly occurs from pressure of the blade of the forceps upon the portio dura, at a point external to the stylo-mastoid foramen. It may also occur in children of any age, as it is known to be in the adult, from exposure of the face to a

cold wind. The pressure of a tumor upon some part of the portio dura, or even of the fist of the child placed under the face during sleep, may cause it. It may also result from disease of the temporal bone, producing pressure on the nerve, as caries, periostitis, suppuration, or hemorrhage into the aquæductus Fallopii, and also from intracranial disease affecting the pons Varolii or the medulla oblongata.

Symptoms.—The portio dura, which is a nerve of motion, supplies the muscles of the face, and therefore its loss of function is at once manifest in distortion of the features. The eye of the affected side remains open in consequence of paralysis of the orbicularis palpebrarum, the upper lid being raised by the levator muscle, which is not paralyzed, as its nerve is derived from the third pair. From the inability to wink, the eye becomes irritated by dust and constant exposure, and, in children old enough to have an abundant lachrymal secretion, the tears are apt to flow over the cheek. On account of the paralyzed and relaxed state of the facial muscles the mouth is drawn towards the healthy side, while the affected side presents a swollen appearance. Movement of the eyebrow and of the anterior portion of the scalp on the paralyzed side is also impossible, since the occipito-frontalis and corrugator supercilii are supplied by the portio dura. If the cause of the disease is located above the origin of the chorda tympani, the flow of saliva, and consequently the taste, on the affected side are impaired. If the injury is posterior to the gangliform enlargement, those symptoms are superadded which are due to paralysis of the petrosal nerves.

Prognosis.—This depends on the cause. If the cause is peripheral, as from the pressure of the forceps or from cold, the prognosis is favorable. In cases of deep-seated lesion, unless syphilitic, the prognosis is usually unfavorable. A syphilitic lesion can often be removed by appropriate remedies and the paralysis cured.

Treatment.—In the paralysis of the new-born, from pressure of the forceps, all that is required is occasional rubbing or gentle kneading over the affected muscles. In those who are older, the nature of the cause, so far as ascertained, must determine the treatment. If there are glandular swellings, and discharge from the ear from scrofula, cod-liver oil and the syrup of the iodide of iron are required internally, with appropriate external treatment of the glands and ear. If syphilis is the cause, mercurials, and the iodide of potassium should be employed. If the patient do not soon begin to improve, the treatment recommended for infantile paralysis, modified somewhat on account of the difference in location, is appropriate. Iron and strychnia may be administered internally; friction, kneading, hot applications, and the electric current employed. The current should have only moderate intensity, for a high degree of it might injure the vision. It should be applied every second day, with one pole over the mastoid foramen, and the other moved slowly over the muscles.

Paralysis with Pseudo-Hypertrophy.

This is a rare disease. It was first described by Duchenne in 1861, and since the attention of the profession was directed to it, cases have been observed on the Continent, in Great Britain, and in this country. Though our acquaintance with this disease is so recent, it has been fully and accurately described by various writers in our language. The *Transactions of the London Pathological Society* for 1868 contain a translated paper relating to it, communicated by M. Duchenne, with photographic views, remarks by Lockhart Clarke, and also the histories of two cases occurring in London, and exhibited to the Society by Adams and Hillier. In this country an elaborate paper has appeared on this form of paralysis, from the pen of Dr. Webber, of Boston, who succeeded in collecting the records of forty-one cases. (*Boston Med. and Surg. Journ.*, Nov. 17th, 1870.) And more recently Dr. Poore, physician to the New York Charity Hospital, collated the records of eighty-five cases, which furnish the material of an excellent monograph published in the *New York Medical Journal* for June, 1875.

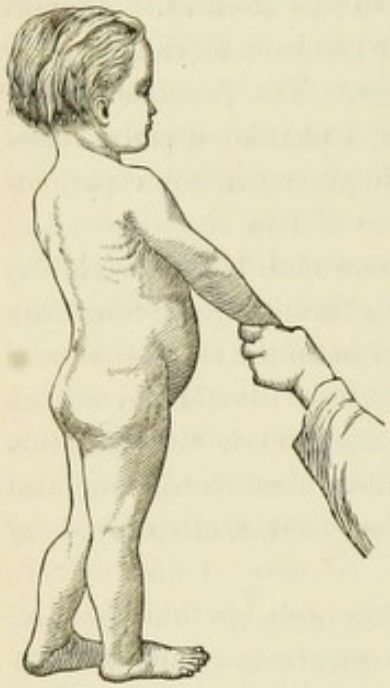
Weakness of the legs, and a peculiar waddling gait, are the first observable symptoms, and by them we are able to ascertain approximately the date of the commencement of the paralysis. In 27 of the cases collated by Dr. Poore, the malady began so early in infancy that they were never able to walk like other children; in 5 there is no record in regard to the time when the peculiar gait was first observed, or whether they ever could walk. Fifty-two, or about two-thirds of the cases, walked well at first, having no symptoms of the paralysis till after the age of two years. In 15 of these weakness of the legs and the peculiar gait were first observed between the ages of two and a half and five years; in 23 between the ages of five and ten years; in 6 between the ages of ten and sixteen years, and in 8 over the age of sixteen years. It is seen, therefore, that this malady is pre-eminently one of infancy and childhood.

The gait, which is unsteady and waddling, has been compared to that of a duck. The child stands with the legs wide apart, and from the weakness of the legs, and unsteadiness of the gait, frequently stumbles and falls. In many cases this muscular weakness and difficulty in walking occur before there is any perceptible enlargement of the muscles beyond the normal size.

The hypertrophy occurs without tenderness, pain, or other nervous symptoms, and without fever or constitutional disturbance. Occasionally the patient complains of stiffness or aching in the limbs, especially after exercise, even before the enlargement is observed, and exceptionally there is pain, even acute, in the legs. The hypertrophy is ordinarily observed first in the calf of one leg, and then in the opposite calf. In a case related by Niemeyer, the muscles of the gluteal region were first affected.

In nearly all cases the gastrocnemii are hypertrophied. There were only two exceptions in the 85 cases collated by Dr. Poore; but almost any of the other muscles, or groups of muscles, may also be involved. The muscles which are most conspicuously affected, and which produce the characteristic deformities, are those of the extremities and posterior aspect of the trunk. Spinal curvature, which is attributed to the weakened state of the erector muscles of the spine, appears early, and is seldom absent. The bending is such that a plumb-line, falling from the most posterior of the spinous processes, falls behind the plane of the sacrum, which is a means of distinguishing this disease from certain other spinal affections. The woodcut represents a case which came to the children's class at Bellevue, in April, 1872. The boy was two years old, and the mother stated that the peculiar gait and the enlargements had only been observed from four to six weeks, and yet the curvature of the spine was quite marked. Hed did not return to the class, and his subsequent history is therefore unknown.

Fig. 21.



Of the muscles in the upper extremities the deltoid and scapular are the most frequently enlarged. Hypertrophy of the temporals has been observed in three cases, of the masseters in two, of the tongue in three, and of the heart in four (Poore).

We shall see presently that atrophy occurs in the muscular element of the muscles which are affected, and that the hypertrophy is due to hyperplasia of the connective tissue. Now occasionally this hyperplasia does not occur or is tardy in occurring, while the atrophy has taken place. Therefore, certain muscles may have less than the normal volume, which, from contrast with those which are hypertrophied, increases the deformed appearance. In ordinary cases the enlargement advances more rapidly and continues greater in the gastrocnemii, which are, as we have stated, the muscles first affected, than in other muscles, and therefore there is more prominence and hardness of the calves of the legs than elsewhere. In advanced cases walking is impossible, and the patient is obliged to remain in a reclining posture. Sometimes from the unequal muscular action the feet become extended and the toes flexed, so that the child in attempting to walk steps on the anterior part of the sole of the foot, as in talipes equinus.

In the first stages of the disease the electric contractility of the muscles is nearly normal, but in advanced cases response to the galvanic current

becomes more and more feeble, according to the degree of atrophy of the muscular fibres. The skin retains its normal sensibility, with exceptional instances in which there is numbness either general or in places. Reddish or bluish mottling of the surface of the extremities is sometimes observed, which is attributed by some to obstructed venous circulation in the hypertrophied muscles, and by others is supposed to be due to the peculiar neuropathic state. The bladder and rectum are not involved. The mental faculties are more or less blunted and feeble in certain cases, especially in those which commence in early infancy, but in some patients they do not seem to be materially impaired.

Anatomical Characters.—There have been so few post-mortem examinations of those who died having this disease, that it is still uncertain whether there is any centric lesion. Cohnheim examined the spinal cord in one case, and could find nothing abnormal. Recently, Mr. Kesteven has examined the brain and spinal cord from a case, and found dilatation of the perivascular canals, both in the brain and spinal cord, and also spots of granular degeneration chiefly in the white substance, "caused by loss of cerebral tissue replaced by morbid matter." (*Jour. of Mental Sci.*, Jan. 1871.) As this child was imbecile, it is not improbable that these lesions were connected with the mental state, and not the muscular disease.

Professor Charcot (*Archiv. de Physiol.*, March, 1872) reports a careful microscopic examination of the spinal cord and of the nerves in a case which had continued ten years. He could discover no deviation from the healthy state. More recently Dr. J. Lockhart Clarke examined a case and found the encephalon healthy, but in the spinal cord there was more or less disintegration of the gray substance in each lateral half, and in places dilatation of vessels, and commencing sclerosis (*Medico-Chir. Trans.*, 1874).

It seems, therefore, that central lesions are not essential, and are sometimes absent. When they do occur, it is probable that they are consecutive to the paralysis.

The essential lesions in this malady are atrophy of muscular fibres and hyperplasia of the connective tissue which surrounds these fibres. The hyperplasia of the one element in the muscle is greater than the atrophy of the other, and hence the increase of volume above the normal size. The atrophy is probably a primary lesion, for muscular weakness ordinarily occurs for a considerable time before there is any evidence of the enlargement, and, as we have seen, certain muscles may undergo the atrophy without the hyperplasia. Still the mechanical effect of the newly-formed connective tissue, doubtless, increases the atrophy in those muscular fibres which this tissue surrounds, and the comparatively quiet state of muscles in consequence of paralysis not only tends to promote the atrophy and degeneration of these muscles, but also of contiguous healthy muscles.

The muscles which are involved in this paralysis present a pale yellowish hue, resembling, says Niemeyer, the appearance of lipoma. Examining by the microscope, we find in addition to a large increase in the fibrous tissue and atrophy, and in some places disappearance of the muscular element, more or less fatty matter, granular and globular, occupying the interstices. Mr. Kesteven describes as follows the appearance of the muscles in the case which he examined: "The muscular substance is pale, almost white, and very greasy. The superabundance of fat is evident to the naked eye. The muscular fibres present the ordinary striation, but less distinctly than usual. The ultimate fibres are pale, and separated by a large increase of areolar and fibrous tissue."

Causes.—Why there is this strange perversion of nutrition, so that there is an exaggerated development of the intermuscular connective tissue, and atrophy of the muscular fibres, is unknown. Boys are more apt to be affected than girls. Of the eighty-five cases embraced in the statistics of Dr. Poore, seventy-three were boys, and there was a similar excess of males in the cases collated by Dr. Webber.

There is in a considerable proportion of cases the record of hereditary transmission, and in almost all the instances the predisposition is acquired from the mother's side. Thus in thirty-seven of Dr. Poore's cases "two or more belonged to the same family." In some instances three and even four maternal relatives had this form of paralysis. In one case observed by Duchenne, and in a few others subsequently observed, this malady seemed to be congenital, for the limbs at birth were unusually large, and the patients, when they came under observation, were unable to walk. No relation has been observed between this paralysis and syphilis, scrofula, or other diathesis diseases.

Prognosis.—This disease is in most instances progressive, terminating fatally after a variable period. It is in its nature chronic, rarely ending in less than five or six years. A considerable proportion live longer, some even attaining adult age. The paralysis may be stationary for a time, but afterwards continue to increase. Duchenne has reported one case of recovery. In two or three other instances patients appeared to improve somewhat under treatment, but the writers admit they may have become worse afterwards. Death is apt to occur, not directly from the paralysis, but from some intercurrent disease, especially of the lungs.

Treatment.—The treatment thus far employed has been chiefly local, consisting in the use of electricity, and kneading or shampooing over the affected muscles. Both the primary and induced electrical currents have been employed, but, unfortunately, without any appreciable benefit in most cases. Benedikt, who claims a better result from electrization than any other observer, applied the copper pole over the lower cervical ganglion, and the zinc pole along the side of the lumbar vertebræ by means of a broad metallic plate.

CHAPTER XVII.

DISEASES OF THE SPINAL CORD AND ITS COVERINGS.

The diseases of the spinal cord, and of the parts which cover and protect it, are important, but they are less understood than are those of any other portion of the body. This is partly due to the fact, that in many cases the spinal disease coexists with a similar pathological state of the brain or its meninges, the symptoms of which predominate and mask those which pertain to the spine, partly to the fact that the chief symptoms of spinal disease are often located in organs or parts which are at a distance from the spine, and lastly, to the fact that it is difficult, for obvious physical reasons, to determine the exact state of the spine at the bedside; while post-mortem inspection of the spine, which alone can give accurate pathological knowledge, is less frequently made than of any other organ.

Certain spinal diseases occurring in childhood are the same as in adult life, presenting identical symptoms and lesions in the two periods, and therefore they require no extended notice in this treatise. Others are common to childhood and maturity, but they present peculiarities in the former period, which require to be pointed out, while others still are peculiar to childhood.

Spinal irritation is not infrequent in delicate and poorly-fed children. I have from time to time observed marked cases of it in the class in the Outdoor Department of Bellevue, the patients usually being above the age of three or four years, and exhibiting evidences of cachexia. Most of them have been spare and pallid, some affected with a nervous cough or palpitation, and some with neuralgic pains in the chest, abdomen, or elsewhere, which pressure at a certain point upon the spine intensified. These cases recover by better feeding, outdoor exercise, mild counter-irritation along the spine, and the use of tonics, especially of iron.

Primary inflammation of the cord and its meninges is rare in children. Secondary inflammation of these parts is, on the other hand, more common in children than in adults. It is common in caries of the vertebræ, and in cerebro-spinal fever. The preponderance in functional activity of the spinal cord, and the feeble controlling power of the brain, render childhood more liable to convulsions and reflex paralysis than any other period of life. Until within a recent period, most cases of infantile paralysis were believed to be reflex, due to dentition, intestinal irritation, etc., but it is now attributed to congestion of the spine, or to disease of the nervous filaments at the seat of the paralysis. Still there are cases of true reflex

paralysis in children, in regard to the etiology of which there can be no doubt. Prof. Sayre of this city has called attention to the fact, that balanitis and preputial adhesions sometimes cause paraplegia, more or less pronounced, in young children, and which is relieved by dividing the adhesions, and restoring the mucous surface of the glans and prepuce to its normal state. Such a case was brought to the children's class in the Outdoor Department at Bellevue, in April, 1875. The child could not walk, or scarcely stand, without support, but after the division of the adhesions, and subsidence of the inflammation, locomotion rapidly improved.[1] It is well known that masturbation sometimes causes a similar weakness of the lower extremities. Dr. West relates the case of a child "between two and three years old," who began to totter in his gait, and finally almost ceased walking. He was observed to practise masturbation. "This was put a stop to," and he soon recovered his health and his power of locomotion. (*Diseases of Children*, page 146, 4th American edition.)

Congestion of the Spinal Cord and its Membranes.

Congestion of the spinal cord and meninges occurs both as a primary and secondary malady, the latter being more frequent than the former. It may be active or passive. Active congestion, occurring independently of meningitis or myelitis, is in most instances transient, and subordinate to some graver disease, in the course of which it arises. It is probably often overlooked. It is not fatal, and its symptoms are frequently masked by those which are referable to the brain or some other organ. It is believed to be common in the initial period of certain of the fevers of childhood. It is not improbable that the hyperæsthesia observed upon the thoracic and abdominal surfaces and along the thighs, in the commencement of remittent and certain other febrile diseases, have their origin in a congested state of the spine. To this congestion writers attribute the lumbar pain and occasional paraplegia in the initial stage of variola. Active spinal congestion may also result from the sudden impression of cold, and to it, as has been stated above, most neuropathists attribute those sudden attacks of paralysis which are peculiar to infants, and which have therefore been designated infantile paralysis.

Certain anatomical circumstances favor the occurrence of passive congestion of the spinal cord and meninges, to wit, the tortuousness of their veins, and the absence of valves in these veins, the lack of muscular sup-

[1] Some months since I requested Drs. Holgate and Bosly, attending physicians in the children's class at Bellevue, to make examination of the state of the prepuce in infancy. They report that they have found preputial adhesions almost daily, in most instances without symptoms, but sometimes with dysuria, and only in rare instances with paralysis.

port of the vessels, and the inferior position of the spine in sickness as the patient lies quietly in bed. A common cause of passive congestion of these parts is some protracted and enfeebling disease, which diminishes the contractile force of the heart (cardiac paresis), producing congestion of the spinal cord in the same manner as under similar circumstances hypostatic congestion of the lungs occurs. Severe convulsive diseases, as tetanus or eclampsia, when protracted or occurring at short intervals, commonly produce spinal congestion. In tetanus, this congestion is extreme, so that extravasation of blood is apt to occur from the engorged vessels, especially from those of the pia mater.

Anatomical Characters.—It is often impossible, at post-mortem examinations, to determine how much of the congestion of the spine and its meninges is pathological, and how much cadaveric; since, if the corpse is placed on its back at death, a very considerable engorgement of the spinal vessels occurs from gravitation of blood. If the body has been placed on the side or face, this cadaveric congestion is prevented. Since, in active congestion, the arterioles and capillaries are distended with arterial blood, the color is a brighter red than in passive congestion, in which venous blood predominates. *Active* congestion of the cord usually coexists with that of the meninges, but it may occur without it. In cases of considerable congestion, the "puncta vasculosa" appear upon the incised surface, both of the white and gray substance. If the congestion be protracted, or if it recur frequently, it may produce permanent dilatation of the arterioles and capillaries, in greater or less degree, and it may also lead to sclerosis of the cord. *Passive* congestion seldom, perhaps never, occurs in the cord; without being equally and often to a greater extent present in the meninges. Continuing for a time it gives rise to transudation of serum into the interspaces over the cord, and even softening of the cord may occur to a limited extent from imbibition of serum. In either form of congestion, extravasations of blood are frequent.

Symptoms.—Spinal congestion is announced by pain in the region of the spine, usually in the lumbar, or dorsal and lumbar portions, and irradiations of pain, and tingling in the legs. In addition, more or less paralysis of the bladder and legs may occur. The paraplegia may occur early or not till the lapse of several days. In active congestion, the symptoms are rapidly developed, and they attain their maximum intensity sooner than in the passive form. In passive congestion the development of symptoms is not only more gradual, but they are ordinarily less pronounced, and are attended by more fluctuations than in the active form. The paralysis, if present, comes on slowly after several days and is incomplete. Spinal congestion, especially of the passive form, is apt to be associated with cerebral congestion, as for example in tetanus and severe eclampsia, and the spinal symptoms therefore coexist with those which have a cerebral

origin. The duration and the result of a hyperæmic state of the spinal cord and its meninges, depend largely on the nature of the cause. If it is not relieved within a few days, there is strong probability that some other serious pathological state has supervened, as meningitis, myelitis, extravasation of blood, or serous transudation, with softening of the nervous substance.

Treatment.—In the adult, spinal congestion sometimes results from the sudden cessation of the hemorrhoidal or catamenial flow, and the application of leeches or wet cups along the spine is indicated. But in the child, the abstraction of blood is seldom required. Nor is the application of cold along the spine ordinarily advisable, since it promotes congestion of the internal organs, and its debilitating effect is prejudicial to most children who have spinal congestion, since, in most forms of this malady occurring in childhood, sustaining treatment is required. In active hyperæmia, laxatives are often useful, and rubefacient applications should be made along the spine, as by mustard, or by friction with a stimulating liniment. In the inflammatory spinal congestion of cerebro-spinal fever, I have employed with a very satisfactory result a liniment containing equal parts of camphorated oil and turpentine. In both active and passive hyperæmia lateral decubitis should be prescribed rather than dorsal. The internal use of ergot, in order to diminish the turgescence of the spinal vessels, has not been attended by such benefit as to justify us in recommending it. On the other hand, bromide of potassium is a remedy of real value, but it is more useful in certain cases than in others. It is signally beneficial in those cases in which there is also cerebral congestion. When the congestion is increased or produced by clonic convulsions, the bromide is the most reliable remedy which we possess for the removal of the cause. Thus it should be employed in the treatment of the spinal and cerebral congestion in the commencement of variola, in which convulsions are so common, and in the convulsions of pertussis, which cause extreme passive congestion of the cerebro-spinal axis. Passive congestion of the spine, common in exhausting diseases, and due to feebleness of the circulation, is best treated by stimulating and sustaining remedies, and by the lateral decubitus. It is hypostatic, and may be associated with a similar congestion in the posterior part of the lungs.

CHAPTER XVIII.

SPINA BIFIDA.

This is one of the most common of the malformations. In its severe form it is from its nature incurable, admitting only of palliative treatment, while in its milder forms, it may be cured, or so relieved as not to compromise life. The term spina bifida is applied to a hernia of the spinal meninges, which produces a rounded tumor, situated posteriorly over the spine in the median line. It is due to the congenital absence or incompleteness of one or more of the arches of the vertebræ. In exceptional instances, the arch is said to be complete at birth; but the lateral portions separate, and are pressed outwards during the first weeks of life. The tumor contains the cerebro-spinal fluid, and unless it is small, and its walls are unusually thick, fluctuation may be detected in it. When the child cries the tumor enlarges, and it is reduced by compression, the fluid re-entering the spinal canal. If the tumor is large, its complete subsidence by pressure is apt to produce dangerous cerebral symptoms. Spina bifida is the counterpart of hydrocephalus, and the two often coexist. If we compress the hydrocephalic head, the spinal tumor increases, and *vice versa*.

Fig. 22.

Club-foot is another not infrequent complication. In the case which is represented in the accompanying wood-cut, hydrocephalus, spina bifida, and club-foot coexisted. The child was brought to the children's class in the Outdoor Department at Bellevue, and after a few visits I lost sight

of it. It probably died soon after, since the tumor, over which the cuticle was wanting, presented a deep-red appearance as if inflamed, so that ulceration and escape of the fluid seemed near at hand. There is ordinarily but one spina bifida, the common seat of which is the lumbar region, but occasionally there are two or more. If the aperture through which the tumor protrudes is small, it is usually pedunculated, but if large, it is sessile. In some patients it is covered by skin which may be normal or somewhat indurated; in others the skin is absent over the entire tumor or its most prominent part, and the dura mater or the connective tissue lying directly over the dura mater is exposed, and is liable to inflammation from friction. If the walls of the tumor are thin the liquid may transude in drops, and they are apt to give way by ulceration or rupture. Sudden escape of the liquid, and collapse of the spina bifida, involve great danger, for convulsions, coma, and death are the probable result.

The relation of the spinal cord or nerves, or of the cauda equina, to the tumor, is a matter of great importance. In many patients the adjacent portion of the cord or cauda equina, is deflected through the aperture, and lies against the interior of the sac. Spinal nerves also not infrequently lie within the sac, some returning into the spinal canal, and others passing through the walls of the sac to their points of distribution. Those which are deflected into the tumor and return into the canal obviously lie lowest. In the most favorable cases, namely, those with a small aperture, or small tumor, or a narrow and long peduncle, neither the cord, cauda equina, nor nerves lie within the sac. It is important to the practitioner to bear in mind that in all probability, unless under the favorable anatomical circumstances stated above, the sac contains nervous elements. In rare instances the liquid, instead of lying externally to the cord, lies within its central canal. The substance of the cord then becomes distended, and it incloses the liquid like a delicate sac, just as the hemispheres of the brain are unfolded and expanded in the common form of congenital hydrocephalus. As might be expected from the anatomical characters of the more serious forms of spina bifida, paralysis, more or less complete, of the vesical and rectal muscular fibres, and paraplegia sometimes occur, in which event the fatal issue is probably not far distant.

Diagnosis.—This is easy in ordinary cases. The congenital nature of the tumor, and the bony edge of the aperture, appreciable to the touch, suffice in ordinary cases to establish the diagnosis. The diminution of the tumor by pressure, and its enlargement when the child cries, are important diagnostic signs. There are various lumbo-sacral tumors located in the median line, from which it is important that spina bifida should be diagnosticated. Sometimes a cyst occurs in this situation which was originally a spina bifida, but obliteration of the canal in the pedicle occurred, just as the canal connecting a hydrocele with the abdominal cavity closes. Solid congenital tumors sometimes also occur in the same situation, among

which, as most common, may be mentioned fatty tumors, and tumors containing fœtal remains. The most common seat of tumors which inclose fœtal remains is at the point where spina bifida ordinarily occurs. Physicians have erred in confounding these tumors, as well as those which consist of fat, with spina bifida; but a mistake in diagnosis can only occur through haste or carelessness of examination.

Prognosis.—This is in most instances unfavorable. Ordinarily the tumor increases slowly, and finally the sac gives way by ulceration or rupture; the liquid escapes, and death occurs in convulsions and coma; or, if the escape of the liquid is prevented by pressure, and the aperture closes, a second rupture is probable with a fatal result. In other cases the tumor may not rupture, but the cord is softened, or it is injured by the abrupt bend, so that paraplegia results, and death after a time occurs in a state of emaciation. Rarely the tumor may shrivel away by absorption of the liquid, and the disease is cured, or so nearly cured that it gives no inconvenience, and the patient lives for years. In other rare instances the tumor may remain without any material change, and without giving rise to symptoms. The spina bifida being small and covered with skin, and the aperture leading from it into the spinal canal being also small, the patient lives through the natural period of life with little inconvenience.

Treatment.—It is evident, from what has been stated, that no fixed rule can be laid down for the treatment of the spina bifida. In the most favorable cases, in which no symptoms occur, and there is no indication that the tumor will change or undergo any unfavorable change, surgical treatment is not required, except the application of a soft pad to support the tumor, to prevent its injury by friction. Indications which justify active surgical interference are growth of tumor, absence of skin from it, with tension of the parietes, so that an early rupture is inevitable, and dangerous nervous symptoms, as convulsions or paraplegia.

From the nature of spina bifida it is evident that operations upon it must be conducted with caution. The usual presence of the spinal cord in the pedicle and in the sac forbid ligation and excision, and render hazardous attempts to obliterate the sac by producing inflammation within it. A safe mode of treatment, but not the most efficient, is to puncture the sac and withdraw a portion of the liquid by a grooved needle or hypodermic syringe. A soft pad should then be applied to produce gentle compression. If no unfavorable symptoms occur, the puncture may be repeated after a day or two. This operation has been employed with a satisfactory result by Sir Astley Cooper among others; but, simple as it is, it is not devoid of danger, for the removal of the liquid, if carried beyond a certain point, may produce dangerous nervous symptoms, especially convulsions. In performing the operation, the puncture should never be made in the median line, on account of the danger of wounding the

cord, which lies against the median portion of the sac. The veins, also, should be avoided.

Another mode of treatment is by iodine injections. They are preferable to other methods, if the neck is long and pedunculated, so as to be easily compressed. If the tumor is sessile, and the aperture into the spinal canal is free, these injections involve great danger, and are not to be recommended; for more or less of the solution will inevitably enter the spinal canal, and give rise to spinal meningitis. Iodine injections have been employed with success by Professor Brainard, of Chicago, who states that he "perfectly and permanently cured" three of seven cases; and by Velpeau, of Paris, by whose method five in ten operations were successful, and by many others. Professor Brainard withdrew some of the liquid contents, and then injected half an ounce of water containing $2\frac{1}{2}$ grains of iodine, and $7\frac{1}{2}$ grains of iodide of potassium. In a few seconds this was allowed to flow out, and the sac was then washed out with tepid water. Then a portion of the cerebro-spinal fluid, which had been kept warm, was returned into the sac. When he had withdrawn six ounces of this fluid he returned two ounces. In employing the iodine, or any other irritating injection, it is necessary to compress the pedicle, so that the liquid does not enter the spinal canal. Velpeau employed one part of iodine, one of iodide of potassium, and ten of distilled water.

During a debate in the Société de Chirurgie, M. Debont recommended the evacuation of only a little of the fluid, and the injection of two or three drops of the tincture of iodine diluted with an equal quantity of water; and T. Smith, by the injection of one drop of the tincture, produced an amount of inflammation which nearly obliterated the sac (see Holmes's *Surg. Dis. of Children*). Since statistics show so good a result of iodine injections, this mode of treatment seems preferable to any other for certain cases, and as one drop has produced general inflammation of the sac and nearly obliterated it, it seems safest and best to begin with so small a quantity.

If there is reason to believe, from the small size of the orifice and other anatomical characters, that neither the cord, cauda equina, nor any of the spinal nerves, lie within the sac, it may be thought best to remove the tumor. It has, indeed, been proposed to open the tumor, immersed under warm water sufficiently to observe the relation of the nervous elements, and to press them back gently into the canal if they lie within the sac. If it is decided to remove the spina bifida, a clamp, or elastic band, is placed around the pedicle so snugly as to cause firm adhesion of the walls of the pedicle, and excite sufficient inflammation in them to produce agglutination, but without causing strangulation or suppuration.

After a time, perhaps two or three days, when it is evident that agglutination has occurred from the fact that the liquid cannot be returned within the spinal canal by compressing the sac, the tumor may be removed

by the knife or écraseur. Statistics do not show so favorable a result of this operation as of the iodine treatment, and the reason is obvious, for it is only in exceptional cases that the tumor can be removed without injury to the nervous tissue, and excision of a portion of the cord, or of important nerves, either produces death or a condition to which death would be a relief.

Spina bifida has also been treated by opening the sac on its side, pressing back the spinal cord or its nerves into the spinal canal, uniting the edges of the wound, and then applying pressure to prevent protrusion, but the result has not been favorable. Treatment by simple puncture, followed by compression, and if it fail, as it probably will, the cautious use of iodine injections, is the preferable mode of treating ordinary cases of spina bifida, which require surgical interference.

CHAPTER XIX.

VERTEBRAL CARIES.

Vertebral caries, designated also Pott's disease, occurs chiefly in childhood, but now and then adults are affected with it. It is an osteitis of the bodies of one or more vertebræ, ending in their ulceration and a lifelong deformity, if not checked.

Causes.—A reduced state of system, and especially the scrofulous diathesis, strongly predispose to caries. Hence this malady is more common in the city than in the country, where better hygienic conditions produce a more vigorous constitution. Masturbation has also been assigned as a cause. It certainly may be a predisposing cause from its lowering effect upon the system. In certain cases, there is no apparent exciting cause, while in others there is the history of a fall upon or some injury of the spine.

Vertebral caries may occur in the cervical, dorsal, or lumbar portions of the spinal column, but it is more common in the lower dorsal than elsewhere. With the development of the osteitis, the body of the vertebra which is affected, becomes hyperæmic, and the spongy tissue is soon infiltrated with blood and pus. The bone becomes swollen and softened, and, therefore, less resisting than in the healthy state, so that it yields under the weight of the shoulders and head, which it sustains. Therefore, after the osteitis has continued a certain time, there begins to be posterior convexity or rather angularity of the spine, for while the vertebral bodies soften and yield by the weight above them, the arches retain their integrity and firmness, and are unyielding.

Much of the tediousness and suffering of this malady is due to the fact that the inflammation is so deep-seated, and a healthy bony barrier is interposed between it and the surface, so that there is no ready escape of the pus. It permeates the spongy tissue, filling the cavities produced by the softening and absorption of the bone-substance. If the inflammation is of small extent, the amount of pus small, the constitution good, and if the disease is early recognized and properly treated, the child may recover without any fistulous opening, by absorption of the pus, and with little remaining deformity.

In the large proportion of cases, however, the history is different. The disease is not recognized till the stage of deformity, the caries is so extensive and the pus so abundant, that it escapes between the vertebræ, forming an abscess external to them, which connects with the interior of the vertebræ by a fistulous canal. This abscess if in the cervical region may press upon the pharynx or œsophagus, or upon the air-passages, producing dangerous obstruction to the respiration. (See Art. Retro-pharyngeal Abscess.) The pus may point and discharge externally near the seat of the caries, but in a large proportion of instances it takes a long and circuitous route to the surface, or it opens internally. There are instances in which it discharges into the pleural or abdominal cavity, or into one of the abdominal organs. If, as is sometimes the case, it establishes a connection with the intestine and escape in the stools, the result will probably be favorable. In other instances it descends into the pelvic cavity, and finds an outlet by the inguinal ring, or sciatic notch, or it enters the sheath of the iliacus or psoas muscle, and points externally.

When the disease ends favorably, new bone is thrown out around the diseased vertebræ, preventing any further bending, and giving stability to the spine. If the abscess do not discharge, but remains subcutaneous, Billroth says: . . . "While the bone disease recovers most frequently, a large part of the pus, whose cells disintegrate into fine molecules, is absorbed, while the inner walls of the abscess change to a cicatricial tissue, which in the shape of a fibrous sac contains the puriform fluid. Such pus-sacs often remain in this stage for years."

If the pus has escaped externally, the abscesses and fistulæ contract and finally close, their site being occupied by condensed connective tissue. The portions of the diseased vertebræ which have retained their vitality are enveloped and supported by the new bone, so that the part of the spine which was the seat of the disease, though anchylosed and curved, has greater firmness than in health.

The history of unfavorable cases varies; the caries may extend. Pus finding no vent may accumulate in cavities and sinuses, in which detached portions of bone float, or it may make its way in such directions, that it produces alarming complications, and impairs or obstructs the functions of important organs.

Spinal meningitis in the vicinity of the caries, and due to extension of the inflammation, is common, and "the spinal medulla," says Billroth, "may be endangered by participation in the suppuration, or by being so bent by the inclination of the vertebræ, that its function is destroyed." Hence the paralysis of the lower extremities, bladder, and rectum, which occurs in aggravated cases, and which entails a fatal issue. In a certain proportion of cases the blood becomes more and more impoverished from the continuance of the inflammation and suppuration, and death occurs in a state of exhaustion. In such cases post-mortem examination often discloses waxy degeneration of important organs, as the spleen, liver, kidneys, and intestines, for it is well known that chronic suppurative inflammation of the bones is one of the two chief causes of the waxy disease, syphilis being the other.

Symptoms.—Caries of the vertebræ is often preceded by symptoms or appearances which are due to the strumous cachexia. Strumous ailments have probably occurred in the patient, or in members of the family, or without any clear history of struma, the child has perhaps for some time been in failing health. In cases which I have observed, one of the chief symptoms, and sometimes almost the only symptom in the commencement of the caries, has been neuralgic pain, usually not severe, intermittent, or more or less constant, at some point in the anterior aspect of the body, most frequently in the chest, epigastric or umbilical region. This pain has been present in a larger proportion of cases, than pain in the spinal region at the seat of the caries, though Guersant dwells particularly upon the latter as a symptom of caries. Patients with this neuralgia are not infrequently treated for indigestion, or worms, the true nature of the malady not being suspected, and the spine not even being examined. This neuralgia seems to be due to compression of the spinal nerves, by inflammatory exudation at the points where they emerge from the spinal canal. I can recall to mind a number of cases, in which I have on different occasions been asked to prescribe for this neuralgia, which was shown by the sequel to be undoubtedly the result of vertebral caries, and yet with a careful examination of the spinal column could discover no evidence of disease at any point. After a time, tenderness, pain, and inflammatory induration, appreciable to the touch, may occur in the spine, but not usually till the malady is well advanced. Lassitude, fatigue after slight exertion, poor appetite, with slight fever, are common symptoms in the first stage of the caries.

As the case advances, if the nature of the disease is not recognized, and no artificial support of the trunk is provided, the child instinctively seeks some way of supporting the head and shoulders. He rests his head upon his hands, or his elbows upon the table. Soon a gibbosity or angularity appears, affording clear and positive proof of the nature of the disease. Even now there is little or no tenderness when pressure is made directly on the

spine, but it is observed more when pressure is made laterally upon it. If the inflammation extends so as to involve the meninges and the cord, pricking, tingling, numbness or weakness of the legs may occur, which are symptoms of grave import, for it is probable that the case will end in paraplegia and death. A state of emaciation and general weakness, sometimes accompanied by diarrhœa and œdema of the limbs, precedes death. But a very considerable degree of curvature is not incompatible with a healthy and normal performance of all the functions, and the number who recover, and lived to an advanced age with great deformity, is large, as every one knows.

Diagnosis.—This is often from the nature of the disease obscure and uncertain for a time. The long continuance of pain in the chest or abdomen, or perhaps in the thighs, without any cause, which we can detect, located at the seat of the pain, should excite suspicion of spinal disease. Such pain may be produced by spinal irritation, but in this malady pressure on the spine is badly tolerated, and when we touch a certain part, the neuralgic pain is intensified. In caries, as we have seen, firm pressure upon the spine is tolerated, and it does not increase the neuralgia. At a later period in caries, there may be spinal pain and tenderness, but there is now also spinal deformity, by which alone the diagnosis is clearly established; stiffness observed in the movements of the spine, pain in the spine, on sudden movement or jarring the body, impaired appetite and general health, and instinctive desire to sit or recline in such a way as to relieve the spine partially of the weight of the head and shoulders, are symptoms which, if they coexist, afford very strong evidence of the presence of caries, although there is as yet no deformity.

The spinal deformity of rachitis is distinguished from that of caries, by the fact, that it occurs slowly without pain or tenderness, and is rounded instead of angular. Moreover, the rachitic diathesis precludes scrofulous ailments, and the scrofulous diathesis rachitic ailments, as the two diatheses do not coexist or but rarely; so that if there are in the state of the patient or have been in his history evidences of scrofula, the presumption is that the bending of the spine occurs from caries. In a case of rachitic curvature, we find also enlargements of the ankles and wrists, keel-shaped thorax, prominent abdomen, rachitic head, etc.

Prognosis.—The course of this malady, even when the caries is slight and the symptoms mild, is tedious. In the most favorable cases, the general health is but slightly impaired, the caries confined to one vertebra, and is early diagnosticated and properly treated. On the other hand, if the general health is decidedly poor, the child anæmic and wasted, the curvature great, and an abscess has occurred, the case is very serious. Between these two extremes is every grade. The prognosis is more favorable in the child than in the adult. The few adults whom I have seen with it all died. It is less favorable in the cervical region than in

the dorsal or lumbar. A mild case occurring in a good condition of health, may become grave and even fatal by neglect and improper treatment. A majority of the patients, if the disease is not too far advanced when recognized, recover if properly treated, but the deformity which results may prove serious in after-life. The incomplete expansion of the lungs in the humpbacked, greatly increases the danger and the dyspnœa in bronchitis and pneumonia, and if the caries has been at a low point in the spine, and the patient a female, the deformity will probably present an obstacle to childbearing.

TREATMENT.—The treatment must be constitutional and local, hygienic, medicinal, and mechanical. It is of the utmost importance to improve the general health, as it is in all chronic inflammations and scrofulous ailments. Pure air, sunlight, personal cleanliness, and plain but the most nutritious diet are required. Tonic and anti-strumous remedies are indicated. To many patients I have prescribed, three times daily, cod-liver oil, to which the syrup of the iodide of iron was added, giving two drops to a child of one year, and one additional drop for each additional year. The judicious use of alcoholic stimulants will often be found useful, if the appetite is poor and general health seriously impaired, as will also the vegetable bitters.

In all strumous inflammations of the bones, which extend to or involve joints, and which are in their nature chronic, perfect quiet of the parts, so far as it is consistent with the degree of exercise which is required in order to improve the appetite and general health, is indispensable for successful treatment of the case. The patient with this malady should be encouraged to lie much of the time in bed, for the double purpose of preventing movements of the inflamed vertebræ, and of relieving them of the weight of the shoulders and head. But confinement in bed is badly tolerated, and exercise is necessary for a healthy functional activity of the organs; therefore mechanical support of the spine is required. The apparatuses which have been invented for the purpose of supporting the spine and rendering it immovable, and of sustaining the head, if the caries is in the cervical region, or the head and shoulders, if it is in the dorsal or lumbar region, are ingenious and effectual. Some of them are rather cumbersome, but others are sufficiently light for the youngest child who can walk. The apparatus should be worn for months, care being taken to prevent excoriation or undue pressure upon any point. It may be removed at night, and reapplied on rising in the morning.

SECTION II.

DISEASES OF THE RESPIRATORY SYSTEM.

CHAPTER I.

CORYZA.

The term coryza is applied to inflammation of the Schneiderian membrane. It is acute or chronic. The acute form is primary or secondary. Acute primary coryza is common in infancy and childhood. Its usual cause is exposure to currents of air, to cold, and especially to sudden changes of temperature from warm to cold. The cause is the same as that in the ordinary forms of bronchitis. These two diseases frequently indeed coexist, occurring from the same exposure. The inflammation in such cases commences upon the Schneiderian membrane, immediately upon the operation of the cause, and soon after extends to the bronchial tubes. Acute coryza may also be produced by the inhalation of irritating vapors, hot air, or dust, and also by the presence of a foreign body, as a button or bean, in the nostril.

Secondary coryza is commonly due to a specific cause. The diseases in connection with which it occurs are hooping-cough, measles, scarlet fever, diphtheria, and constitutional syphilis. In the infant, coryza is one of the first manifestations of hereditary syphilitic taint.

Acute primary coryza ordinarily abates in from one to two weeks. The secondary form gradually declines, in most cases, when the primary affection on which it depends is cured. Syphilitic coryza is more protracted than the primary form, or than that accompanying the eruptive fevers. Some children are so liable to coryza that it occurs whenever they take cold. Occasionally it is so frequently renewed in the winter months that it resembles the chronic form of the disease.

Chronic coryza is commonly dependent on a dyscrasia. It corresponds with chronic inflammation of the external ear, and otorrhœa is not infrequent in connection with it. The dyscrasia is indicated by pallor, flabbiness of the flesh, and liability to glandular swellings. Chronic coryza may also occur in those who have good general health, as the result of an acute attack. Many a case dates back to one of the exanthematic fevers,

the local affection continuing after the general health is restored. Rarely chronic coryza comes on gradually and without appreciable cause.

Anatomical Characters.—The alterations which the nasal mucous membrane undergoes when inflamed, vary considerably in different cases. In the simplest and most common form of coryza, this membrane is sometimes in patches, sometimes generally reddened, thickened, and softened. Its papillæ are prominent, producing an inequality of the surface. Ulcerations are not common in simple acute coryza, but they sometimes occur in the chronic form.

In diphtheria, and sometimes in scarlet fever and variola of severe type, the coryza is pseudo-membranous, and when it presents this form it is commonly but not always associated with pseudo-membranous angina or laryngitis. A case of pseudo-membranous coryza occurring in measles is related by M. Guibert. The patient was a rachitic boy, three and a half years old. The pseudo-membrane, in grave cases, may cover almost the entire surface of the nostrils, but ordinarily it occurs in patches.

Symptoms.—The constitutional symptoms are mild or severe, according to the gravity of the inflammation. If the coryza is acute and pretty general, there is febrile movement, with thirst and loss of appetite. Frontal headache is common, from the proximity of the inflammation to the head, or its extension to the frontal sinuses. Sneezing is the first symptom in many cases of acute coryza. As the inflamed membrane swells, more or less obstruction occurs to respiration. The breathing is noisy, especially during sleep, and in severe cases the patient is compelled to breathe mostly through the mouth. If there is much obstruction to respiration the suffering of the patient is considerable, from the sensation of fulness in the nostrils, the headache, and the muscular effort required in each respiratory act.

In the commencement of coryza the patient experiences a sensation of dryness in the nostrils, which is soon succeeded by a thin discharge of a serous appearance. In the course of a few hours the secretion becomes thicker. It is muco-purulent, and remains such till the disease begins to decline. Inspissated mucus and crusts are apt to collect within the nostrils and around their orifice in chronic coryza, and sometimes also in the acute disease, if the discharge is not abundant. These crusts increase the difficulty of breathing. Often the acridity of the discharge is such that the skin of the upper lip and around the nostrils is excoriated.

Prognosis.—Uncomplicated catarrhal coryza rarely terminates fatally. It is only dangerous in young nursing infants, in whom it may seriously interfere with lactation. Coryza, accompanying the eruptive fevers, although it may increase the suffering, does not materially increase the danger. Syphilitic coryza subsides when the system is sufficiently affected by antisyphilitic remedies. Chronic coryza is sometimes very obstinate.

It may continue for months or years, giving rise to a constant, but often not abundant, discharge.

Treatment.—Common mild attacks of coryza require little treatment. The bowels should be kept open, the feet soaked in mustard-water, and the body should be warmly clothed. Inunction of the nostrils is a popular remedy, and it seems to give some relief. If coryza commence with symptoms which indicate a pretty severe attack, and there are evidences of extension of the disease towards the bronchial tubes, an emetic of syrup of ipecacuanha, given at an early period, moderates the severity of the inflammation and may prevent the occurrence of bronchitis. Afterwards a simple diaphoretic mixture, as the following, should be given:—

℞. Syrupi ipecacuanhæ, ʒij;
Spirit, æther. nitr., ʒj;
Syrupi simplicis, ℥ij. Misce.

One teaspoonful every three hours to a child of six months. In place of sweet spirits of nitre, acetate of potash may be employed in the dose of one to two grains for infants; and if there is decided febrile reaction, from half a minim to two minims, according to the age, of tincture of digitalis, should be added to each dose.

A three to five per cent. solution of common salt in warm water injected into the nostrils with a small syringe, aids materially in removing the muco-pus which obstructs the respiration, and in establishing a healthier state of the inflamed surface. I have employed in the same way, with apparent benefit, carbolic acid, glycerine and water, with or without a few grains of chlorate of potash. This may also be conveniently used in the form of spray, with the steam atomizer, or thrown up the nostrils with the hand atomizer.

In pseudo-membranous coryza the main treatment must be directed to the accompanying laryngitis, if, as is usual, the latter affection is present, since the coryza is much less dangerous than the other inflammation. Still, if it cause any obstruction to the respiration and increase the suffering of the patient, it requires attention. The same mixtures which have been recommended in our remarks relating to the local treatment of diphtheritic croup are also applicable in the treatment of pseudo-membranous coryza. The spray from the steam atomizer inhaled through the nostrils exerts the same solvent and curative effect upon the exudative inflammation of the nasal surface, as it does upon that of the larynx. The mixtures alluded to, which are recommended on page 260, may also be thrown into the nostrils with a small syringe, the head of the child being held back, and eyes covered; but they should be used with two or three times their quantity of warm water, for solutions injected into the nostrils should always be warm, and so weak as to cause little or no smarting. Chronic coryza, dependent on a dyscrasia, is best treated by tonic and alterative remedies. The various ferruginous preparations, as wine of iron, tincture

of the chloride of iron, iron lozenges, may be advantageously employed, or the vegetable tonics. If there are pallor, softness of flesh, and especially glandular swellings, indicating a scrofulous state of system, the syrup of the iodide of iron is useful, with or without cod-liver oil. The diet should be nutritious, and the hygienic measures such as invigorate the general health. Injections into the nostrils of a solution of alum, five grains to the ounce, of nitrate of silver, three to five grains to the ounce, or of one of the other mineral astringents, are sometimes useful in connection with constitutional measures. A good formula in chronic coryza, for application to parts which can be reached by a camel's-hair pencil, is the following:—

℞. Ung. hydrarg. nitratis, ʒij;
Ung. zinci oxid., ℥ij. Misce.

At the Outdoor Department of Bellevue, this ointment has proved more effectual in this disease than any other local remedy. It should be applied at least three or four times daily, as far within the nostrils as possible. Recently it has been modified by the substitution of Squibb's five per cent. solution of oleate of mercury in place of the citrine ointment. The zinc ointment is softer and therefore applied more readily with the camel's-hair pencil, if made up with vaseline.

Meigs and Pepper recommend the following ointment in chronic coryza, to be applied at night, after the use of injections through the day:—

℞. Unguenti hydrargyri nitratis, ʒss;
Extracti belladonnæ, gr. x;
Axungiæ, ℥ss. Misce.

In a case now under observation, of severe ulcerative coryza, due to inherited syphilitic taint, the application once daily of a few drops of the oleate of mercury, has within two weeks produced marked amelioration of the inflamed surface.

CHAPTER II.

CATARRHAL LARYNGITIS.

Acute catarrhal laryngitis occurs at all ages, but it is so common in infancy and childhood, that it is proper to treat of it in a work relating to the diseases of these periods. Like other inflammatory affections of the air-passages, it is most common in the cold months, or when the weather is changeable. Its usual cause is, therefore, exposure to cold. Protracted and violent crying, and the inhalation of acrid vapors are occasional causes. Catarrhal, or as it is sometimes designated simple laryngitis, also occurs in connection with certain constitutional diseases, among which

may be mentioned, measles, scarlatina, and variola. Laryngitis is also a common accompaniment of bronchitis, and not infrequently of pneumonitis, though its symptoms are apt to be obscured by those of the graver disease. It often likewise accompanies pharyngitis, due to extension of the inflammation.

Symptoms.—Catarrhal laryngitis produced by the impression of cold, is commonly preceded and accompanied by coryza. The initial symptom is chilliness, followed by sneezing, and the discharge of thin mucus from the nostrils in consequence of irritation of the Schneiderian membrane.

The commencement of laryngitis is indicated by hoarseness, which is apparent when the child cries, or, if old enough, when it attempts to speak. There is often in severe cases complete loss of voice, so that speech above a whisper is impossible. I have noticed this most frequently in the laryngitis which accompanies measles. A cough occurs which is at first dry and husky but becomes loose in the course of a few days. Expectoration is scanty, unless the inflammation has extended to the trachea and bronchial tubes.

This disease is often accompanied by soreness of the throat, noticed in the act of coughing or when the larynx is pressed with the finger. In laryngeal catarrh, when uncomplicated, the respiration remains nearly natural and the pulse is but little accelerated. In mild cases the nature of the disease is often not apparent as long as the child remains quiet, in consequence of the absence of symptoms, but the character of the voice, when it cries or speaks, or of the cough, reveals at once the nature of the affection.

Acute laryngeal catarrh subsides in from one to two weeks. Occasionally it lasts three or four weeks before the symptoms entirely disappear. Death, which is rare, is due to some complication.

Chronic laryngitis is much less frequent than the acute form. Its anatomical characters are similar to those in other chronic inflammations affecting mucous surfaces, namely, thickening and more or less infiltration of the mucous membrane, increased proliferation and exfoliation of the epithelial cells, and increased functional activity of the muciparous follicles.

In the adult, chronic laryngitis is common as one of the lesions of the syphilitic or tubercular disease. In the child syphilitic and tubercular laryngitis is more rare, but the latter sometimes occurs in connection with pulmonary or bronchial tuberculosis. Such patients are emaciated, and have the ordinary symptoms of the tubercular disease. Chronic laryngitis also occurs in young children, usually infants, as one of the manifestations of the strumous diathesis. I have records of several such cases, mostly nursing infants. Some of these patients had mild bronchitis, but it was obviously subordinate to the laryngitis. Their respiration was noisy and harsh, continuing of this character for several weeks and even months. The cough

was also harsh and loud, conveying the idea of thickening and relaxation of the mucous membrane covering the vocal cords. Their respiration was not notably accelerated, and the blood was apparently fully oxygenated, though the friends were often alarmed by the noisy breathing and cough.

In this form of chronic laryngitis there is little expectoration, the fever is slight or absent, the appetite remains unimpaired, and the general condition of the child is good. There are from time to time exacerbations, and occasionally improvement is such as to encourage the hope of speedy cure, but in the cases which I have seen there has not been complete intermission in the disease till the final recovery. Those patients whom I have been able to follow through the disease have recovered in from three or four months to one year.

Chronic laryngitis is to be distinguished from frequent attacks of acute laryngitis, which are due to fresh exposures, and also from the laryngitis which is associated with bronchial phthisis. It is to be distinguished from protracted acute laryngitis, which sometimes does not entirely subside in less than a month or six weeks, by its longer duration, the greater thickening of the inflamed membrane, and more noisy respiration. Often chronic laryngitis results from the acute disease, the inflammation being perpetuated by the struma or dyscrasia of the patients.

Anatomical Characters.—In acute catarrhal laryngitis the mucous membrane of the larynx presents the usual appearance of mucous surfaces when inflamed, namely, redness and thickening. It is also somewhat softened. Ulcerations rarely, perhaps never, occur in primary acute laryngitis. When present in chronic laryngitis, the ulcers are small and situated upon or near the vocal cords. Tubercular and syphilitic ulcers of the larynx are much more rare in children than in adults. The inflammation in simple acute laryngitis usually extends over the whole surface of the larynx, and also to the upper part of the trachea. It may be pretty uniform, or more intense in one place than another, and, like other mucous inflammations, it is accompanied by more or less rapid proliferation and exfoliation of epithelial cells. In most cases of simple laryngitis, whether acute or chronic, the inflammation extends to the pharynx, producing redness and thickening, though generally moderate, of the mucous membrane which covers it. Examination of the fauces therefore aids in diagnosis.

In the adult œdema glottidis occasionally results from laryngitis. In the child there is little danger that this will occur, in consequence of the anatomical character of the larynx. In early life there is but little submucous connective tissue in the larynx, and therefore less submucous infiltration or effusion during the inflammation. The structural changes occurring in catarrhal laryngitis of infancy and childhood relate almost exclusively to the mucous membrane.

Treatment.—Primary and uncomplicated catarrhal laryngitis requires little treatment. Most cases would do well by the employment of suitable hygienic measures, without medicines. Benefit is, however, derived from the use of demulcent drinks and an occasional laxative. A mixture of paregoric and syrup of ipecacuanha, or a small Dover's powder, will relieve the cough if it is troublesome. For restlessness, a warm mustard foot-bath is useful. Inhalation of the spray of glycerine and water from the atomizer, or of steam, plain or medicated, is also useful. Mildly stimulating embrocation, as by camphorated oil with or without a little turpentine, also aids. It should be rubbed several times daily over the throat, or a strip of flannel soaked with it may be applied around the neck. Chronic laryngitis dependent on syphilis or tuberculosis requires the constitutional treatment which is appropriate for that disease. Measures not specific have little effect upon this form of inflammation. The chronic laryngitis which I have described as occurring chiefly in infancy, and which appears to be of a strumous character, is apt to be obstinate. The patient should be warmly clothed, and constant care should be taken that there be no exposure which would endanger taking cold, as this would produce an exacerbation of the disease, and tend to counteract what had been gained by remedial measures. This form of chronic laryngitis is most satisfactorily treated by the application of tincture of iodine upon the neck, directly over the larynx, and the internal use of cod-liver oil and the syrup of the iodide of iron. Little benefit results in this inflammation from the usual expectorant remedies, as squills or senega.

Spasmodic Laryngitis.

This is a common disease. It is also called false croup, in contradistinction to true or pseudo-membranous croup, and, by some of the continental writers, stridulous angina or stridulous laryngitis. It should not be confounded with spasm of the glottis, which is a form of internal convulsions, and is not inflammatory. It occurs ordinarily between the ages of two and five years. It is commonly a sporadic affection, but Rilliet and Barthez state that "it is incontestable that it may prevail epidemically." They express this opinion, not from their own observations, but chiefly from those of Jurine, made in the commencement of the present century.

Causes.—Children in some families are more liable to false croup than in others, so that an hereditary tendency to it must be admitted. The exciting cause in most cases is exposure to cold. False croup is not uncommon in the commencement of measles. Narrowness of the rima glottidis, and an excitable state of the nervous system both of which are common in early childhood, are predisposing causes.

Symptoms.—Spasmodic laryngitis is ordinarily preceded for a day or two by a slight cough and fever, by symptoms of mild nasal catarrh, such as all children are liable to on taking cold. In exceptional cases these symptoms are absent and the disease begins abruptly. Singularly, it commences in most patients at night, after the first sleep, between ten and twelve o'clock. The sleep is usually quiet and natural, but the child awakens with a loud, barking cough. There is great dyspnœa, and the respiration is harsh or whistling, on account of the narrowing of the chink of the glottis from the swelling and tension of the vocal cords. The face is flushed and indicative of suffering. The child cries, moves from one position to another, wishes to be held or carried, seeking in vain for relief. The skin is hot, pulse accelerated, the voice hoarse or even whispering. After a variable period, usually from half an hour to two or three—not more than half an hour with proper treatment—these symptoms abate. The patient is then somewhat exhausted, and falls asleep. The face is less flushed or even pallid, the heat abates, and the pulse is less accelerated. The cough, though less frequent, remains for a time barking or sonorous, and the respiration, though greatly relieved, is not at once entirely natural, but it gradually becomes so. Often there is no return of the spasmodic respiration and cough, but sometimes the attack is repeated once or more, especially during the subsequent nights. The symptoms vary greatly in intensity in different patients.

As the attack declines, the disease, losing its spasmodic character, becomes a simple inflammation. In some patients there is immediate return to perfect health, but oftener the inflammation extends not only into the trachea, but also into the larger bronchial tubes, and there remains a tracheo-bronchitis which gradually declines.

The termination is not always so favorable. Spasmodic laryngitis is, in exceptional instances, the precursor of other serious affections, which may prove fatal. It has been stated that measles often begins with spasmodic laryngitis. Bronchitis becoming capillary, may occur in connection with it, as may also pneumonia, and by either of these severe inflammations the prognosis may be rendered doubtful. There are a few cases on record in which it is believed that spasmodic laryngitis was of itself fatal. In some of these cases the dyspnœa was extreme and persistent, and was the cause of death. In a case reported by Rogery, on the other hand, the respiration became easy before death, and the pulse more and more frequent and feeble. Death apparently occurred from exhaustion. It is not improbable that, had careful post-mortem examinations been made in those cases of spasmodic laryngitis which have ended fatally, other lesions would have been discovered besides those located in the larynx, perhaps tracheo-bronchitis, with an accumulation of mucus in the larynx, producing suffocation, or perhaps in some cases congestion of the brain or lungs and serous effusion.

Anatomical Character—Pathology.—The opportunity does not often occur of determining the anatomical characters of spasmodic laryngitis. I have witnessed but one post-mortem examination. A little girl, nine years old, was taken on Friday night with cough and dyspnœa, indicating a pretty severe attack. The mother, acting through the advice of a friend, gave kerosene oil to her in considerable quantity. This was succeeded by obstinate vomiting and purging, which continued during Saturday and Sunday, and terminated fatally on Monday. At the autopsy we found uniform and intense injection throughout the whole extent of the larynx and trachea and in the bronchial tubes, but there was no pseudo-membrane on the inflamed surface, and but little mucus and pus. The solitary follicles of the intestines and Peyer's patches were tumefied, and the gastro-intestinal surface was injected in places. The cause of death was obviously the diarrhœa, apparently of an inflammatory character, and probably produced by the kerosene oil. The condition of the mucous membrane of the larynx was that which is ordinarily present in spasmodic laryngitis, though in some cases in which post-mortem examinations have been made the evidences of laryngeal inflammation were slight. Guersant relates a case in which the surface of the larynx seemed to be nearly in its normal state. Death in cases of slight laryngitis is due to causes which are independent of the larynx. In Guersant's case there was tuberculosis.

There is, as has already been intimated, another and an important element besides the inflammation in the pathology of spasmodic laryngitis—an element producing those phenomena which render it a disease distinct from simple laryngitis. I refer to spasm of the laryngeal muscles. This element pertains to the nervous system, so that spasmodic laryngitis is allied both to the neuroses and to the inflammations.

Diagnosis.—The disease for which spasmodic laryngitis is most frequently mistaken is pseudo-membranous croup. The friends, indeed, usually make this mistake in forming their opinion of the case before the physician arrives; and there can be no doubt that many of the cases which physicians have published in medical journals as true croup were examples of this affection. The points of differential diagnosis are the following: True croup begins with symptoms which at first are slight, so as scarcely to arrest attention, but which gradually increase in intensity. The cough becomes more harsh, and the respiration more difficult, by degrees. This increase in the gravity of the symptoms occurs by day as well as by night. On the other hand, false croup, though preceded by symptoms of nasal catarrh, commences abruptly. The symptoms have from the first their maximum intensity, and the time at which it commences is the night. Again, the cough in spasmodic laryngitis possesses a loud, sonorous character; while in true croup it is harsh or rough, from the presence of the membrane, and having, therefore, less fulness. The voice in spasmodic laryngitis may be hoarse, but it is not lost, or is lost only for a short time.

It afterwards becomes natural, or is slightly hoarse. On the other hand, in true croup, the voice, from being natural at first, is gradually extinguished. In fatal cases it soon becomes whispering, and continues such till the close of life; in those that recover, the voice remains hoarse for several days. These differences are important, and, if fully appreciated, are in most instances sufficient to establish the diagnosis. Besides, in a large proportion of cases of true croup, portions of the pseudo-membrane may be discovered on inspecting the fauces, and the faucial surface is deeply injected, while in spasmodic laryngitis there is, with rare exceptions, no false membrane upon the surface of the fauces, and but a moderate amount of congestion.

Laryngismus stridulus, or internal convulsions, must not be confounded with this disease. It is not inflammatory, but purely spasmodic, suddenly commencing and abating—identical, it is believed, in character, with tonic convulsions of the external muscles, but affecting the internal muscles of respiration. This disease has already been fully described.

Prognosis.—Little need be added, as regards the prognosis, to what has already been stated. While a favorable opinion in reference to the result may ordinarily be expressed, the physician should not forget the fact that death may occur. Symptoms indicating an unfavorable termination are: great and continued dyspnœa, not diminished by the proper remedial measures; stridulous expiration as well as inspiration; lividity of the prolabia and fingers; pallor and coldness of surface; pulse progressively more frequent and feeble. Convulsions and coma may also occur near the close of life.

Treatment.—The indications of treatment are twofold: first, to relieve the spasmodic action of the laryngeal muscles; secondly, to cure the laryngitis. To meet the first indication, a warm bath of the temperature of about 100° should be employed as soon as possible after the commencement of the attack. The patient should be kept in it ten or fifteen minutes, in order to obtain its full relaxing effect. In mild cases a warm foot-bath may be sufficient. A second means is the use of an emetic, which should be simultaneous with the bath. To children under the age of three years, syrup of ipecacuanha should be given, in doses of one teaspoonful, repeated in twenty minutes, till vomiting occurs; or alum and syrup of ipecacuanha, two drachms of the former to one ounce of the latter, may be given in the same dose. The alum and the syrup produce more prompt emesis than the syrup alone. Children over the age of three years, unless of feeble constitutions, are best treated by the compound syrup of squills in teaspoonful doses, or a mixture of this with syrup of ipecauanha. It is not often necessary to give more than three or four doses, and sometimes one or two are sufficient to produce vomiting.

In most cases, by the use of the warm bath and the emetic, the symptoms are rendered milder, and convalescence soon commences.

In the *American Journal of the Medical Sciences*, April, 1867, Dr. R. R. Livingstone reports a case of laryngitis treated by Squibb's ether. It is stated that portions of pseudo-membrane, from one-eighth to three-fourths of an inch in length, were expectorated; but the symptoms certainly indicated a spasmodic element as decided as in spasmodic croup, and the benefit from the ether was apparently due to the relaxation of the laryngeal muscles which it produced. The treatment of the patient, who was two years old, was commenced by the administration by the mouth of half a teaspoonful of the ether, and followed by its inhalation. "In precisely eight minutes from the time the patient commenced the inhalation, the abnormal muscular exertion ceased; a general relaxation took place; the pulse (which had numbered 150) fell to 100." Ether, judiciously employed, will probably prove to be a useful remedial agent in spasmodic forms of laryngitis, whether or not it has any effect on pseudo-membranous formations. A large majority of cases, however, recover speedily without its employment, or by the other measures recommended.

Attention should always be given to the state of the bowels in spasmodic laryngitis. If they are not well open, a purgative should be administered. For those that are robust, and with considerable febrile movement, the saline cathartics are ordinarily preferable, as Rochelle salts, or a purgative dose of calomel may be administered. The cathartic should not be prescribed till the nausea from the emetic has subsided. By its derivative effect, it tends to diminish the laryngitis, and, in severe cases, it may obviate the need of depletion by leeches.

Inhalation of the vapor of hot water, and the application of a sinapism over the neck and upper part of the sternum, followed by an emollient poultice, are useful adjuvants to the treatment.

The most convenient and effectual way of employing vapor is, however, by the atomizer, and as the chief danger is that the inflammation may become pseudo-membranous, I am in the habit of using in the atomizer lime-water with one-fifth or one-sixth part of glycerine.

When the spasmodic element in the disease is relieved, the case becomes one of simple laryngitis, and the general plan of treatment recommended for that disease is proper for this. Small doses of ipecacuanha, or of one of the antimonial preparations, as the compound syrup of squills, not sufficient to cause nausea, should now be given at regular intervals. I have sometimes added to the expectorant one drop of the tincture of aconite root for robust children over the age of three or four years, having a full and rapid pulse, flushed face, and other evidences of active febrile movement. Its effect should be watched, and it should be discontinued when its sedative influence on the circulation begins to be apparent. It should not be given in the spasmodic laryngitis which occurs in the commencement of measles.

If, however, there is not a speedy termination of the disease by recovery,

or, more rarely, by death, there is nearly always tracheo-bronchitis, or a more serious affection, coexisting with the laryngitis, or following it; therefore, depressing measures should not be long continued. Expectorants of a stimulating character, as carbonate of ammonia, or syrup of senega, are required in the course of a few days, and in young and feeble children they should be given at an early period.

The mode of treatment recommended above is appropriate for that large class in whom the inflammatory element predominates. In a smaller number of cases the nervous element predominates over the inflammatory, and the treatment should be in some respects different. Such children are usually pallid and of spare habit, having, indeed, the nervous temperament. They are liable to attacks of this disease, though generally of a mild form, on slight exposure to cold, and with a very moderate amount of inflammation. The treatment in these cases should be directed more to the nervous system. My plan has been, in the treatment of such patients, after perhaps the use of a mild emetic, to give quinine, one grain three or four times daily, to a child from three to five years old, prescribing at the same time a simple expectorant, as syrup of squills, and a mildly irritating application to the throat. The symptoms in these cases are not severe, and active measures are not required, though the peculiar cough continues longer than in the more inflammatory forms of the disease.

The patient with spasmodic laryngitis should be kept in a warm room during the paroxysms, and should inhale an atmosphere loaded with moisture.

Trousseau recommends a mode of treatment of spasmodic laryngitis which was first suggested by Graves, of Dublin. It consists in the application underneath the chin, so as to cover the larynx, of a sponge soaked in water as hot as can be borne; in ten or fifteen minutes it is repeated. This reddens the skin, producing revulsion from the larynx. The hoarseness, dyspnœa, and cough diminish with this treatment, and some recover without other measures.

Guersant and others speak of the importance of prophylactic management of children who are liable to this disease. Attention should be given to the dress, so that there may be sufficient protection from changes of temperature, and there should be an equable temperature of the apartments in which they reside. Children of a decidedly nervous temperament, in whom the slightest laryngitis is apt to be spasmodic, require additional prophylactic measures. They are pallid, and in a more or less cachectic state. Such children are benefited by chalybeate and vegetable tonics, and by exercise in suitable weather in the open air.

CHAPTER III.

PSEUDO-MEMBRANOUS LARYNGITIS.

The term pseudo-membranous laryngitis, or true croup, is applied to a common and fatal disease, the essential anatomical character of which is inflammation of the mucous membrane of the larynx, with the formation upon its surface of a pseudo-membrane. It occurs most frequently between the ages of two and seven years. It is rare in adult life, and also under the age of six months.

Causes.—There is greater liability to this disease in some children than in others, and occasionally the predisposition to it appears to be inherited. The common exciting cause is exposure to cold. Those children, especially, are liable to croup, who live in heated apartments, and are taken into the open air without proper covering, and those who a part of the time are warmly and a part of the time thinly clothed, especially as regards the covering of the neck. This disease is common among the poor of New York, who live in close rooms, overheated through the day and cool at night. Another less common cause is the inhalation of irritating vapors, or swallowing irritating or corrosive liquids. I have known a child to die from swallowing acetic acid, and another from scalding water, both having the dyspnœa and cough of true croup.

This disease is ordinarily primary, but occasionally it is secondary. The secondary form is not unusual in the declining period of measles, and it is an occasional complication of scarlet fever. Croup is most common in the winter months, and in times of changeable weather. It is said, also, that it sometimes occurs as an epidemic, but it is a question whether the supposed epidemics may not have been diphtheritic.

Anatomical Characters.—The inflammatory action in this malady affects not only the mucous membrane, but, in a certain proportion of cases, extends to the submucous connective tissue, causing infiltration or œdema. The mucous membrane itself undergoes similar alteration to that in simple or spasmodic laryngitis, consisting of hyperæmia and thickening, proliferation, and rapid desquamation of its epithelial cells, and an abundant production of muco-pus. Sometimes the redness is found only in patches at the autopsy; in other cases it extends over the whole surface of the larynx. Exceptionally the redness has disappeared, so that the laryngeal mucous membrane, though thickened and softened, presents nearly its normal color. In all except the mildest cases the inflammation extends

further than the larynx, involving not only the surface of the pharynx, but also in greater or less degree that of the trachea and bronchial tubes.

The distinguishing feature as regards the anatomical character of this disease remains to be noticed, namely, the false membrane which covers the laryngeal and often contiguous surfaces. It has long been supposed that this consists of fibrin, which, exuding in its liquid state from the submucous vessels, becomes fibrillated when exposed to the air, its interstices being filled with a greater or less amount of pus, epithelial cells, and amorphous matter. At a recent date Wagner surprised pathologists by the statements that these pseudo-membranes contain no fibrin, but that they consist of epithelial cells, which, undergoing some form of degeneration as they are pushed forward from the mucous surface, enlarge so as to appear under the microscope as irregular blocks interlacing with each other. By employing the picro-carminate of ammonia, or a weak ammoniacal solution of carmine, Weber and other microscopists have been able to trace the boundaries of these irregular and interlacing blocks, which have prolongations like the shape of a stag's horns, and they have observed the intermediate forms of transition between these and the normal epithelial cells.

But some of the highest authorities in pathological histology, as Rindfleisch, state that they find fibrin in the pseudo-membrane, in addition to the enlarged and degenerated epithelial cells of which it is chiefly composed. Rindfleisch says: "The pseudo-membrane is of a peculiarly stratified structure, since upon a layer of cells at tolerably equal distances there always follows a layer of fibrin, and this sequence is repeated from one to ten times, according to the thickness of the membrane." (*Patholog. Histol.*, translated, page 351.) As lending support to the views that the pseudo-membrane does contain fibrin, the fact may be stated, that while in the ordinary pneumonia of young children there is no fibrinous exudation in the air-cells, this exudation does occur, at least in a certain proportion of cases, in pneumonia occurring as a complication of croup. Thus, recently, in this city, in a pneumonic lung, from a case of fatal croup, occurring at the age of about two years, Prof. Francis Delafield found fibrin in the exudation of the air-cells. The exact nature of the degeneration which the epithelial cells undergo is unknown. Their appearance is so altered by protoplasmic change and infiltration, that they can be recognized as altered epithelial cells only by chemical tests. MM. Cornil and Ranvier state: "We have verified the correctness of the description given by Wagner; we have separated and colored the cells by means of the picro-carminate of ammonia, and, in consequence of the facility which they present of fixing the carmine, we conclude that they are not filled with fibrin, but rather by a matter resembling mucin. These exudats of true croup are pressed forward and detached in proportion as the globules of pus or new epithelial cells are produced underneath them."

In Virchow's Archiv., Band. lxx, 1877, Dr. Carl Weigert relates very interesting experiments in which he produced pseudo-membranous croup upon the laryngo-trachial surface of the rabbit, by applying to it a weak ammoniacal solution. After two days the animal was killed, and the exudation was carefully examined. The mucous membrane underneath the exudation was found hyperæmic, and denuded of epithelium. Weigert, indeed, concluded from his observations, that the croupous membrane does not form, unless the epithelial layer is first destroyed, a point, in reference to which some of the New York microscopists would take issue. The relation of the pseudo-membrane to the mucous surface was simply that of contact. The microscopic examination of the adventitious layer was interesting. Its lowest part contained ill-defined (*informes*) elements, some of which preserved a resemblance to the epithelial cells. By the addition of strong acetic acid, these elements swelled, took the form of epithelial cells and exhibited nuclei. Free nuclei were found in the interspaces, more resembling pus cells or white blood corpuscles than the nuclei of epithelial cells. Therefore Dr. W. concludes that the undermost part of the croupous layer consists mainly of epithelial debris. Secondly, immediately above this he found a different layer consisting of a network of delicate fibres in the meshes of which were free nuclei. This network evidently consisted of fibrin, as it gave the reactions of this substance. Thirdly, penetrating the upper part of the fibrinous network and overlying it was a layer of mucus containing large cells with large nuclei, and grains of black pigment. From all these examinations which have been made by competent microscopists, we must conclude that the croupous exudation consists largely of altered epithelial cells, and that it also contains a network of fibrin.

The pseudo-membrane varies greatly in amount in different cases. It may occur only in points or small patches, which are generally found in the vicinity of the vocal cords, while in other cases it extends an almost continuous membrane from the epiglottis into the bronchial tubes, and there is every grade between these two extremes. It fills the orifices of the muciparous follicles, and the minute depressions upon the mucous surface, being closely adherent, so as not to be detached by efforts of coughing or vomiting, except in small portions.

As the inflammation commonly extends beyond the larynx, so the pseudo-membrane, in a large proportion of cases, is formed not only upon the laryngeal, but also upon contiguous surfaces. In thirty-three cases of true croup, comprised in the statistics of Dr. Ware, of Boston, pseudo-membranous pharyngitis was also present in all but one; and in nineteen cases observed by Dr. Meigs, of Philadelphia, in all but three. The formation of a pseudo-membrane in the trachea in connection with that in the larynx is also common, and is not infrequent in the bronchial tubes. M. Guersant has, so far as I am aware, collected the largest number of

records relating to the extent of the pseudo-membrane in true croup. In an aggregate of 120 cases it was confined to the larynx and trachea in 78, or about two-thirds, while in the remainder, namely, 42, it extended into the bronchial tubes.

In those whose systems are robust, the false membrane is usually firmer than in those whose systems are reduced. In a state of decided cachexia it is sometimes friable and easily detached. If the case continue from four to six days, it begins to soften from commencing decomposition, the minute fibres which attach it to the mucous membrane give way, and, in favorable cases, by the effort of coughing or vomiting, it is thrown off. Separation is aided by muco-pus, which collects underneath. In fatal cases the false membrane, if detached by the efforts of the child, may be reproduced, so that in twelve to eighteen hours the dyspnœa returns. Pneumonia not infrequently complicates croup. In extreme cases, in which inspiration is difficult in consequence of the obstruction, the lungs are only partially inflated, and imperfect decarbonization of the blood and sometimes collapse of certain pulmonary lobules are the result. Occasionally there is that degree of thickening of the mucous membrane, and submucous infiltration, that the dyspnœa and danger occur more from these than from the presence of the pseudo-membrane.

Symptoms.—In some cases, pseudo-membranous, like catarrhal laryngitis, is preceded by coryza and pharyngitis, while in others laryngitis is present from the first. The commencement of croup is indicated not only by fever, diminished appetite, thirst, and such symptoms as accompany all acute inflammations, but by certain other symptoms which serve to distinguish this from all other diseases, except diphtheritic croup.

The cough is one of the earliest symptoms which distinguish true croup from other laryngeal inflammations. It is hoarse or harsh; its character may be expressed by the term dry or suppressed. It differs from the cough of spasmodic laryngitis, which is less hoarse and more sonorous. It is much more frequent in some cases than in others; in many patients, towards the close of life, it nearly or quite ceases. Hoarseness of the voice is also one of the first and most constant symptoms, and it continues throughout. Towards the close of life the voice is usually lost, and the child expresses its thoughts in an indistinct whisper.

The amount of expectoration varies considerably in different patients, according to the presence or absence of bronchial inflammation. If the inflammation extends no lower than the upper part of the trachea, the sputum is scanty during the whole course of the disease. In ordinary cases it is scanty at first, then more abundant, and again more scanty if the case is fatal. The scantiness of the sputum towards the close of life is due not entirely to exhaustion of the patient, but in part to obstruction in the larynx above the mucus and pus. By vomiting a much larger quantity is expectorated than by the cough. Frequently small portions

of pseudo-membrane are expectorated with the mucus and pus, and occasionally also larger masses, complete moulds, indeed, of the larynx, trachea, or even of the bronchial tubes.

The respiration is accelerated, but not so much as in pneumonia or capillary bronchitis. In the advanced stage it commonly becomes slower than at first. As the obstruction in the larynx increases, the respiration assumes more and more the character which has been designated abdominal; the infra-mammary region is depressed in each inspiratory act, while the larynx approaches the sternum, and the alæ nasi are dilated. Patients sometimes have painful attacks of dyspnœa, due to detachment of an edge of the pseudo-membrane, and its doubling upon itself. In the paroxysm, the sufferer throws himself from side to side in the bed, or reaches his arms to his mother or nurse for relief; his eyes are wild, features anxious, and, in severe paroxysms, fingers and prolabia livid. In the interval there is comparative quietude, though the respiration is constantly embarrassed.

The frequency of the pulse varies according to the extent of the inflammation and the stage of the disease. In the commencement of primary croup it ordinarily varies from about one hundred and ten to one hundred and twenty beats per minute. In the course of the disease it becomes more frequent, and towards the close of life feeble.

Now and then a patient presents a remission in symptoms, due to expectoration of membranous shreds and muco-pus, and the friends may think that the danger is passed. Unfortunately the lull in symptoms is in most cases deceitful, as the cause of the dyspnœa is rapidly reproduced. I once attended a case in which there had been such dyspnœa that an unfavorable prognosis was given. An almost complete intermission, however, occurred in the symptoms, with the exception of the febrile movement, so that a physician who visited the patient at this time diagnosticated an essential fever. Within a few hours, the obstruction being reproduced, the symptoms returned with greater violence than ever, and the child died. So complete an intermission seldom occurs in a fatal case; and in most patients, during the time of temporary improvement, there is still such dyspnœa, with the characteristic cough, that the nature of the disease is apparent.

If the stethoscope is applied over the larynx in true croup, the loud expiratory as well as inspiratory sound is heard as the air passes by the obstruction. This sound is often transmitted to every part of the chest, so as to obscure the râles which may be produced there. Auscultation over the chest reveals either the vesicular murmur, perhaps somewhat diminished in intensity, or more frequently the sonorous and afterwards moist râles due to coexisting bronchitis. In a limited number of cases, dulness on percussion is observed at some part of the chest, with bronchial respiration, indicating pneumonia. Recovery from croup is in most patients gradual; the voice becomes less hoarse, the cough looser, and the

dyspnœa ceases by degrees. The structural changes which have occurred in the mucous membrane of the larynx do not disappear till several days after the last pseudo-membrane is detached.

Fatal cases may terminate in two or three days, but their ordinary duration is from five to fourteen days. Death may result directly from the thickness and firmness of the pseudo-membrane, which obstructs the entrance of air. Sudden death in a paroxysm of dyspnœa may occur from the detachment of one end of the pseudo-membrane, and its folding upon itself. In many patients, death is not due so much to obstruction to the entrance of air from the presence of the pseudo-membrane, as to the mucus and pus which collect in the trachea and bronchial tubes, and which are not expectorated on account of the presence of the pseudo-membrane and the feeble expiratory efforts of the child. In a case which was examined after death in the Nursery and Child's Hospital of this city, the false membrane was apparently not sufficient to produce a fatal result, but the air-passages below it were nearly filled with muco-purulent matter, which obstructed the entrance of air.

Pathological Characters.—This disease is then essentially a laryngitis presenting the lesions of a simple though usually severe mucous inflammation, but with a superadded element, namely, the false membrane. The coexistence of catarrhal or pseudo-membranous pharyngitis, tracheitis, and bronchitis is also, as we have seen, common. The impediment to respiration, which renders croup so dangerous and fatal, is due not only to the presence of the false membrane, and to the mucus and pus which collect below it, but also to the inflammatory swelling of the mucous membrane and submucous œdema. In addition, there is a neuropathic element which increases the dyspnœa, and which most observers consider a spasmodic contraction of the laryngeal muscles induced by the inflammation, and hence the easier breathing in sleep, and in the general muscular relaxation, which precedes death. Professor Jacobi (*Amer. Jour. of Obstet.*, etc., N. Y., May, 1868), however, holds that the state of these muscles is one of paralysis rather than spasmodic contraction. In his opinion, this paralysis "is secondary. It depends on the œdematous soaking of the posterior crico-arytenoid muscles following the œdema of the mucous membrane of the crico-arytenoid folds."

In several fatal cases which I have had an opportunity to examine after death, I have found the appearance of the lungs quite uniform. They were reduced in volume (semi-collapsed) and more or less congested. Certain parts distant from the bronchi, especially the edges and thin portions, were collapsed completely, and certain lobules also hepatized. I have also observed, though in some of the cases my attention was not directed to it, distension of the right cavities of the heart, with blood, and large thrombi. From the nature of the disease, the blood is less oxyge-

nated, and somewhat darker than in those who die of diseases not involving the respiratory apparatus.

Diagnosis.—The diagnosis of true croup is ordinarily easy. It might be mistaken for spasmodic laryngitis, but more frequently spasmodic laryngitis is mistaken for it. The differences which will aid in differential diagnosis are the following: Commencement abrupt and at night in one, gradual in the other; presence in one, absence in the other, of a pseudo-membrane upon the surface of the fauces; fragments of the membrane in the sputum in one; character of the cough; course of the disease growing gradually worse in one, in the other, with few exceptions, rapidly improving. Trousseau speaks of the liability to error of diagnosis in those cases in which spasmodic laryngitis is associated with pseudo-membranous pharyngitis. Few physicians hesitate to designate as true croup those cases in which there is a croupal cough in connection with false membrane upon the surface of the fauces, and yet the laryngitis under such circumstances may be merely spasmodic. This coexistence of pseudo-membranous pharyngeal and of spasmodic laryngeal inflammation is, however, probably rare, but its occasional occurrence should be borne in mind.

True croup is readily distinguished from laryngismus stridulus, or internal convulsions. Laryngismus stridulus is a purely nervous affection; it occurs suddenly, causing great dyspnœa, or momentary suspension of respiration, without the fever and without the hoarse voice and cough of croup. When muscular relaxation occurs, the attack ceases. The difference between the two diseases is therefore obvious.

Prognosis.—The great mortality from true croup is universally known, and those physicians who report a large number of favorable cases have probably mistaken spasmodic croup for this disease. According to the statistics of Dr. Ware, nineteen out of twenty die; but with the modern mode of treatment, begun early, the proportionate number of recoveries is probably larger than this estimate. Increase of dyspnœa, cough and voice becoming more hoarse, and the pulse more accelerated, indicate a fatal form of croup. The occasional temporary improvement due to the expulsion of a portion of the membrane, may lead, as we have seen, to error of prognosis. However improvement continuing more than twelve hours is evidence of the decline of the malady. The near approach of death is shown by lividity with great restlessness, or pallor with somnolence. If the patient recover from croup there often remains more or less bronchitis or broncho-pneumonia, which requires treatment, and the laryngitis, when its pseudo-membranous character is lost, persists for a time, causing more or less hoarseness, and increase of temperature.

Treatment.—The importance of early treatment has been sufficiently alluded to, for if croup have continued two or three days, when first recognized, the chance of recovery is greatly diminished. As the danger is from the presence of the adventitious layer, measures should be immediately

employed to prevent as much as possible its further formation, and remove that already formed.

Emetics, which have been largely employed in times gone by, should, as a rule, be employed only in the beginning of croup, and those employed which are attended with least depression; for the strength should be preserved, in order that the cough may continue strong, and sufficient to expel any portion of the membrane which may loosen. Moreover it is impossible in localities where diphtheria is endemic, to distinguish at the bedside membranous from diphtheritic croup, and depressing remedies in the latter accelerate, as all know, the fatal result. The emetic causes the expulsion of a considerable quantity of mucus, which is found in the matter vomited, and it may cause the detachment and expulsion of the softer portions of the pseudo-membrane. Syrup or wine of ipecacuanha may be given, and repeated after fifteen minutes once or twice, if necessary, provided that the previous health of the child has been good, and he is robust. The sulphate of copper in two-grain doses given alone, or in suspension with syrup of ipecacuanha, acts promptly, and with little depression. There is, in most cases, more or less relief after the emesis, though it may be only temporary. In one case, in my practice, in which there were at my first visit dyspnœa, croupy cough, and a pseudo-membrane over each tonsil, and in which I had made an unfavorable prognosis, the parents, observing the good effects of an emetic containing two grains of sulphate of copper and two of pulverized ipecacuanha, repeated the medicine, contrary to my directions, at intervals of two to four hours till the following day, and the patient recovered. Probably, however, in ordinary cases the best emetic is the yellow sulphate of mercury prescribed in powder in two-grain doses. The use of this emetic in croup was prominently brought to the notice of the profession in New York City by Prof. Fordyce Barker, who prescribes it immediately on being summoned to a case, and he states that he has not lost a patient thus treated in several years. With or without the emesis other measures are urgently demanded. The profession long sought for a remedy, which taken internally, might, by its effect on the blood or the inflamed surface, prevent or diminish the membranous formation, and also for a remedy which, employed topically, might liquefy and remove it. Calomel has been much used in times gone by for its supposed "antiplastic" action, and more recently chlorate of potassa and muriate of ammonia, as in the following formula:—

℞. Potas. chlorat., ʒi;
Ammon. muriat., ℈ss;
Syr. simplic., ℥ss;
Aquæ, ℥ij. Misce.
Give one teaspoonful every half hour or hourly.

Since the discontinuance of the calomel treatment this mixture has been

largely used in New York, but it is now being superseded by the atomizer, or it is employed along with the atomizer.

The atmosphere which the child breathes should be constantly loaded with moisture, without, however, that degree of heat which would add materially to the discomfort of the patient. Moist air coming in contact with the inflamed surface promotes expectoration, and renders the cough looser. A temperature of 80°, if the atmosphere is loaded with moisture, is more readily tolerated than a lower temperature with a dry atmosphere, and a temperature as high as 75° to 80° is required, or too much of the steam is deposited.

Of late years a very important instrument has been employed in the treatment of acute laryngitis, whether croupous or diphtheritic, and since vapor inhaled comes directly in contact with the exudation and the inflamed mucous membrane, the proper use of the atomizer is the most important and useful therapeutic measure yet employed to control this dangerous malady. The steam atomizer is preferable to that employed by hand, since a steady and full stream of vapor is produced by means of the spirit-lamp, and without the necessity of maintaining an uncomfortably high temperature in the room. Lime-water is the most efficient solvent of the pesudo-membrane which can be safely employed, and I prefer using it with glycerine in the officinal strength, or in double the officinal strength, as in the following formula :—

℞. Calcis, ℥ss ;
Aquæ, ℥viij ;
Glycerinæ, ℥ij. Misce.

That nothing may be left undone, I have been in the habit of employing each second hour in the atomizer one ounce of the following, which occupies not more than fifteen minutes, the lime-water being used constantly between-times :—

℞. Potas. chlorat., ℥ij ;
Ammon. muriat., ℥j ;
Glycerinæ, ℥ij ;
Aquæ, ℥vj.

If the croup is not too far advanced, the atomizer thus employed commonly renders the cough looser, the voice clearer, and respiration easier. And under its use, more than from any other treatment, we are gratified by observing the expectoration of croupous fragments. I am convinced, from my observations, that the necessity for tracheotomy might often be avoided, and many lives saved, by the early and continued use of this simple instrument. The inhalation may be continued for hours without wearying the child. A saturated atmosphere, while it may cause swelling of the croupous layer, also renders it more friable and more easily expectorated.

In order to reduce the temperature, and at the same time to sustain the strength, quinine should be employed. If the temperature is high, it should be given in two or three large doses. As an antipyretic it is to be greatly preferred to veratrum viride, aconite, or any other agent. If the fever is moderate, a smaller dose is preferable, repeated every three or four hours.

It is to be recollected, in the treatment of croup, that the pseudo-membrane, by commencing decomposition, and by the pus and mucus which collect underneath, is more easily detached after a few days, if the patient lives, than at first. Therefore the physician should endeavor to sustain the vital powers, in order that the cough may have sufficient force to separate this substance as soon as its fibres of attachment begin to loosen. A patient with croup rarely takes solid food, but he should be allowed beef-tea, milk, and farinaceous drinks, at short intervals. If there are signs of exhaustion, alcoholic stimulants are proper, and fresh air should also be allowed so far as is compatible with the inhalation of steam.

As regards external treatment of the throat the late Professor Peaslee, of this city, in a series of papers on the pathology of croup, published in the *American Medical Monthly*, 1854, says of cold applied externally: "We consider this of the greatest value and importance. If cold applications are efficacious in all cases of external inflammation, they are scarcely less so here, where the inflamed surface is so nearly superficial. Cold must, however, be continuously applied to produce the desired effect. Applied at intervals, indeed, it rather promotes than retards the inflammatory process; since during the intervals the temperature rises above the normal standard, in consequence of the reaction of the chill on the surface.

"Cold water may be constantly dropped from a sponge upon a compress laid over the throat of the child; and the latter should be of only one or two thicknesses of linen, that evaporation may go on as rapidly as possible."

In ordinary cases cold applied over the larynx is, in my opinion, preferable to poultices or warm applications. Two or three thicknesses of muslin soaked with camphorated oil may be applied over the larynx, so as to cover the neck in front, and over this a bladder containing pieces of ice, or ice surrounded by oil silk, to prevent dripping, be constantly retained. Ice is, I think, better tolerated when applied in this way than where there is no intermediate substance. This mode of applying cold I have found more convenient than that recommended by Prof. Peaslee. The temperature of the neck may be kept constantly below the normal standard by ice thus applied. Cold is especially serviceable if the child is robust, with flushed cheeks and full and rapid pulse. In secondary croup, or croup occurring in feeble states of system, or presenting a subacute character, poultices or fomentations to the neck, with moderate counter irritation, sometimes give most relief.

Unfortunately, as I have already stated, true croup is, in a large proportion of cases, a progressive disease. The hoarseness of the cough and voice and the dyspnœa gradually increase. The pulse, becoming more frequent and feeble, indicates the need of the most nutritious food, as the animal broths, and of alcoholic stimulants. The danger is, however, from the dyspnœa rather than asthenia. But if other measures fail to give relief shall tracheotomy be performed? In the cities where companies provide oxygen, in portable apparatus, prepared for inhalation, this agent will be found to relieve greatly the dyspnœa, and increase the chances of a favorable result. In New York it is often employed, and with much relief of suffering.

The published statistics relating to tracheotomy in croup are to a considerable extent unsatisfactory, since we are not informed, as regards most of them, at what stage of the disease the operation was performed, and what were the evidences of a fibrinous exudation. The most valuable and reliable statistics bearing upon this subject, so far as I am aware, are those published by Prof. Jacobi, of this city, in the *American Journal of Obstetrics*, etc., for May, 1868, and containing the results of the cases which were operated on by himself and Drs. Krackowizer and Voss. These gentlemen are known to the profession of New York as careful and judicious practitioners, not likely to operate when there was probability of success by therapeutic measures, and not likely to mistake simple or spasmodic laryngitis for true croup. I have tabulated the statistics of their operations. But it is evident, at a glance, that these statistics are only approximately correct, as showing the proportion of recoveries and deaths, after the operation in membranous croup, as certain cases of diphtheritic croup have been included.

Age.	Number.	Recovered.	Died.
Under 2 years,	8	1	7
From 2 to 3 years,	29	5	24
" 3 to 4 "	26	4	22
" 4 to 5 "	34	11	23
" 5 to 6 "	9	2	7
" 6 to 7 "	1	1	0
" 7 to 8 "	3	0	3
10 "	1	0	1
Not given,	55	15	40
	166	39	127

Time of death after operation.	Number of cases.	Time of death after operation.	Number of cases.
Within 24 hours,	19	On 5th day,	9
On 2d day,	7	" 6th "	4
" 3d "	16	" 7th "	2
" 4th "	15	" 9th "	1
		From 10th to 31st day,	5
Total,			78

The following were the causes of death, as given in the records of seventy-three cases :—

In Operation,	1	Pneumonia,	5
Apnœa from too late operation,	6	Broncho-pneumo. and pul. gangrene,	1
Apnœa,	3	Pulmonary œdema,	1
Anæmia and exhaustion,	4	Pseudo-membranous bronchitis,	18
Diphtheria,	8	Tuberculosis,	1
Bronchitis,	6	Convulsions,	2
Broncho-pneumonia,	15	Emphysema,	2
Total,			73

The following table gives the result of tracheotomy in one hundred cases. It is prepared from the statistics of Güterbach, lately published :—

Age.	Result.
Under 1 year,	1 case fatal.
Between 1 and 2 years,	1 "
" 2 and 3 "	$33\frac{1}{3}$ per cent. recovered.
" 3 and 4 "	40 " "
" 4 and 5 "	$38\frac{8}{13}$ " "
" 5 and 6 "	$44\frac{4}{9}$ " "
" 6 and 8 "	$14\frac{3}{7}$ " "
" 8 and 9 "	25 " "

From conversations which I have had with surgeons of New York, I am persuaded that the above tables present a more favorable result than could be furnished by the general surgical practice of this city. Most New York surgeons, however, seem to shun the operation and regard it with ill favor, and, did they operate as frequently as those whose names I have mentioned, possibly the result would be better. Statistics in Paris probably give nearly the true proportion of successful and unsuccessful operations of tracheotomy for croup, as it is performed by skilful and careful surgeons. Of 388 cases occurring in the practice of several Parisian surgeons, 346 died and 42 recovered; while in the Hôpital Sainte Eugenie, of 374 operated on, 310 died. (Bouchut.)

The facts in reference to tracheotomy in croup are the following: The majority of those operated on do not recover, but some live who without the operation would die. The operation is now more successfully performed than formerly, as the conditions of successful operation are better understood. Those who have operated several times, confess that their last cases did better than their first. Trousseau's experience was striking and instructive in this respect. No one, probably, ever performed this operation for croup more times than he, and, from constantly greater success, he became more and more an advocate of the operation. Tracheotomy, if properly performed, does not in any case shorten life, but it frequently prolongs it several days. It diminishes greatly the dyspnœa, and renders death easy.

The objections to the operation are partly of a moral nature. The parents, already in the extreme of grief on account of the suffering and probable death of the child, consent with reluctance to an operation which promises not cure, but a prolongation of life. Common sympathy with the child and regard for the emotions of the parents should certainly have an influence in deciding for or against the operation. The first case of tracheotomy which I witnessed was such as, if common, would condemn this operative measure entirely. No anæsthetic was given, and, in the midst of the struggles of the child, large veins were severed, from which an abundant hemorrhage occurred. The trachea was opened, but this was no sooner done than death occurred, partly from the loss of blood, and partly from the obstruction to respiration caused by its entrance into the bronchial tubes. Such cases are, however, quite exceptional. Death rarely occurs during the operation, unless the patient is already moribund, and the possibility of such a result should have little weight in our decision for or against the operation.

Few will deny, in the light of statistics, that tracheotomy is, in certain cases, proper, and that a physician at times would be culpable if he did not strongly urge its performance. There are certain supposed contraindications. One is age less than two years. It is true that those under the age of two years are less likely to recover after the operation than those above that age; still, tracheotomy has now and then saved the lives of the youngest infants who have croup. The possibility, therefore, of success justifies the performance of the operation, however young the infant, when the only alternative is death. In the foregoing statistics it is seen that one of eight recovered who were under the age of two years.

The presence of capillary bronchitis or pneumonia does not positively contraindicate tracheotomy, though it diminishes greatly the chances of a favorable issue. Nor is tracheotomy forbidden by the extension of the false membrane into the bronchial tubes, since it diminishes the amount of obstruction along which the air passes in order to reach the lungs, and the muco-pus as well as pseudo-membrane, lying below the point of operation, may be expectorated through the aperture. A decidedly asthenic state, as after measles or scarlet fever, indicated by feeble pulse and other symptoms of exhaustion, may or may not contraindicate the operation, whether the pseudo-membrane is limited to the larynx and trachea or is more extensive.

The manner of performing tracheotomy and the subsequent treatment pertain to surgery, and are described in surgical works. A skilful surgeon should, indeed, be employed to perform the operation when it is practicable. At what time in the course of the disease tracheotomy should be resorted to is an important practical question. Trousseau at one time recommended it as soon as there were certain evidences of the presence of

a pseudo-membrane, but in the latter part of his life he did not operate so early. The correct rule, in my opinion, is not to operate till there are signs that the blood is not sufficiently oxygenated, such as lividity of the prolabia and tips of fingers. When these signs occur, it is unsafe to delay long. The arrangements should be previously made, that no time be lost.

It is an interesting fact that a large proportion of those who die after tracheotomy, die of bronchitis, usually capillary, or of pneumonia developed after the operation. These diseases seem to be partly attributable to the operation, or, if previously existing, to be aggravated by it. It is believed that the introduction into the bronchial tubes and the lungs of cool air, of air not warmed by the natural circuit through the nostrils and larynx, may be a cause of these inflammatory complications. Sometimes, also, the canula by pressure increases the inflammation of the surface on which it lies. Therefore, not only does the operation require skill in its performance, but much of its success depends on the subsequent management. After the operation, the temperature of the apartment should be kept constantly at from 85° to 90°, and loaded with moisture. This obviates in part, but only in part, the tendency to bronchitis and pneumonia. Constant attention should be given to the canula, to prevent its filling with mucus and pus. Most surgeons use a double canula, which can be readily cleaned by removing the internal cylinder. The nurse, when properly instructed, can remove this cylinder as often as may be necessary in order to clean it. Mr. Lawrence, of London, and, following him, some other surgeons, prefer not to use the canula. The edges of the wound are kept apart by a wire which passes around the neck, or a little of the trachea is removed so as to produce a sufficient aperture. The reader is referred for particulars regarding this mode of operating to recent treatises on operative surgery.

After the operation no more medication is required. The patient should be kept quiet and free from excitement. His diet should be mainly liquid, and of the most nourishing character. In a few days, if the symptoms abate, the aperture may from time to time be closed with the finger after the withdrawal of the canula, in order to ascertain if the larynx is free from obstruction. If bronchitis or broncho-pneumonia arise, the oil-silk jacket, with counter-irritation to the chest, is required, and quinine, digitalis, carbonate of ammonia, and alcoholic stimulants should be ordered.

CHAPTER IV.

BRONCHITIS.

Inflammation of the bronchial tubes, or bronchitis, is probably the most frequent disease of early life. It is usually associated with more or less inflammation of the mucous membrane of the nostrils, larynx, and trachea. We designate the disease coryza, laryngitis, or bronchitis, according as one or the other inflammation predominates. Sometimes bronchitis occurs with but slight inflammation elsewhere, and often the coryza and laryngitis abate while the bronchitis is still active.

Bronchitis occurs both as a primary and secondary disease. The secondary form is common in connection with measles, hooping-cough, pneumonia and pulmonary phthisis, and it is not uncommon in scarlet fever, variola, remittent and continued fevers. Bronchitis is acute, subacute, or chronic, and according to its extent it is mild or severe. If the smallest bronchial tubes are involved, the inflammation is designated capillary bronchitis, a term not well chosen, but which it is convenient to employ in a description of the malady. Bronchitis is commonly bilateral, affecting the tubes on the two sides with about equal intensity. When due to tubercles, or to pneumonia, it is apt to be unilateral, being confined to those tubes or nearly to those which are surrounded by tubercular or inflammatory product.

Causes.—The causes of secondary bronchitis are obviously the diseases in connection with which it occurs. The cause of primary bronchitis is the same as that of simple acute laryngitis or coryza, namely, sudden change of temperature from warm to cold, exposure to currents of air, the practice of sending children without sufficient clothing from heated rooms into the open air, the throwing off of bedclothes at night, etc. Dentition is also an occasional cause, since some children have attacks which coincide with the eruption of the teeth. The cough of dentition is usually purely a nervous affection; but in other instances it is accompanied by more or less mucous secretion, and is evidently dependent on a mild catarrh.

Anatomical Characters.—In the most common form of bronchitis, the larger bronchial tubes only are affected. They are the seat of the inflammation in most of those cases which are designated "colds" by families, and which are often treated without the aid of the physician. The lining membrane of the bronchial tubes presents the ordinary anatomical characters of mucous inflammations. It is reddened uniformly or in patches,

intensely, or in that milder degree known as arborescence, according to the severity of the inflammation.

The secretion of the muciparous follicles is at first arrested, and the surface of the membrane is dry. In the course of a day or two the secretory function is re-established, and the surface is covered with thin and transparent mucus. A day or two later, the secretion becomes thicker, consisting of mucus and pus. Mixed with these substances are epithelial cells, which are exfoliated in abundance from the inflamed surface. At the same time the mucous membrane becomes thickened and more or less softened. If the inflammation is severe, the vessels of the submucous connective tissue are also injected.

Usually, in about a week in the young child, in from one to two weeks in older children, the inflammation begins to abate. Gradually the inflamed membrane returns to its normal consistence, thickness, and vascularity, and with this return to the healthy state the muco-purulent secretion abates.

In this, which is the simplest form of bronchitis, and most common, there is no ulceration, and rarely any pseudo-membranous formation, if the disease is idiopathic. Pseudo-membranous bronchitis is not unusual as an accompaniment of pseudo-membranous laryngo-tracheitis.

Were bronchitis limited to the larger bronchial tubes, it would indeed be a simple affection, but unfortunately it has a tendency to extend downwards. Commencing in the larger, it gradually invades the smaller tubes in a similar manner to the extension of erysipelas upon the skin. More rarely the inflammation commences simultaneously in the larger and smaller tubes. Now the gravity of bronchitis is proportionate to the degree of its extension downwards. It may stop at any point in its progress, but if it reach the smaller tubes it is one of the most serious affections of early life.

The mucous membrane of the minute tubes, those next to the air-cells, is delicate, with but little submucous connective tissue, and it frequently, at post-mortem examinations, does not present to the eye those distinct inflammatory changes which are observed in tubes of large diameter. It is sometimes not notably thickened, nor its vascularity much increased, even when there is reason to believe from the symptoms that it was the seat of active phlegmasia. As we pass from these minute tubes to those of larger calibre, the inflammatory lesions become more distinct. The inflammation produces minute and abundant points of redness, and the membrane is evidently thickened; often it is rough or granular.

The minute bronchial tubes are very small, especially under the age of three years, and since in capillary bronchitis a large proportion of them are inflamed, the source of the danger is apparent. It is with difficulty that the patient with capillary bronchitis can, by the effort of coughing, free the tubes from the secretions which are constantly collecting in them.

In weakly children, under the age of two years, expectoration is most difficult, and hence the great and increasing dyspnœa from which such patients suffer.

In severe and unfavorable cases of bronchitis, which are chiefly those in which the small as well as large tubes are inflamed, the following anatomical changes commonly occur: The muco-purulent secretion, which is tenacious, collects more rapidly in the smaller tubes than it is expectorated by the child, whose strength begins to be exhausted. The accumulation of the secretion is chiefly in the tubes which lie in the posterior and inferior portions of the lung. As the obstruction from the muco-pus increases in these tubes, less and less air passes through them into the alveoli with which they communicate, while the quantity of air which passes through the unobstructed tubes into the anterior and superior portions of the lung is proportionately increased. The effect, as regards the state of the lung, is obvious. In cases having a fatal issue, and in which we are therefore able to inspect the lesions, we find that the lower and inferior portions of the organ, from which air was to a greater or less extent excluded, have a diminished crepitation, that they lie a little below the general level, or that certain lobules do, and that they present a congested appearance, for while they contain too little air they have an excess of blood. We shall also find that the upper and anterior parts of the organ, perhaps the entire upper lobe, contain more than the normal quantity of air, so as to rise above the general level. There is distension of the alveoli in these parts, so that they are probably visible to the naked eye, and may appear to be emphysematous, but this is a state distinct from emphysema. It is merely an inflation of the alveoli to nearly their full capacity.

Here and there, in the portion of lung in which the inflation has been incomplete, lobules may be observed which are entirely collapsed, having a dusky red color and no crepitation; while in other parts, if the bronchitis has continued some days, there may be nodules of pneumonia. The incised surface of those portions of the lung to which the access of air has been prevented, whether they are collapsed fully, or partially, or not, has a reddish color from congestion, and is moist from serum and blood. On compressing the lung, the muco-purulent secretion appears upon the surface in points, having escaped from the divided ends of the tubes. For other facts relating to atelectasis, the reader is referred to the chapter in which this malady is described.

Exceptionally even when not accompanied by laryngeal croup, fibrinous exudation occurs in the bronchial tubes, forming a delicate film, here and there, and readily detached from the surface underneath, while in rare instances it occurs as a firm and continuous membrane, forming a mould of the tubes, increasing greatly the dyspnœa, and constituting a true bronchial croup. If the patient with capillary bronchitis survive, the

inflammation of the mucous membrane soon begins to abate. The tubes which have been the seat of the disease, and the alveoli which have been secondarily involved, may return to their normal state almost immediately; but in other instances such anatomical changes occur in them, even when there is no pneumonia, nor atelectasis, that full restoration to their normal state is necessarily somewhat slow. When the function of a lobule ceases, as it does when the tube leading to it is obstructed, not only hyperæmia occurs with or without collapse, as already stated, but its cells and nuclei, and perhaps other parts, begin to undergo fatty degeneration. These elements become granular, somewhat enlarged and opaque, and here and there mixed with them are other large cells filled with oil-globules. These are the compound granular cells of pathologists, and, occurring in this situation, are produced by metamorphoses of the epithelial cells. They are epithelial cells which have progressed more rapidly than others in fatty degeneration, having reached that stage of it which immediately precedes liquefaction. We often with the microscope observe not only these corpuscles, but their fragments as they are dissolving.

Minute abscesses, usually directly under the pleura, have occasionally been observed at the autopsies of those who have recently had capillary bronchitis, and pathologists are not agreed as to the mode in which they are produced. Some of them, if not all, are evidently connected with the minute bronchial tubes, and the quantity of pus contained in each is not usually more than one or two drops. The most reasonable view of their causation is that they are produced in the terminal tubes where the mucus and pus collect. The pus acts as an irritant and causes inflammation, and the inflammation increases the quantity of pus. The walls of the tube which is now the seat of an abscess are destroyed by ulceration, and probably, also, some of the contiguous air-cells. The little cavity is soon surrounded by a delicate membrane, the same in character, though less thick and firm, as that which constitutes the walls of larger abscesses. The pus presents the usual appearance of this liquid, or it may be tinged by the presence of blood-cells, or again it may be thick from partial absorption of the liquor puris so as to resemble softened tubercle.

The abscess is ordinarily located in the centre of a collapsed lobule. In certain cases it approaches the surface of the lungs, so as to produce circumscribed pleurisy, with adhesion of the costal and visceral pleura. At the autopsy of such a case, on separating the adhesions and attempting insufflation, the air passes through the aperture, so that the lung on that side cannot be inflated unless the aperture is closed. Occasionally pneumothorax results from opening of the abscess into the pleural cavity.

In severe protracted bronchitis dilatation of certain of the bronchial tubes sometimes results. The alveoli in the upper lobes may also be distended beyond their physiological capacity, so as to produce emphysema, but as we have stated above, their maximum distension within physiolo-

gical limits, must not be mistaken for emphysema. Emphysema in the upper lobes is common in feeble young children, with relaxed and weakened tissues, occurring even without any severe disease of the respiratory organs. It may be vesicular or interstitial. If it is interstitial the sacs of air often attain considerable size, lying as wedges between the alveoli, or like little bladders upon the surface of the lung. It is not difficult to understand how emphysema occurs in capillary bronchitis, since the air partly arrested in the tubes leading to the lower lobes enters the upper lobes in increased volume and force.

Symptoms.—It is evident, from the description which has been given of the anatomical characters of bronchitis, that its symptoms vary greatly in severity in different patients. It usually commences with more or less coryza. The symptoms are headache, flushed face, elevation of temperature, acceleration and fulness of pulse. In the mildest cases these symptoms are scarcely appreciable. The child is observed to sneeze and have some defluxion from the nostrils, and this is followed by an occasional mild, almost painless, cough, which declines in the course of a few days. The respiration and pulse are scarcely accelerated, and the appetite is but slightly impaired. There may be a little fretfulness, but the child is not confined to his bed or room, and usually amuses himself with his playthings. Auscultation in these mild cases reveals coarse mucous râles in the larger bronchial tubes, while the smaller tubes are free from mucus. Sibilant and sonorous râles are also observed, especially in the commencement of the bronchitis, at which time the secretion of mucus is suppressed or scanty. The cough in the commencement is for the same reason dry. It becomes looser by the second or third day, the sputum consisting of frothy mucus, with the admixture of pus and epithelial cells. The pus becomes more abundant as the disease continues. Expectoration from the mouth does not usually occur till after the age of four or five years; under this age the sputum is ordinarily swallowed.

The mild form of bronchitis described above, that in which only the larger bronchial tubes are affected, is common at all periods of infancy and childhood, but a severer grade of the disease is also of common occurrence, exclusive of those cases in which the minute branches of the bronchial tree are affected. It has already been stated that there is a tendency in bronchial inflammation to extend downwards, and symptoms are proportionate in gravity to the degree of this extension. In severe bronchitis the pulse rises to 120 or 130 per minute, and the respiration is in a corresponding degree accelerated. The cough is frequent and painful, the pain being referred to the sternum, and often there is a steady dull pain in this region. The face is flushed and indicative of suffering, the temperature is considerably elevated, and the appetite is greatly impaired or lost. There is frequently an exacerbation of symptoms in the latter part of the day. De-

pression of the infra-mammary region during inspiration, and dilatation of the alæ nasi, accompany grave attacks o the inflammation.

Auscultation in severe bronchitis reveals the presence of râles in all parts of the chest, sibilant and sonorous sparingly, coarse mucous and subcrepitant more abundantly.

Capillary bronchitis or suffocative catarrh, the most dangerous form of this inflammation, is less frequent than bronchitis, which is limited to the larger tubes, or to the larger tubes and those of medium size. It may commence quite abruptly, but ordinarily it results from the milder form of the disease. The symptoms at first are such as occur in the common form of bronchial inflammation, but instead of abating or remaining stationary, they gradually increase in severity till, suddenly, marked dyspnœa supervenes. The inflammation has now reached the minute tubes, and what promised to be an ordinary attack of bronchitis becomes one of great severity and danger.

The respiration in *capillary* bronchitis is short and hurried. Sixty to eighty inspirations per minute are not infrequent, while the pulse also is greatly accelerated, attaining as high a number as 140 to 160 or 180 beats per minute. The cough is frequent, and the sputum, which collects in abundance, is expectorated with difficulty. If expectorated so as to be examined, it is found to consist largely of frothy mucus with epithelial cells. After a few days, if the patient live, it becomes more purulent. Sometimes, as in bronchitis of the adult, streaks of blood appear upon the mucus. In the first days of capillary bronchitis, the temperature is considerably elevated, the face flushed and indicative of suffering. The patient is restless, moving from one part of the bed to another, seeking in vain for relief. The digestive function is impaired, as in all severe inflammations; the tongue is moist and covered with a light fur; the appetite is nearly or quite lost. The nursing infant nurses with difficulty, frequently relinquishing the breast on account of the dyspnœa; older children take no solid food in consequence of the anorexia and the dyspnœa, and even drinks are swallowed hastily and apparently without relish, since deglutition interferes with respiration. On auscultation in capillary bronchitis, at first sibilant, and after a day or two subcrepitant, râles are observed in every part of the chest. Percussion elicits a good resonance, unless the substance of the lung has become involved. As the disease approaches a fatal termination, the pulse becomes greatly accelerated, the respiration is also in a corresponding degree frequent and panting, the inspiration being accompanied by marked infra-mammary depression and dilatation of the alæ nasi. The face becomes pallid, the prolabia livid, and the tips of the fingers livid and cool. The mucus and pus, accumulating in the air-passages, increase more and more the obstruction to the entrance of air, and, finally, death occurs from apnœa. The nursing infant usually ceases to nurse for several hours before death, and a state of stupor commonly pre-

cedes the fatal event, due to the accumulation of carbonic acid in the blood. In young infants, especially those under the age of six months, not only in capillary bronchitis, but in severe ordinary bronchitis, I have often observed, toward the close of life, intermission in the respiration. It occurs after every six or eight or ten respirations, and equals in duration the time occupied in, perhaps, half a dozen respiratory movements. It is, therefore, an unfavorable prognostic, but some recover by stimulation in whom it occurs.

The duration of acute bronchitis varies according to the extent of the inflammation. In the mildest form, the patient is convalescent after three or four days, and, in severer forms that terminate favorably, the disease begins, ordinarily, to decline by the close of the first week or in the second. The progress of bronchitis is somewhat more rapid in young children than in those of a more advanced age. When convalescence is fully established, it is not unusual for the cough to continue three or four weeks, though gradually declining. It is loose and painless, and is scarcely regarded by the patient.

Death sometimes occurs as early as the second or third day in capillary bronchitis. The younger the infant, with the same extent and intensity of inflammation, of course the sooner the fatal result. The ordinary duration of fatal bronchitis is from six to eight days. If the patient pass beyond the tenth day, decline of the inflammation may be confidently expected, and recovery, unless there is a complication.

Occasionally bronchitis becomes chronic, lasting several months before it entirely ceases. The *chronic* form may result from mild, as well as severe, bronchitis. The active fever and accelerated respiration which characterize the acute affection abate, and the general health is nearly or quite restored; but an occasional cough continues, and the respiration is often audible, from the mucus which collects in the tubes, or from thickening of the mucous membrane. Sometimes there is moderate febrile movement, especially in the latter part of the day. On auscultation, coarse mucous, with perhaps sibilant and sonorous, râles are observed in the chest.

There is great liability in chronic bronchitis to exacerbations. The disease often seems to be abating, and there is prospect of its speedy cure, when all the symptoms are intensified. The exacerbations are due to the fact that the bronchial surface, when it has been a considerable time inflamed, is very sensitive to the impression of cold. Even when the disease is entirely relieved, it is very apt to return by exposure to currents of air or changes of temperature. Chronic bronchitis occurs most frequently in the winter and in the spring and fall, when the weather is changeable, and is most intractable in these periods of the year. Many cases of chronic bronchitis are associated with dilatation of the bronchial tubes or with emphysema. The general health in chronic bronchitis, when not

dependent on a tubercular deposit, ordinarily remains good. Tubercular bronchitis, which is the result of a grave disease, does not require separate consideration. It is attended with emaciation, and is obstinate on account of the nature of the primary affection. It is due to the irritating effect of tubercular matter lying against the bronchial tubes.

Diagnosis.—Bronchitis can ordinarily be diagnosticated by the character of the respiration and cough. The absence of hoarseness, stridulous inspiration, and croupy cough, excludes laryngitis; and the absence of the expiratory moan and of the stitchlike pain on coughing, which characterize pneumonia and pleurisy, excludes those diseases. Accurate diagnosis, however, can be most readily made by percussion and auscultation. Examination of the chest enables us to state with positiveness, not only the nature, but the extent of the affection. If the inflammation is confined to the larger bronchial tubes, coarse râles are discovered in them, while finer mucous râles are absent. If the bronchitis is capillary, subcrepitant râles are discovered in the smaller tubes. Percussion gives clear resonance on both sides, except in those instances in which collapse or pneumonia has supervened.

Prognosis.—Bronchitis, limited to the larger bronchial tubes, or to these and those of medium size, terminates favorably in a large majority of cases. Occasionally, severe inflammation, not extending to the smaller tubes, proves fatal in young infants, or those of feeble constitution. True capillary bronchitis is, on the other hand, a disease of great danger. It may be fatal at any period of childhood, but the younger the patients and more feeble, the greater the proportion of deaths. Under the age of one year, it is one of the most fatal diseases of early life.

The prognosis, in the commencement of all cases of bronchitis of average severity in the young child, should be guarded, on account of the tendency of the inflammation to extend, as has been already stated in the preceding pages. After five or six days extension ceases, and, if during that time there is no increase in the severity of symptoms, the prognosis is favorable. Signs which indicate an unfavorable result are increasing frequency of pulse and respiration, difficult and scanty expectoration, restlessness, a countenance indicative of suffering, and a progressively greater accumulation of mucus in the bronchial tubes, as determined by auscultation. Pallor and coldness of the face and extremities, lividity of the tips of the fingers, rapid and feeble pulse, drowsiness, diminution of cough, while the mucus and pus accumulate in the bronchial tubes, and, in young children, intermissions in the respiration, indicate the near approach of death. Cases may, however, recover by proper treatment, although the symptoms are most unfavorable.

It is unnecessary to mention the favorable prognostic signs of bronchitis. This disease, when fully established, continues a certain number of days, whatever remedial measures are employed, and, if the symptoms do not

increase in severity during the first five or six days, a favorable result is highly probable. The prognosis in chronic bronchitis is ordinarily favorable, so far as life is concerned, provided that there is no emaciation. If there is emaciation, the bronchitis may be due to tubercles in the bronchial glands or lungs, and, of course, the prognosis is unfavorable.

Treatment.—Bronchitis may be rendered much milder, and perhaps even prevented, by an emetic employed in the first twelve or twenty-four hours, in conjunction with a warm bath. The physician is not, however, ordinarily called sufficiently early to render this treatment effectual. The remedial measures proper for this disease vary greatly, according to the stage and intensity or extent of the inflammation and the age of the patient. Bronchitis, *limited to the larger tubes*, requires simple measures. A laxative may be employed, with a mild expectorant, and moderate counter-irritation should be produced by camphorated oil, or the occasional employment of a sinapism. I have sometimes ordered for these cases a mixture recommended by Dr. James Jackson, of Boston, in his letters to a young physician. "For young children," . . . . says he, "I employ the following: Take of either almond or olive oil, of syrup of squills, of any agreeable syrup, and of mucilage of gum acacia, equal parts, and mix them. Of this mixture, a teaspoonful may be given to a child at two years of age; a little less if younger, and increased if older, so as to double the dose to one in the sixth year. This may be given from three to six times in the twenty-four hours. Sometimes a little opiate must be added at night to appease an urgent cough." These cases also do well with simple mucilaginous drinks in conjunction with gentle aperients.

Bronchitis, *extending* beyond the primary or secondary bronchial divisions, requires more careful watching and more decided measures. The abstraction of blood by leeches, or otherwise, is seldom required in the treatment of bronchitis. Occasionally, if the inflammation is intense and the symptoms urgent, moderate abstraction of blood at an early period might perhaps be useful, but the employment of cardiac sedatives as aconite or digitalis under such circumstances is generally preferable.

As a rule, actively depressing agents should be avoided in the treatment of bronchitis in patients under the age of two years; and, on the other hand, sustaining remedies are in a large proportion of cases required after the first two or three days. Many infants with bronchitis are sacrificed in consequence of the old theory, which still influences medical practice, that an inflammation, with its increased force of circulation, is necessarily best controlled by depletory and sedative measures. Remedies too depressing are prescribed, and with a less favorable result than would follow the use of sustaining measures or even a strictly expectant course of treatment.

What is, therefore, the proper mode of treating bronchitis, severe or of ordinary gravity, occurring in infancy and childhood? It is supposed that the physician is called when the inflammation is fully established, or that, if he has seen the patient at the commencement, and has prescribed an

emetic, it has failed to throw off the disease. A large emollient poultice not thicker than the cover of a book, so wet as to produce constant moisture of the surface, and sufficiently irritating to produce constant redness without necessitating its removal, should be applied to the front and sides of the chest, and over it an oil-silk jacket placed. I prefer a poultice of the following:—

℞. Pulv. sinapis, ℥ss;
Pulv. semin. lini, ℥viij. Misce.

Local treatment in bronchitis is very important. The exact mode of applying it, or the substances used, matters little, provided that it meets the indication, which is twofold,—namely, derivation to the surface, and the application to it of warmth and moisture. Such applications are found, by experience, to give most relief. Warmth and moisture are furnished by cataplasms most conveniently, or by warm water applications under oil-silk.

Derivation to the surface, early made and repeated, tends to check the downward extension of bronchitis; but it is not advisable to vesicate, or to produce anything more than moderate and continued redness. Often improvement in symptoms is observed, especially less dyspnœa and restlessness, immediately on the employment of the local measures recommended above. If the bronchitis have that severity that there is a decided febrile movement, accelerated respiration or pain on coughing, this external treatment should in my opinion always be employed, but if the disease is so mild that these symptoms are absent the case will probably do well without it. The internal treatment appropriate for bronchitis varies according to the age of the patient and the character of the inflammation, whether it be primary or secondary. The following formulæ will be found useful:—

℞. Ammon. carbonat., gr. viij;
Syr. bal. tolut., ℥ss;
Aquæ, ℥iss. Misce.

Dose, one teaspoonful every two or three hours for an infant of three months.

Instead of the carbonate, twice its quantity of muriate of ammonia may be prescribed.

Infants of this age usually require also alcoholic stimulants, as six or eight drops of brandy every hour or two.

℞. Spts. æther. nitr., ℥j;
Syr. ipecacuanhæ,
Ol. ricini., āā ℥ij;
Syr. bal. tolut., ℥vij. Misce.

Dose, one teaspoonful every two to four hours to an infant one year old with acute primary bronchitis.

℞. Syr. ipecacuanhæ, ℥ij;
Potas. acetat., gr. xvj–℥ss;
Syr. simplicis, ℥xiv. Misce.

Dose, one teaspoonful to an infant of six months with acute primary bronchitis.

Medicines which exert a greater controlling effect upon the action of the heart than those which we have mentioned, are often required during the progress of severe bronchitis, namely, in those cases in which the patient is weakly, while the pulse is unusually rapid and temperature elevated. One or two drops of tincture of digitalis may be added as a heart tonic to each dose of the prescription for a patient of six months to two years. For children over the age of two years, whose previous health has been good, aconite is preferable as a cardiac sedative. The following will be found a useful recipe for a robust child of five years :—

℞. Tinct. rad. aconit., gtt. xvj ;
Syr. scillæ composit., ʒij ;
Syr. bal. tolut., ʒxiv. Misce.

Dose, one teaspoonful from two to four hours.

The medicine should be omitted or given at a longer interval if the frequency of the pulse is reduced. I have nearly abandoned the use of veratrum viride for the bronchitis of children on account of its very depressing effect. If there is restlessness, Dover's powder, paregoric or syrup of poppy should be administered with the expectorant mixture or separately. Squibb's liquid Dover's powder, the tinct. ipecac. comp., is a useful and convenient remedy to procure sleep in these cases. It may be given to an infant of one year in one-drop doses. Agents more depressing than ipecacuanha should not be administered to infants under the age of six months, even in the commencement of acute bronchitis.

The effect of the stronger cardiac sedatives, as aconite and veratrum viride, in the bronchitis of children, should be carefully watched. In general they should be administered only during the first three to five days; but if the child is robust, with full and strong pulse, they may be continued longer. In many cases of primary and secondary bronchitis during its active period, quinine administered with or without digitalis, is an invaluable remedy, as a substitute for aconite or veratrum viride. Like those agents it diminishes the temperature and the frequency of pulse, while it acts as a general tonic and preserves the strength of the heart's contractions. This effect of quinine, which has only in recent years been brought prominently to the notice of the profession, and is now accepted as a valuable fact in therapeutics, indicates an important use for this agent in several of the most common and severe diseases of children, as bronchitis, pneumonitis, scarlatina, and diphtheria. While it may not reduce the frequency of the pulse as quickly as aconite, or to the same extent, it has in my practice been equally effectual in reducing the temperature. As many as six or eight grains may be administered daily in divided doses to a child of two or three years. If this agent is properly administered, and the dose reduced as the fever abates, cinchonism, at least so as to be injurious, seldom occurs. As the active inflammation begins to abate, simple expectorant mixtures may be given, as syrup of squills or ipecacuanha in

spiritus Mindereri. At this stage of bronchitis, it is usually best to commence the use of stimulating expectorants, and they are required in nearly all cases of advanced bronchitis. In secondary forms of the disease, as when it occurs in connection with hooping-cough or measles, such expectorants should be employed from the first; and also, if there is a state of feebleness or cachexia, although the bronchitis is primary. The following will be found useful prescriptions, the digitalis being employed as it is the best heart tonic with which we are acquainted, reducing the frequency of the heart-beats while it gives them more force:—

℞. Tinct. digital., gtt. xvi;
Ammon. muriat., gr. xvi;
Syr. bal. tolut.,
Aquæ, āā ℥i.

Dose, one teaspoonful every two hours to a child of one year.

℞. Ammon. carbonat., gr. xvj–xxiv;
Tinct. digital., gtt. xxiv;
Syr. senegæ, ℥ij;
Ext. glycyr., ℥ss;
Aquæ, ℥xiv. Misce.

Dose, one teaspoonful every two or three hours to a child of two years.

During convalescence the medicine should be administered less and less frequently, or in smaller doses. Emetics in ordinary cases of bronchitis are not required, except in the commencement. In severe bronchitis, however, especially when the smaller tubes are inflamed, they sometimes appear to be useful. The cases which justify their administration are those in which mucus and pus collect in the tubes more rapidly than they are expectorated, so as to give rise to urgent dyspnœa. An emetic administered under such circumstances may give prompt and decided relief. The object to be gained is obviously very different from that in the commencement of bronchitis, and such agents should be employed as act promptly, with the least possible depression. Turpeth mineral or sulphate of copper is, then, the proper emetic. The former may be given in a dose of three grains; the latter, of one or two grains to a child five years old. If there is considerable strength of pulse and heat and dryness of surface, ipecacuanha may be administered. If there are evidences of exhaustion stimulants may be administered immediately before and after emesis. Infants oppressed by the accumulation of mucus and pus may sometimes be relieved by tickling the fauces with the finger. This provokes vomiting, and the viscid mucus which collects at the entrance of the glottis is removed by the finger.

In secondary bronchitis whatever the age, in primary or secondary occurring in infants or feeble children, the diet should, as a rule, be nutritious through the entire disease. Robust patients, or those who have had

ordinary health, if over the age of two years, and affected with primary bronchitis, should have light diet, chiefly farinaceous, in the first days of the attack, after which animal broths are proper. Whatever food is given in severe bronchitis must be in the form of drinks, since the appetite is lost, while the thirst is such that liquids are less likely to be refused.

In primary bronchitis, if mild or of ordinary severity, alcoholic stimulants are not required. In secondary bronchitis they are often needed, and also in capillary or severe ordinary bronchitis, if there is dyspnœa with evidences of prostration. The occasional loose cough which is often present during the period of convalescence requires but little treatment; either no medicine or a gently stimulating expectorant may be given.

CHAPTER V.

ATELECTASIS.

In certain new-born infants the lungs do not undergo inflation, or only a portion of the lobules are inflated, to wit, those in the upper lobes, while the remainder of the organ continues unchanged from the fœtal state. This non-inflation of the lung is designated congenital atelectasis. It is not due, unless in rare instances, to any defect or vice in the respiratory apparatus, for at the autopsies of cases which have ended fatally, as most cases do, at an early period, insufflation is easy, there being no occlusion of the air-passages, nor unusual adhesion of the walls of the alveoli to prevent the admission of air. Physicians have believed that in some instances they discovered the cause in an enlarged thymus gland, which compressed the lower part of the trachea, but this cause, in my opinion, does not exist or is exceptional, for although the thymus at birth is large, having nearly the size of an unexpanded lung, it has not seemed to me to be unduly enlarged in most atelectatic cases which I have examined after death.

The ordinary proximate cause of atelectasis neonatorum is feebleness of inspiration, whether due to general debility, as in infants born prematurely, or weakened by placental hemorrhage in the last months of fœtal life, or, as is frequently the case, to injury of the brain and consequent impairment of the function of the pneumogastrics during birth. I have more fully treated of this form of atelectasis in the chapters which relate to the maladies incidental to the birth of the child, and to these the reader is referred.

Acquired Atelectasis, or collapse of lung, is less extensive than congenital atelectasis, being confined to a portion of a lobe, and often to only a few lobules. It occurs chiefly during the period of infancy and in feeble children. It is a common malady, in foundling asylums, in wasted infants who perish before the close of the first year. I have frequently at

the autopsies of such infants observed it along the thin inferior margins of the lower lobes, and in the tongue-like prolongation of the left upper lobe. In this class of cases, catarrh of the bronchial tubes appears to have little or no agency in causing the collapse. The cause is found in the impaired functional activity of the lungs. In the state of debility the heart beats feebly and the stream of blood from it to the lungs is small and slow, so that the inspiration of a small amount of air suffices for its decarbonization. The inspirations also are seen to be feeble, causing little expansion of the walls of the thorax. Consequently the entire lung is imperfectly inflated, as is seen in fatal cases, but the distant thin portions of the organ are least expanded. These receiving little or no air, soon begin to contract from the presence of the elastic tissue, and collapse or atelectasis ensues.

This has been the most common form of atelectasis in cases of this malady, which I have observed in foundling asylums, and it probably occurred in the manner which I have described.

Another cause of acquired atelectasis to which all writers allude is bronchial catarrh, which commencing in the larger tubes extends downwards into those of smallest size. By the swelling of the mucous membrane, and the accumulation of viscid muco-pus which cannot be expectorated, certain of these tubules become occluded, so that the inspired air is shut off from the alveoli situated beyond them. Occlusions are obviously most apt to occur in the bronchitis of feeble infants, whose cough has little expulsive force, so that debility is also a factor in the production of this form of atelectasis. The portion of lung withdrawn from the respiratory function soon collapses, the air which it contained being probably in part expired, but chiefly absorbed.

Atelectasis is not, however, so important or frequent a complication of bronchitis as was formerly supposed, for catarrhal pneumonitis due to extension of the inflammation from the bronchioles into the lung has been mistaken for it. Solid non-crepitant nodules or portions of lung are frequently observed at the autopsies of infants who have perished of severe bronchitis, and these may be atelectatic or pneumonic, but they have in my observations been more frequently the latter than the former.

The possibility of insufflating these solid portions when removed from the body after death, was till within a few years regarded as the decisive proof of atelectasis. But this is now known to be no test, since a lung solidified by recent catarrhal pneumonitis can be almost as readily inflated as that which is collapsed. Nevertheless, the inflated pneumonic lung is more solid and resisting when pressed between the thumb and fingers than is the collapsed lung. The decisive proof is afforded by the microscope, by which cell-proliferation is discovered within the alveoli in catarrhal pneumonitis, while it is lacking in simple collapse. An increase of the dyspnœa not infrequently occurs in severe infantile bronchitis, without either pneumonia or collapse from the accumulation in the bronchioles of

the secretion which is with difficulty expectorated, but if dulness on percussion and other physical signs indicate solidification of the lung at some point, of course pneumonia or collapse has occurred. If a sufficient amount of lung is involved to produce well-marked physical signs the disease is in most instances pneumonia and not collapse, though it may be the latter. Both these pathological states may, however, occur in the same lung as complications of severe bronchitis. The severe paroxysmal cough of pertussis, especially when accompanied by considerable secretion, is apt to produce collapse of portions of the lower lobes, while it causes emphysema in the upper lobes.

Symptoms.—Atelectasis resulting from bronchitis gives rise to no new symptoms. So far as it has any appreciable effect it aggravates certain symptoms of the primary disease, but as it is ordinarily limited to a small area this effect is not very marked. When a bronchial tube is so occluded by muco-pus that the alveoli with which it communicates, collapse, there is ordinarily, at the same time, more or less accumulation of this secretion in other tubes throughout the lungs. Therefore, the entrance of air into the alveoli with which these tubes communicate is slow and difficult, but usually without complete obstruction, and without true atelectasis, but with a semi-collapse such as we observe in fatal croup. This explains the dyspnœa which is present in these cases. If the secretion is expectorated from these tubes the dyspnœa abates, even if the plug which has completely occluded a tube, and the consequent atelectasis remain.

Atelectasis occurring in wasted and feeble infants, in consequence of the diminished force of the inspirations, does not in most instances give rise to any prominent symptom, since it occurs chiefly in distant thin portions of the lungs. I have observed an occasional short, nearly painless cough in such infants, when the autopsy revealed no pulmonary lesion except the atelectasis.

Anatomical Characters.—The portion of lung which is affected with recent atelectasis, has a dark-brown or dark-bluish color. It is depressed below the general level of the lung, is firm and non-crepitant on pressure, and its incised surface is smooth. Hyperæmia supervenes, for a portion of lung in which the circulation continues, but from which air is excluded, becomes congested. In acquired atelectasis the congestion is especially marked, since the vessels which have been adapted by growth for a larger area, are compressed into one of smaller extent, so that they become tortuous and bulging within the lumina of the alveoli, while the free flow of blood through them is retarded by the constriction of the elastic fibres of the lung. An obvious and certain result of the hyperæmia is the transudation of serum into the alveoli, producing œdema. This union of pulmonary hyperæmia with œdema by which air is excluded from the alveoli constitutes the state known to pathologists as splenization, and in proportion as it occurs, the lung depressed by the atelectasis rises towards

the general level. It may even rise above it, and it now has a doughy elastic feel. The pathology of these œdematous atelectatic spots, heretofore obscure, has been clearly explained by Rindfleisch.

If the patient live, and the atelectatic lobules do not soon return to a state of health, they undergo further changes. Rindfleisch says: "From the series" (of changes, provided inflammation do not occur) "we especially render prominent two conditions, *inveterate œdema*, and *slaty induration*. But inflammation does commonly occur after a time in a collapsed lung." Those who are familiar with the post-mortem examinations of infants will fully agree with Rindfleisch when he says: "Splenization, quite generally taken, appears to present extraordinarily favorable preliminary conditions for the occurrence of inflammatory changes. It may directly represent the initial hyperæmia of acute inflammation, and be followed by lobular and lobar, but constantly catarrhal infiltrates." It is well known by pathologists that protracted congestion, active or passive, of whatever organ or tissue, is very apt to pass from a state of simple stasis of blood to one of cell-proliferation, and the atelectatic lung, as I have myself observed at autopsies, affords a common example of this. I have several times made or have procured microscopic examinations of the atelectatic portions of lungs of infants, who had died, for the most part, in a wasted and enfeebled state, and have found in them clear evidence of the presence of a catarrhal pneumonia. The interesting fact, therefore, must be recognized, that atelectasis frequently passes to a state of inflammation, so as to present the characters of ordinary hypostatic pneumonia, and no doubt undergo the same subsequent changes.

Atelectasis, when recent and simple or uncomplicated, may soon disappear by the expectoration of the obstructing secretion, if such is present, or if there is no obstruction, by increased force of inspiration. If it do not soon disappear it undergoes one of the ulterior changes alluded to above, and henceforth the symptoms and history are those of the new malady which has supervened.

Treatment.—The treatment of acquired atelectasis is simple. If it is recent and there is evidence that it is due to the accumulation of the secretion in the bronchial tubes, an emetic, which acts promptly and with the least possible depression, may be very useful. It is especially indicated if there is little or no pneumonia, the strength not greatly reduced, and there is dyspnœa with insufficient decarbonization of blood in consequence of the abundance of the secretion in the smaller tubes. An emetic which acts promptly and with little prostration, may aid greatly in establishing the respiratory function in collapsed lobules, by expelling the obstruction, and producing a freer and deeper inspiration. One of the best if not the best emetic for this purpose is sulphate of copper, given in a dose of one to two grains to a child of one year. With or without the use of the emetic our main reliance must be on sustaining and stimulating measures,

by which the cough, the cry, and the inspirations acquire more volume and force. Most cases require alcoholic stimulants and carbonate of ammonia. Rubefacient applications to the chest are also commonly employed, and are probably useful.

CHAPTER VI.

PNEUMONITIS.

In children over the age of three years, pneumonitis differs but little in form or phenomena from that of the adult, being ordinarily primary except as it depends on an irritant, as tubercles, and extending rapidly over one or more entire lobes. In those under the age of three years it is, on the other hand, as a rule, a secondary affection, and limited to a part of a lobe. Most writers, until recently, have classified cases according to their origin as primary and secondary, or their extent as lobar and lobular, or their duration as acute or chronic. A better classification, having an anatomical basis, is that into catarrhal, croupous, and interstitial.

Catarrhal pneumonitis consists in an inflammation of the air-cells, with an abundant proliferation of epithelial cells within them, and the exudation of serum, but not of fibrin. The secondary and lobular pneumonitis of young children, alluded to above, is usually of this character. *Croupous* pneumonitis consists also in an inflammation of the alveoli, but with an abundant formation of pus-cells within them, and the exudation of fibrin and serum. The lobar and primary pneumonitis of advanced children and adults is commonly of this character. In both catarrhal and croupous pneumonitis, therefore, the solidification of the lung and exclusion of air are due mainly to the newly formed cellular elements with which the alveoli are filled, though the source and nature of these cells differ in the two diseases. *Interstitial* pneumonitis consists in an inflammation and hyperplasia of the connective tissue of the lungs. It is the chronic pneumonia of authors, resembling in many respects, in its anatomical and clinical characters, cirrhosis of the liver. The inflammation which produces this result is subacute, and in nearly all cases is dependent on some persistent local disease in the minute bronchial tubes or lungs, as softened or cheesy tubercles, cancer, abscesses, protracted inflammation of the alveoli or bronchioles, whether produced by the inhalation of dust of an irritating nature or other cause. Interstitial pneumonia is much more rare in children than adults, and, as it presents no peculiar features in them, it need only be alluded to in this connection.

CAUSES.—*Croupous* pneumonitis in most cases results from that common cause of inflammations—namely, taking cold. It commences as a primary disease within a few hours after exposure. *Catarrhal* pneumonitis, in exceptional instances, also commences abruptly as a primary disease from the same cause, but being, probably in nine cases out of ten, secondary, it commonly results from antecedent pathological states, which we will enumerate.

First. Many cases result from bronchitis. The inflammation extending downward engages the minute bronchial tubes, and from them traverses the alveoli of one or more lobules. This is the broncho-pneumonia of children described by authors; it occurs most frequently between the ages of six and eighteen months.

Secondly. Hypostasis, or passive congestion, is an important factor in the causation of many cases, and in feeble infants it is not infrequently the sole cause. Infants with feeble health and languid circulation, lying in their cribs day after day with little movement of the body, are very liable to passive congestion of the depending portions of their lungs, and this by and by eventuates in a cell proliferation within the alveoli—in other words, a pneumonia presenting some peculiarities, but of the catarrhal form. In foundling hospitals, where feeble infants are received and treated, this is one of the most frequent pathological states, and is the prevailing form of pulmonary inflammation. It is sometimes described as hypostatic pneumonia. Hence physicians, whose observations have been largely in such institutions, have almost ignored any other form of pneumonia in infants. Billard, a close and accurate observer, wrote nearly half a century ago: "Pneumonia of infancy presents peculiar characters, in which it differs from the same affection in adults. Instead of being an idiopathic affection arising from irritation developed in the pulmonary tissue under the influence of atmospheric causes, which often excite the disease, the pneumonia of young infants is evidently the result of a stagnation of blood in their lungs. Under these circumstances this blood may be regarded as a kind of foreign body. . . . . It would, therefore, appear that inflammation of the lungs, which produces hepatization, arises in infants, in general, from some mechanical or physical cause." Valleix also states that he found the lesions of pneumonia in a majority of the infants who died in the Hôpital des Enfants Trouvés. The statements of Valleix are applicable also to the Infants' Hospital, and Nursery and Child's Hospital, of this city, as regards those cases in which death results from chronic disease. We shall see hereafter that hypostatic pneumonia is one of the most common complications of chronic infantile entero-colitis, the summer complaint of the cities.

Thirdly. Catarrhal pneumonia of infants sometimes results from collapse. It is not unusual to find, at the autopsies of infants who have died in a state of emaciation and feebleness, portions of the lungs remote from

the bronchi collapsed, as, for example, the thin edges of the inferior lobes, and the tongue-like process of the upper lobe, the process which lies over the heart. The immediate cause of the collapse has been a bronchitis, or it has resulted directly from the general weakness of the infant, and its feeble respirations. Now, a collapsed lung soon becomes affected by passive congestion. The functional activity of an organ favors circulation through it, and if the function is abolished the flow of blood in the part is retarded, and stasis more or less complete results. The hyperæmic state of collapsed pulmonary lobules presents the same anatomical condition, for the supervention of pneumonia, as occurs in cases of hypostatic congestion. Consequently, cell proliferation soon begins in the collapsed alveoli, the volume of the affected lung increases, and it becomes firmer and more resisting to the touch, and the microscope reveals the characters of a subacute but genuine catarrhal pneumonitis. I have made or have procured microscopic examinations of a considerable number of such specimens, and have found the alveoli more or less filled with cells of the epithelial character.

In rare instances in infancy and childhood pneumonitis results, as it more frequently does in the adult, from an embolus detached from a clot, which had formed in some remote vein, in consequence of arrest of circulation in it, by inflammation of the contiguous tissues. This is described by writers as a distinct form of pneumonitis, designated embolic or embolismal. A specimen showing this mode of causation was exhibited by me at the New York Pathological Society, in February, 1868. An infant, born January 22d, 1868, of strumous parents, had been fretful, but without appreciable ailment till February 3d, when inflammation of the connective tissue occurred on the anterior aspect of the left leg, a little below the knee. This extended downwards, suppurated, and the pus was evacuated February 5th. In the mean time three other similar inflammations occurred, two on the right foot and leg, and the other over the parietes of the chest in the right infra-mammary region. Suppuration occurred in all of these.

Fig. 23.

On February 8th this infant was suddenly seized with extreme dyspnœa, and died in a few hours. Numerous minute puriform collections (formerly called metastatic abscesses) were discovered in each lung, most of them scarcely larger than a pin's head. One of them on the right side in the middle lobe connecting with a bronchial tube had ruptured into the pleural cavity, causing pneumothorax, collapse, and incipient pleuritis.

The annexed figure exhibits the microscopic appearance of this softened fibrin, which, to the naked eye, so closely resembled pus.

On account of the speedy death, the emboli had produced, in the lobules where they had lodged, little more than congestion or the first stage of pneumonitis around them. Had the infant lived longer, doubtless the ferments or the vibriones, which some consider the irritating element of emboli, would have produced suppurative inflammation.

Anatomical Characters.—Nothing need be added in this connection to what has already been said, in reference to interstitial and embolismal pneumonias. Being comparatively rare in children, they present the same anatomical characters as in the adult. That unimportant form of pneumonia called pleurogenous, and which consists in a croupous inflammation of the superficial infundibula of the lung underneath an inflamed pleura, occurs in children as well as adults. Being secondary to the pleuritis, produced by extension of the inflammation of the pleura, it gives rise to no physical signs, or appreciable symptoms, on account of its slight extent, and as it presents no peculiar features in the child, it need only be alluded to.

Croupous pneumonitis, which we have stated is the ordinary form of pulmonary inflammation in children over the age of five years, has the same anatomical characters as in the adult. It ordinarily involves an entire lobe. It is more frequent in the right than left lung, and in whichever lung it occurs its most frequent seat is the lower lobe. The inflammation may, however, be limited to an upper lobe, especially on the right side. It ordinarily commences near the root of the lung, and extends forward.

Croupous pneumonitis presents three stages, that of congestion, red hepatization, and gray hepatization. In the stage of congestion the capillaries in the walls of the alveoli are greatly distended, bulging forward in loops within the alveolar spaces so as to diminish them, and a viscid albuminous fluid begins to exude, in which points of extravasated blood appear. The affected lung in this stage has a deep-red color, its elasticity is greatly diminished, and its density and weight increased. On account of the reduced size of the alveoli from the bulging of the alveolar walls, and the viscid fluid within the alveoli and terminal bronchial tubes, the function of the affected lobe is nearly lost, and hence the dyspnœa which patients experience in the first stage of the inflammation.

The second stage is characterized by the continued and increased escape of the liquor sanguinis and red and white corpuscles through the stigmata or little apertures which exist normally in the walls of the capillaries. The inflamed alveoli and the minute bronchial tubes which terminate in them are filled with this pneumonic exudation. The relative proportion of the elements of the blood in the exudate varies in different cases. Fibrin is always present, immediately coagulating in delicate filaments

within the interstices of which the corpuscles are lodged. The white corpuscles in some cases are much in excess of the red, while in others the red predominate. The lung in the second stage contains no air, has a greater specific gravity than water, is friable so as to be readily torn and penetrated by the finger. The torn surface in the adult presents a granular appearance, each granule being the contents of an air-cell. In the child the granules are not distinct on account of the small size of the air-cells, but the volume of the inflamed lobe is somewhat increased as in the adult.

The stage of gray hepatization succeeds, in which the volume of the lung is still greater. The change of color is due partly to the compression of the capillaries by the inflammatory material, partly to the destruction of the red corpuscles, and disappearance to a greater or less extent of their coloring matter, while the white corpuscles (pus-cells) remain, but more to commencing fatty degeneration in the exudate prior to its liquefaction. In favorable cases the lung soon returns to its normal state, the liquefied substance which filled the alveoli being in part absorbed, in part expectorated.

Croupous pneumonitis often causes inflammation of the portion of the pleura which covers it. Pleuritis developed in this way is circumscribed, but it frequently extends beyond the inflamed parenchyma to the distance of one or two inches. Bronchitis is also a common accompaniment. It may be general, in which case it occurs independently, or be limited to the tubes lying within the inflamed lung, in which case it results like the pleuritis from the pneumonitis. It is seen from this description that the pus-cells which are produced so abundantly in the alveoli are believed to be chiefly exuded white corpuscles of the blood. Possibly some of them may be produced by proliferation of the epithelial cells, which line the alveoli, in the same manner as they are believed to be produced in the bronchial tubes.

Catarrhal pneumonitis, which is, as we have stated, for the most part the lobular pneumonitis of writers, and which, with an occasional exception, is the form of inflammation in children under the age of five years, presents not only clinical but anatomical features, which distinguish it from the croupous form of the disease. Those who have witnessed few post-mortem examinations of young children, and whose views of the lesion are influenced by the expression lobular, are apt to suppose that there is an alternation of inflamed and healthy lobules, so that the surface of the lung presents an appearance not unlike mosaic work. This is a mistake. Although an entire lobe is seldom inflamed, as in croupous pneumonitis, the inflammation commonly extends over more or fewer contiguous lobules, but we find certain lobules in the midst of the inflamed area which are but slightly affected or have escaped entirely. The extent of the inflammation is ordinarily from one to three inches, but I have seen

a nodule of true catarrhal pneumonia not larger than a pea, while every other portion of the lung was healthy. On the other hand, almost an entire lobe may appear hepatized to the naked eye as in the croupous inflammation, but by a careful examination certain lobules will be found unaffected. Thus, in a case in the Nursery and Child's Hospital, in which death occurred at the age of one year from pneumonitis supervening upon pertussis, an entire lower lobe, with the exception of a little of its anterior border, presented the appearance and feel of red hepatization, but a careful microscopic examination revealed not only the absence of fibrin in the exudate, showing the catarrhal nature of the inflammation, but also certain lobules in the midst of the inflamed lung which were not involved.

The first change occurring in a lung invaded by catarrhal pneumonitis is congestion, whether active, as in the common form of the disease, in which the inflammation has extended into the lung from the bronchioles, or passive, as when the inflammation results from hypostasis or collapse. An exudation of serum, but not of fibrin, follows, and soon the epithelial layer which lines the alveoli begins to swell. The nuclei of the epithelial cells divide, the cells themselves forming large round cells with vesicular nuclei. These cells, to which the solidification of the lung is mainly due, are, therefore, on account of their origin and appearance, regarded as epithelial. The alveoli in catarrhal pneumonitis, it is seen, are filled with an inflammatory product quite different from that in the croupous inflammation.

Inflammation of the pleura over the inflamed lung, so common in croupous pneumonia, and which gives it the name pleuro-pneumonia, by which it is sometimes designated, rarely occurs in this disease. The seat of this inflammation is ordinarily the posterior part of the lungs, even when it results from extension of the inflammation from the bronchial tubes. When resulting from collapse, it affects chiefly those lobules which are remote from the bronchi, and which the air enters only by a long circuit.

Catarrhal pneumonitis, when it arises from extension of acute inflammation of the bronchioles, is acute, but in those forms of the disease which supervene upon passive congestion it is subacute. The alveoli are less distended by inflammatory products than in croupous pneumonia, not only from the absence of fibrin, but from a less amount of cells. Hence the volume of the inflamed lung is not so great as in that disease, and the torn surface, even in the adult, does not present a granular appearance. Hence, also, the stage of gray hepatization does not supervene so uniformly and regularly, since there is less compression of the capillaries in the alveolar walls, and the mutual pressure of the inflammatory product is less. In infants who have died with this form of pneumonitis, of six or eight weeks' duration, it is not unusual to find the affected lobules still in the stage of red hepatization. Cell proliferation occurs in the bronchioles of the inflamed lung as in the alveoli, producing within them numerous plugs,

which, though they obstruct the entrance of air, are not so firm as in croupous pneumonitis, as they are destitute of fibrin.

In favorable cases the lung affected by catarrhal inflammation returns to its normal state, probably by the same process as in croupous pneumonitis. In other cases, especially in scrofulous and feeble children, the inflammation, instead of resolving, passes into what is now designated cheesy, or by certain writers scrofulous, pneumonitis.

Cheesy Pneumonitis.—Cheesy degeneration of the inflammatory product occasionally occurs in the croupous form of inflammation, but it is more common in the catarrhal. I have most frequently observed it in New York during epidemics of measles, when this form of pneumonitis supervened upon the catarrhal bronchitis of that disease. Cheesy pneumonitis is in its nature chronic, and attended with great reduction of the vital powers.

Cheesy degeneration of the exudate or infiltrate consists essentially in the absorption of the liquid portion, and fatty degeneration of the solid. The obstruction of the circulation in the capillaries and the accumulation of cells in the alveoli and bronchioles which cannot be expectorated, are conditions which favor the cheesy metamorphosis. The appearance and consistence of the lung when it has undergone this change are well expressed by the term which is employed to designate it. The cheesy mass consists of fatty, shrivelled, and fragmentary cells, and amorphous matter, in which can be traced the elastic fibres and larger vessels of the parenchyma, the other histological elements having disappeared.

The caseous mass after a time softens, attracting moisture from the surrounding tissues. The molecular detritus and the shrivelled cells are now suspended in a liquid, and, like any dead matter, they are irritant to the surrounding lung-substance. The bronchial tube which supplies the affected lobule, and which in many instances was the starting-point of the disease, again becomes pervious, either by softening of the plug or by ulceration at a higher point upon its walls, and air is admitted, which promotes the putrefactive process and chemical changes of the caseous substance.

The lesion now described is that of pulmonary consumption, a disease not infrequent in children of two or three years. There are as yet no tubercles, but the presence of softening caseous material in the lungs very frequently leads to their development (see Art. Tuberculosis), and accordingly, before the case ends, clusters of tubercles may appear in the connective tissue and walls of the vessels of the lungs and in other organs.

In the subsequent progress of cheesy pneumonitis, if the patient live sufficiently long, there occurs more or less expectoration of the offending substance, producing a cavity. Around the cavity a vascular pyogenic membrane forms, upon which granulations arise. These granulations, which produce pus abundantly, and from which small extravasations of blood are frequent, are gradually transformed into connective tissue. If

the dead portion is expectorated, and there is a single small cavity, the child may recover, the empty space being finally filled up by the extension of the granulations, and the production of a cicatrix, which contracts, producing a puckered appearance. Ordinarily, however, there are several centres of caseous degenerations, and several cavities resulting, which continue to enlarge by the progressive softening of the cheesy matter Often, also, certain of the cavities intercommunicate. The bronchial glands undergo hyperplasia, and certain of them are apt, also, to become cheesy. As the disease advances, the suppuration and expectoration increase. The fatal result occurs sooner in children than in adults, and, therefore, the lesions, destructive and inflammatory, observed at autopsies, are ordinarily not so far advanced in the former as in the latter. Other unfavorable changes may occur in the hepatized lung, but cheesy degeneration is the most common and noteworthy.

Whether it is possible to inflate a lung which presents to the naked eye the appearance of pneumonitis, has long been regarded as a reliable sign of the presence or absence of inflammatory consolidation. The facts as regards the possibility of insufflation are these: In croupous pneumonitis, when it has passed beyond the first stage, insufflation is impossible in the lung of the child as well as adult, with the utmost force of the breath. We produce emphysema in healthy portions of the lungs, while the inflamed area is not encroached upon.

On the other hand, in catarrhal pneumonitis, which we have seen is the common form of pulmonary inflammation in children under the age of three years, and in which there is less distension of the air-cells by inflammatory products, the lung can be inflated, except in protracted cases, but when fully inflated the solidified lobules can still be felt between the thumb and fingers. In protracted catarrhal pneumonitis, as well as in protracted collapse, which, indeed, may and often does become a pneumonitis, full inflation is impossible. Central portions still remain impervious to air. While, therefore, the possibility or impossibility of inflating a lung removed from an adult, and which presents to the naked eye the appearance of pneumonic solidification, is a valuable sign as indicating whether or not the disease was pneumonitis, this test is uncertain and unreliable when applied to the pulmonary lesions of children under the age of three years.

Symptoms.—Croupous pneumonitis commonly begins abruptly, or it is preceded for a brief period by symptoms of a cold. In the adult, the abrupt commencement is ordinarily with a chill. In the child, there is often a sensation of chilliness, but a distinct chill is not common. Convulsions sometimes occur in place of a chill. Catarrhal pneumonitis, being ordinarily a secondary disease, begins in a more gradual way, its symptoms being preceded by, and associated with, those of the primary affection.

The symptoms of acute pneumonitis, whether catarrhal or croupous, are the following: Anorexia, thirst, restlessness, elevation of temperature,

acceleration of pulse according to the intensity of the inflammation and the feebleness of the patient, flushed face, a countenance indicative of suffering, accelerated respiration, with an expiratory moan. These symptoms are constant in the acute inflammation unless of the mildest form. Those which are important I shall describe more fully.

The expiratory moan is described by writers as a pathognomonic symptom of this disease, or of pleurisy. It is evidently due to the pain experienced by the friction of the inflamed pleura. As a rule, the expiratory moan does indicate either pneumonitis or simple pleuritis; but there are exceptions. It may occur, for example, from indigestible substances in the stomach and intestines, giving rise to acute dyspepsia; or from certain forms of abdominal inflammation, which render movements of the diaphragm painful, as diaphragmatic peritonitis.

The cough in the first days of pneumonitis is often dry or hacking and painful. It afterwards, if the case is favorable, becomes looser, and is painless. We very seldom observe in the child the bloody sputum which characterizes pneumonitis in the adult, since in catarrhal inflammation there is little or no exudation of blood-corpuscles. The sputum, which in this form of the disease is the product of secretion and cell proliferation, is at first thin and frothy, but afterwards thicker and less tenacious from the greater number of cells. There is often, in the first period of the inflammation, pretty severe and constant headache, the patient complaining of the head, if old enough to speak, before he does of the chest. In a severe attack the child at this period lies with the eyes shut, apparently in a half-conscious state, fretful if spoken to or aroused, so that the physician might be led to suspect the presence of cerebral disease. If there is vomiting, accompanied with sudden twitching of the muscles, and convulsions—symptoms which sometimes occur—the liability to error in diagnosis is greatly increased. Cerebral symptoms are more prominent in the commencement of pneumonitis than subsequently. As the disease advances they subside, and symptoms referable to the chest become more conspicuous.

The breathing is, as I have said, accelerated. Thirty or forty respirations per minute are common, and, in severe cases, the number reaches sixty or even eighty. In infants there is greater frequency of respiration than in children. In those at the breast, if the dyspnœa is urgent, nutrition is sometimes seriously interfered with, since in these severe cases respiration is performed more through the mouth than nostrils, so that if the infant seizes the nipple, it is forced to relinquish it in order to breathe. Dilatation of the alæ nasi, and depression of the infra-mammary region, accompany inspiration. The dyspnœa in catarrhal pneumonitis is often due in great part to accompanying bronchitis.

The temperature in mild cases of pneumonitis is elevated to about 101° to 103°; in severe cases it may reach 105° or even 107°, the former being

the highest observed by Mr. Squire. In ninety-seven observations made by M. Roger, the average temperature was 104° during the active period of the inflammation. The face is therefore flushed, and the heat of surface pungent, except in weakly children, in whom, even in severe and active inflammation, the face is sometimes pale, and the extremities of natural or less than natural temperature.

The tongue is moist, and covered with a light fur; the thirst is such that nutriment may be given in the form of drinks, when the loss of appetite prevents the use of solid food. The bowels are usually constipated. The secretions, in the first and second stages, are diminished. The urine is more deeply colored than in health, and in vigorous patients it deposits urates on cooling. The chlorides are also deficient, or absent from the urine, so long as the inflammation is extending.

In favorable cases, in from seven to ten days the heat and thirst decline; the pulse and respiration gradually become less frequent; the cough looser; the features have a more placid or contented expression; the appetite returns, and the patient is again amused by playthings. The improvement is progressive, but gradual. A slight cough is occasionally observed for two or three weeks after convalescence is fully established.

Death in the acute stage of the inflammation commonly occurs from asthenia. The pulse gradually becomes more frequent and feeble, the respiration more oppressed, and finally, near the close of life, the face and extremities become cool. Occasionally death results from apnœa, due in great part to coexisting bronchitis. In exceptional instances it occurs from convulsions, followed by coma, especially in the first week. In those protracted cases in which the inflammatory products have undergone cheesy degeneration death occurs from asthenia.

Such are the symptoms and progress of ordinary acute pneumonitis in children. When the inflammation is subacute, as in those forms of the disease which result from collapse or hypostasis, the symptoms are less pronounced. The respiration in such cases is but moderately accelerated, is attended by little pain, and therefore the expiratory moan is often absent. An occasional short, dry cough occurs, with so little increase of temperature and quickening of the pulse that the pneumonitis is apt to be overlooked by the physician, the symptoms being referred to bronchitis. Pleuritis seldom occurs in connection with this form of pneumonitis, except when a small abscess or gangrene results in an affected lobule directly under the pleura. A few such cases I have observed.

Tubercular pneumonitis extends over much or little of the lung according to the amount of tubercles. The symptoms are like those of severe primary pneumonitis, superadded to such as pertain to tuberculosis. This inflammation, when once established in the consumptive child, commonly continues till the close of life. I have sometimes had these cases under observation for several consecutive weeks, even months, and during the

whole time there was not only acceleration of pulse and respiration, but the expiratory moan. As regards pneumonitis occurring in hooping-cough, it is an interesting fact that its symptoms modify those of the primary disease, so that, during the active period of the inflammation, the paroxysmal cough diminishes, and a short, hacking cough and expiratory moan occur in place. As the inflammation abates, the spasmodic cough returns. Pneumonitis, occurring in measles, is more obstinate, protracted, and dangerous than the primary form. It usually commences about the period of the decline of the eruption, and, in favorable cases, continues two or three weeks. It is then a sequel, rather than complication.

Physical Signs.—The physical signs of pneumonitis in infancy and childhood are the same as in the adult, but in a large proportion of cases they are less distinct. In a majority of patients under the age of three years the crepitant râle is not observed. This is due to the small size of the alveoli at this age. I have now and then detected it in quite young children, in whom it is a finer râle than in the adult. If observed, it is, of course, positive proof of the existence of pneumonitis. The physical signs, therefore, in the first stage of the inflammation, are often obscure in consequence of the absence of the pathognomonic râle. The vesicular murmur is somewhat intensified through the chest, and there is in this stage slight dulness on percussion over the seat of the inflammation due to engorgement of the vessels, but it is difficult to appreciate this.

In the second stage, which supervenes more or less rapidly, the physical signs are more distinct. Bronchial respiration is in most cases detected, higher in pitch than the vesicular murmur, with the sound of expiration higher than that of inspiration. The voice of the patient is transmitted to the ear applied over the seat of the disease, and often a peculiar vibratory sensation is communicated to the hand applied over the part, so that it is possible to locate the disease by palpation alone. There are frequently, in the second stage, and sometimes in the first, coarse mucous râles in various parts of the chest from coexisting bronchitis.

Percussion, in the second stage, elicits a dull sound as compared with that produced on the opposite side of the chest. The dulness corresponds in extent with the solidification, and with the bronchial respiration.

As the inflammation abates, the dulness on percussion gradually diminishes, and the bronchial respiration is succeeded by the subcrepitant râle. Often, for a considerable period after convalescence is established, moist râles are observed in the chest, and sometimes the dulness on percussion does not entirely disappear till after the health is fully restored.

In catarrhal pneumonitis these signs are commonly less distinct than in the croupous form of inflammation. This is due in part to the limited extent of the inflammation, in part, in many cases, to its subacute character, and in part to the fact that is apt to be double, especially in those cases in which it results from hypostatic congestion.

Diagnosis.—It will aid in diagnosis to recollect that under the age of three years, pneumonitis is ordinarily catarrhal, and that it is preceded by, and associated with bronchitis. Coincident with, and often preceding its development for a few days, are the usual symptoms of nasal and bronchial catarrh. Defluxion from the nostrils, and other symptoms due to "taking cold," help us to diagnosticate catarrhal pneumonitis from the essential fevers, with the exception of measles. Croupous pneumonitis begins more abruptly, but in this form of inflammation a greater extent of pulmonary solidification soon gives us clear and unmistakable physical signs. The various forms of so-called remittent fever bear considerable resemblance as regards symptoms to certain cases of pneumonic inflammation, but in the latter there is more acceleration of respiration, and greater suffering, especially when the child is disturbed, than in the former. The physical signs, however, afford the decisive proof of the nature of the malady, as dulness on percussion, bronchial respiration of a higher pitch and harsher than the normal vesicular respiratory sound, bronchophony, vocal fremitus, etc.

Difficulty sometimes attends the diagnosis of broncho-pneumonitis from simple bronchitis. The presence of the expiratory moan, if it is pretty constant and marked, affords evidence that the inflammation has extended to the lungs, but the physical signs constitute the reliable means of exact diagnosis. They should be carefully noted, in order to determine if there is some point of solidification.

Solidification gives rise to dulness on percussion, bronchial respiration, and bronchophony. These three signs coexisting afford sufficient proof of pneumonitis, unless there is tubercular consolidation or possibly collapse supervening on suffocative bronchitis. The history of the case aids in determining whether there is either of these diseases. Moreover, collapse occurs later after the attack commences than hepatization, and does not produce so distinct bronchophony or bronchial respiration as is observed in ordinary cases of pneumonitis.

Pleuritis with effusion may present physical signs which bear considerable resemblance to those in pneumonia; but in pneumonia, except when associated with tubercular deposit, the dulness on percussion is not so great as that from pleuritic effusion, nor does the line of dulness vary according to the position of the child. In pleuritic effusion in a young child the respiratory murmur can often be heard with the ear applied over the liquid, but it is indistinct and transmitted through the liquid from a distance. The practised ear is able to discover the difference between it and the bronchial respiration of pneumonitis. Vocal fremitus, which is absent in pleuritic effusions, is another reliable sign of pneumonitis. Occasionally the physical signs indicate the coexistence of the pulmonary and pleural inflammations.

In catarrhal pneumonitis it is often difficult to determine certainly the nature of the disease, since the physical signs, if there is but little extent of inflammation, are absent or indistinct. I have often, in post-mortem examinations, found so small a part of the lung hepatized that it could not possibly have produced any appreciable dulness on percussion, bronchial respiration, or bronchophony. Such cases are apt to pass for simple bronchitis, and, practically, this matters little, since the treatment required by the two is not dissimilar.

Prognosis.—Primary pneumonitis, affecting only one lung, if properly treated, in most instances terminates favorably in children, and even in infants. If double, it is, as in the adult, much more serious, and in a large proportion of cases, fatal. Secondary pneumonitis, pneumonitis occurring in measles, hooping-cough, tuberculosis, or resulting from hypostatic congestion in the course of some exhausting disease, is, on the other hand, more frequently fatal. As death usually occurs from asthenia, the younger the child and more feeble the constitution, the greater the danger.

Unfavorable symptoms are a pulse becoming more and more frequent and feeble, pallor of countenance, inability of the patient to support the head, total loss of appetite, refusal to notice or be amused by playthings, absence of tears when crying—a symptom which the French writers have pointed out—and the appearance of pemphigus on the face or elsewhere.

Indications on which a favorable prognosis may be based are moderate acceleration of pulse, pneumonitis primary and limited to one side, ability to support the head or sit erect, being amused by playthings, etc.

Treatment.—The treatment of the two forms of pneumonitis, namely, catarrhal and croupous, the former occurring chiefly under the age of three years, and being secondary, the latter occurring in most patients over that age, require to be considered separately as much as do their symptoms and anatomical characters.

Catarrhal pneumonitis when developed from and upon a bronchitis, as it so often is, requires for the most part the continuance of the remedies which are appropriate for the primary disease. (See Art. Bronchitis.) But from the fact that it is secondary, and in children of a tender age, and since the danger as regards the pneumonitis is due to asthenia, more actively sustaining measures are demanded than might be required for the uncomplicated bronchitis. When the pneumonitis has continued a few days, and often in its commencement, carbonate of ammonia and alcoholic stimulants are needed, and the diet from the first should be nutritious. An opiate, as the compound tincture of ipecacuanha, should be added to the cough-mixture, if there is restlessness or insufficient sleep, and the external treatment recommended for bronchitis should be continued. In that form of catarrhal pneumonitis which is due to passive congestion or hypostasis, in the causation of which debility is an important

factor, tonic and stimulating measures are still more imperatively required. Frequent change of position is useful in such cases.

In *Croupous* pneumonitis, if seen at the commencement or within a few hours of the commencement, an emetic of ipecacuanha may be given, as recommended by Trousseau. This acts promptly as a cardiac sedative diminishing somewhat the afflux of blood to the lungs, and moderating the inflammation. It should not be employed except at the period mentioned.

The abstraction of blood by leeches or otherwise has justly fallen into disrepute in the treatment of the inflammations of children, as it is too depressing. But while the application of leeches in catarrhal pneumonitis is very rarely admissible, on account of the tender age of the patient and the secondary character of the inflammation, they may be useful in robust children with croupous pneumonitis, if applied sufficiently early, namely, within the first twelve hours. Two leeches are sufficient for a child of five years. When solidification of the lung has occurred, the time for the abstraction of blood is past. But we have in aconite and veratrum viride efficient substitutes for bloodletting, which, by their sedative effect on the heart, diminish the exaggerated afflux of blood to the inflamed lung, and thus enable us to meet the indication of treatment in the first stage of the inflammation. It is important in all severe cases to preserve the blood and the strength, for the danger in the end is chiefly from asthenia. Aconite as a cardiac sedative in the treatment of children is safer than veratrum viride; it is not necessary to watch its effects so carefully.

The following will be found a useful formula for a child of five years:—

℞. Tinct. ipecac. comp. (Squibb's), gtt. xvi.–xxiv;
Tinct. rad. aconite, gtt. xvj;
Syr. bal. tolut.;
Aquæ, āā ℥j.

Dose, one teaspoonful every three hours; or the aconite may be given alone, dropped in sweetened water or syrup of tolu.

If bronchial respiration, bronchophony, and dulness on percussion are present, indicating the second stage; in other words, if it appear from the signs that the inflamed lobe or lobes are hepatized, little benefit accrues from the farther use of aconite or veratrum viride, and harm may result. In this stage the above prescription, with the aconite omitted, may be continued, or the following may be employed:—

℞. Morph. sulphat., gr. j;
Syr. ipecacuanhæ, ℥j;
Syr. bal. tolut., ℥iij. Misce.

Dose, one teaspoonful every three hours to a child of five years.

The remarks made in reference to the use of quinia and digitalis for bronchitis apply with still more force to their use in both the catarrhal and

croupous forms of pneumonitis. In secondary pneumonitis and primary occurring in feeble children these agents are in many instances preferable to any other medicine for the purpose of reducing the temperature and pulse, since they produce this result without depression. They may be administered in these cases from the first day, and their use may obviously be continued longer than would be safe for aconite or veratrum viride.

When the inflammation begins to abate there is usually progressive improvement. Many now recover with simple mucilaginous drinks or mild expectorants for the accompanying bronchitis, as syrup of ipecacuanha or squills in small doses. Others require more sustaining measures, and for such carbonate of ammonia is preferable with, perhaps, quinia. In severe pneumonitis it is of the utmost importance to sustain the vital powers, even from the commencement of the inflammation. There can be no doubt that the great error in the therapeutic management of children with this malady has been the employment of medicines which reduce the strength when gentler measures or those of a sustaining nature were required. Alcoholic stimulants are required sooner or later in most cases, at an early period in feeble children and in secondary forms of the inflammation. Infants may take three or four drops of Bourbon whisky or brandy for each month of their age every two or three hours. The diet should be nutritious, consisting of milk, animal broths, and the like, unless during the first three or four days in robust children.

The bowels should be kept open, as an important part of the treatment of croupous pneumonitis in its first stages. A small dose of castor oil, Rochelle salts, or citrate of magnesia should be given if there is any tendency to constipation, and repeated from time to time if required. A saline aperient by its derivative and refrigerant effect in some cases obviates the necessity of employing cardiac sedatives.

Local treatment is required in all cases; counter irritation should be produced as soon as possible over the inflamed lobe, by mustard, iodine, or some stimulating liniment, and, except at the time of this application, the chest should be constantly covered with an emollient poultice, or with a cloth wrung out of warm water and covered with oil-silk. I prefer, however, the constant application, under the oil-silk, of the following poultice, made large but as thin as the cover of a book, and therefore light :—

℞. Pulv. sinapis., ℥ss;
Pulv. semin. lini, ℥viij. Misce.

In a large proportion of cases vesication is not required. If the inflammation is extensive, and the symptoms urgent, it is occasionally advisable to blister, and the cantharidal collodion should be used for this purpose. A safe, almost painless, and at the same time efficient, mode of applying this is in spots as large as a ten-cent piece, half a dozen, more or fewer

according to the extent of the inflammation, the skin of course remaining sound between them. This mode of application obviates the danger of producing a troublesome sore, which sometimes occurs in children from the ordinary mode of vesication.

In *cheesy* pneumonitis, which is always accompanied by anæmia, and great reduction of the vital powers, carbonate of ammonia with citrate of iron and ammonia equal parts, or cod-liver oil administered three times daily with two drops or more of syrup of iodide of iron, will be found useful, as is also quinine with iron. The patients require the most nutritious diet and alcoholic stimulants. In the local treatment of this form of inflammation vesication, even so mild as that by cantharidal collodion, should be avoided.

CHAPTER VII.

PLEURITIS.

Pleuritis occurs in children, as in adults, both as a primary and secondary disease. Secondary pleuritis, or pleuritis occurring during the course of other diseases, and due to those diseases, is common in infancy and childhood, as it is at other ages. Idiopathic pleuritis was formerly believed to be very rare in children under the age of five years, though not infrequent in those above that age. But greater precision in the examination of cases, more accurate means of diagnosis, more knowledge of the nature of diseases, and more frequent autopsies have enabled the profession of the present time to correct this as well as many other errors, and we now know that primary pleuritis is not very infrequent in young children, even in infants. There can be no doubt that many cases of this malady in young children have been, and even now are mistaken by good practitioners for other diseases, especially for pneumonitis, or if the pleuritis is to a certain extent latent, have been mistaken for remittent or malarious fever, or the fever due to dentition or intestinal irritation. I have records of several cases occurring both in family and hospital practice, in which young children perished with a wrong diagnosis or without a diagnosis, when the post-mortem examination revealed a pleuritis often of long standing. Thus, in one case of fatal empyema commencing at the age of six months and continuing several months, chronic pneumonitis had been diagnosticated by a physician well known to be thorough in his examinations and usually accurate. In another case, which proved fatal at about the age of one year, the child, who lived in a malarial locality, had been

for weeks under treatment for supposed malarial disease, but in this case diagnosis was easy with a proper examination, for at my first visit, which was when the child was dying, there was decided dulness on percussion over the posterior portion of the right side of the chest. In this case the right lung was adherent to the ribs anteriorly and laterally, while posteriorly it was separated by pus which crowded forward this organ so that its posterior surface was concave.

The following statistics probably show about the average frequency of primary pleuritis in young children. Of 404 children under the age of twelve years, whom I treated in private practice during the months immediately preceding May, 1874, two under the age of three years had primary pleuritis, or one-half per cent. A recital of these cases will be permitted, as their histories and physical signs show how liable the practitioner may be to a wrong diagnosis, in similar cases, if he do not take time to make full and exact examinations. One of the children was a girl aged two and a half years, whose previous health had been good. On April 2d she was suddenly taken sick with active febrile movement. Her pulse was about 180 per minute, counted with difficulty on account of the fretfulness, and the respiration was 88, and accompanied by an expiratory moan. At first no marked physical signs were observed in the chest, but within a few days a distinct clicking pleuritic sound was observed in the left infra-scapular region, and later still a creaking sound in the same place, during respiration. No perceptible difference was observed in the percussion-sound upon the two sides of the chest. The febrile movement continued nearly a month when it gradually abated, and the health of the patient was fully restored. The temperature on five of the six days, from April 18th to 24th, was 102°, 103°, 100½°, 99½°, and 102°, and the pulse on two of these days was recorded at 136 and 140. This child was examined by one of the most accurate auscultators in New York, who believed that there was almost no exudation of serum in the chest but an exudation of fibrin of little thickness. The second case was an infant aged eighteen months, who for six weeks had had an expiratory moan with febrile movement. The parents stated that his general health previously to his present sickness had been good, but the family were destitute, and his system had probably been in a more or less cachectic state from bad regimen. This child when first visited was feeble and wasted, as if from tubercular disease. The percussion-sound was flat over the lower half of the right side of the chest. A few drops of pus were withdrawn from the pleural cavity by the hypodermic syringe introduced a little below the angle of the scapula, and then the diagnosis being established, ℥iij to ℥iv of very thick pus were removed by the aspirator when it ceased to flow. The respiration afterwards was less painful and the child slowly but progressively convalesced. There was in this as in the preceding case no appreciable

bulging of the intercostal spaces, and no difference in the dimensions of the two sides.

In hospital and dispensary practice the proportion of cases of primary pleurisies is in my opinion somewhat larger than in private practice, since the cachexia so common in children in these institutions is, as we will see, one of the predisposing causes of this form of inflammation. The frequency of secondary pleurisy varies in different years or seasons, according to the prevalence of the maladies on which it depends. Thus during extensive epidemics of scarlet fever, pleuritis is more frequent than at other times.

Cause.—The ordinary cause of primary pleuritis is the same as that of most other primary inflammations, to wit, the impression of cold. This malady is, therefore, most common in the cool months, and in times of changeable temperature. Feebleness of constitution is an acknowledged predisposing cause in children. Therefore, children whose blood is impoverished by anti-hygienic influences to which they are exposed, or by previous disease, are more liable to pleuritis than those who possess a sound constitution. Hence the fact that a larger proportion of cases occur among foundlings and the children of the city poor, than among those who are well nourished, and live in comfortable circumstances.

It is probably due to both the causes now mentioned, namely, careless exposure by nurses to cold or to currents of air on the one hand, and cachexia on the other, that pleuritis is common in newborn infants in foundling asylums. Cases like the following are not infrequent. In 1867 I made the post-mortem examination of a foundling who died in the New York Infant Asylum. Its age was about one month. A small amount of pus, not more than one drachm, was found in one pleural cavity, and less than this quantity in the other. On both sides there was nearly general injection of costal and pulmonary pleura, but with little or no serofibrinous exudation. There was also pus at the root of each lung, extending somewhat over the lung, but under the pleura. The fact of a double pleuritis without pulmonary disease indicated a constitutional cause, but there was no apparent cause of this nature, apart from the impoverishment of the blood.

Billard, whose observations were made among foundlings in the Hospice des Enfants Trouvés, says: "Pleurisy is more common among young infants than is generally supposed; it often appears without the lungs participating in the inflammation. I have seen several infants die immediately after birth from this affection." He relates two cases of double idiopathic pleuritis ending fatally at the ages of two and ten days. (*Disease of Infants*, page 419.) Mignot, whose observations were made in the same institution, also records ten pleurisies, five of which were idiopathic, in one hundred and nineteen necropsies of newborn infants. (*Maladies pendant la Premier Age.*)

The chief causes of secondary pleuritis are tubercles, pneumonitis, scarlet

fever, and the entrance of some morbid product as pus into the pleural cavity. Tubercles situated under the pleura are, as is well known, a common cause of this inflammation at any age, but pleuritis is less frequent in the tuberculosis of children than of adults. This difference is due to the fact that tubercles in children, especially in young children, are ordinarily small, and disseminated in various organs through the system, so as to produce comparatively little inflammation and destruction of the contiguous tissues before the fatal ending.

A similar difference exists in regard to the frequency of pleuritis as a result of pneumonitis in the two periods. Croupous pneumonia, which is the common form of pulmonary inflammation in adults, ordinarily involves the pleura, as is well known. On the other hand, catarrhal pneumonia, which is the form of inflammation common in childhood, commonly occurs without exciting a pleuritis.

One of the exanthematic fevers, namely, scarlatina, not infrequently also produces pleuritis, occurring either as a complication or sequel. This result appears to be sometimes due to the altered state of the blood resulting from the presence of the scarlatinous virus. In other instances it is probably the result of the retained urea consequent on scarlatinous nephritis, for pleuritis is a common complication of Bright's disease.

In young children pleuritis is sometimes due to the discharge into the pleural cavity of some morbid product, as pus, softened tubercle, or decomposed lung-tissue, which from its very irritating effect produces a fatal inflammation. I have preserved the records of several such cases, which I have observed.

A retropharyngeal abscess, descending behind the œsophagus, has been known to cause fatal pleuritis by bursting into the pleural cavity. A suppurated bronchial gland or abscess in the walls of the chest occasionally produces the same result. In January, 1864, I presented to the New York Pathological Society the lungs of an infant, with the following history: R., aged 9 months, of strumous parentage, and whose only sister had suffered severely from strumous ophthalmia and periostitis, was taken sick about December 19, 1863, with febrile movement, attended by restlessness, but apparently without any serious indisposition. On the 22d, the mother called my attention to a prominence just below the right clavicle. This proved to be an abscess. A poultice was applied, in the expectation that it would discharge externally. On the 24th of December, however, the prominence subsided, and immediately the symptoms were greatly aggravated. The pulse rose to 160 per minute, the respiration to 60 or 80, and expiration was accompanied by a moan, so common in acute inflammation of the pleura or lung. Within a day or two after the disappearance of the tumor, and the exacerbation of the symptoms, dulness on percussion was observed on this side, and this increased till there was perfect flatness. The right pleural cavity had evidently filled with liquid, the

acceleration of pulse and respiration continued, the patient grew more and more feeble, and death occurred December 31st.

At the autopsy, on dissecting away the integument from the right side of the chest, an abscess was opened, containing nearly an ounce of pus, located at the point where the tumor has been observed. There was a small round opening from this abscess directly into the cavity of the chest, so that, on depressing the ribs, liquid escaped from the cavity. On removing the sternum, the liquid was found to consist mainly of serum with lymph, and at the bottom of the liquid was considerable pus. I have met one other case, apparently almost identical with this, the infant being seven months old, but I did not attend it in the latter part of its sickness. The abscess in the case which I have detailed was obviously strumous, probably occurring from glandular inflammation. This mode of production of pleuritis, namely, by the discharge of an abscess located in the thoracic walls, is no doubt rare. It was so considered by the members of the Pathological Society.

We occasionally meet cases, especially in foundling asylums, which have a different origin. An indolent pneumonitis occurs over a circumscribed area in the posterior part of the lung, whether it results from hypostasis, or from exposure to cold. A minute abscess, often not larger than a pin's head, or a small shot, occurs in the inflamed part. Perhaps this abscess is located in a bronchiole, and it may result from the muco-pus, which has collected in this tube, and was not expectorated on account of the low vitality and feeble functional activity of the tissues. The pus approaching the pleural surface, produces circumscribed pleuritis at that point, or opening into the pleural cavity, gives rise to general pleuritis. Often several of these abscesses are observed in the inflamed parenchyma. The following are cases in point:—

Case 1.—I. M., male infant, was admitted into the Nursery and Child's Hospital, May 19, 1859, at the age of two months. He was very delicate at the time of admission, and had slight bronchitis, but, being placed with a wet-nurse, he gradually improved. About the middle of July, attacks of diarrhœa occurred, each lasting from one to two days, and from this time his health declined. Furuncular eruptions appeared on the head and neck, and, though sustaining measures were employed with medicines to control the diarrhœa, emaciation and feebleness gradually increased.

The records on August 1st state, "Continues to fail, apparently from the attacks of diarrhœa; the furuncular eruption continues." On 3d of August, he died suddenly of apnœa, though there has been no symptoms to direct attention to the chest. Possibly he had a slight cough, which had escaped detection.

Autopsy eight hours after death.—Stomach and jejunum healthy; mucous membrane lining the lower part of the ileum and the entire colon vascular, and that of the colon considerably thickened; mesenteric glands enlarged, and of a lighter color than in health; right lung compressed by a

sero-fibrinous exudation, so as to occupy a small space, though the amount of liquid was not more than two ounces; nearly the entire pleura, visceral and parietal, on this side, was covered with a fibrinous deposit of a creamy appearance. Some of this had settled in the depending portion of the cavity. This lung could be inflated, except a little of the lower lobe, which was hepatized.

On the left side, the lung also occupied a very small space, being collapsed; the upper lobe could be readily inflated, when it had the elasticity of healthy lung; the lower lobe had a healthy appearance, and could be inflated, except a portion in the posterior aspect, measuring, perhaps, an inch in diameter; this was partially coated with lymph, and was found to contain two small abscesses, one closed, the other opening externally on the surface of the lung and internally into a bronchial tube. On attempting inflation, the air passed directly through this opening. The closed abscess contained from one-third to half a drachm of pus-corpuscles, and disintegrated lung-tissue, as shown by the microscope. The child was much emaciated.

Case 2.—M. I——, female, was admitted into the Child's Hospital, October 7, 1859, at the age of about four months; at the time of admission was somewhat wasted with diarrhœa; her health improved partially, but she remained feeble, and was at times much troubled with meteorism, which occasioned pain.

On the 2d of November, she was suddenly seized with great dyspnœa, which terminated fatally in about a quarter of an hour. Previously to the dyspnœa, no cough had been noticed, or other symptoms referable to the chest.

Autopsy.—Body considerably emaciated; left lung healthy, with the exception of slight hypostatic congestion; right lung adherent to the diaphragm, and to a considerable part of the costal pleura, by fibrinous exudation; this lung was somewhat compressed and non-crepitant; the upper lobe floated in water; the middle and lower sank and could not be inflated, or but slightly; this portion of the lung contained a few small abscesses, filled with purulent matter, each holding scarcely more than one drop; two of these seemed to have discharged into the pleural cavity, as the air passed through them in attempting to inflate, but possibly they may have been opened in separating the adhesions which united the two pleural surfaces at this point: two or three ounces of fluid were contained in the pleural cavity, consisting, in addition to serum, of fibrinous flocculi, epithelial cells from the pleura, pus-cells, and compound granular cells; the lower portion of this fluid, on standing, contained so much pus that it presented the characteristic gelatinous appearance on the addition of liquor potassæ; the other organs generally were normal in appearance, but the liver was somewhat congested, and there was also decided hyperæmia of the mucous membrane of the colon near the ileo-cæcal valve, and in the descending portion.

Anatomical Characters.—The first appreciable structural change which occurs in pleuritis is engorgement of the vessels lying underneath the pleura. There can be seen, if an opportunity is presented, as in the case detailed above, a network of engorged capillaries. Immediately exudation commences into the connective tissue surrounding the capillaries,

the pleura becomes dry and lustreless, and loses its epithelial covering, and soon the liquor sanguinis begins to exude through it. The amount of serum and fibrin which escapes into the pleural cavity varies greatly in different cases, as does their relative proportion.

In pleuritis due to the irritation of tubercles, or to extension of inflammation from an inflamed lung to the pleura which covers it, the amount of liquid exudation is ordinarily small, and occasionally almost entirely absent, so that the visceral and costal surfaces remain in contact. In other cases, namely, when the pleuritis is idiopathic, or due to uræmia, or to a foreign substance in the pleural cavity, the liquid effusion is considerable, producing more or less compression of the lung. There are, however, exceptions to this general statement. In idiopathic pleuritis the exudation may consist almost entirely of fibrin, and be scanty, as in the case related above. On the other hand, I have seen a considerable exudation of serum with fibrin and pus in tubercular pleuritis, so as to compress considerably the lung.

If the lung is not too firmly attached by the fibrin to the walls of the chest, the liquid which is exuded presses it inward towards its root or its point of attachment to the mediastinum. If the quantity of liquid is large the compression may totally exclude air from the lung, and it becomes like a fleshy mass, or is *carnified*.

Ordinarily the fibrin forms a layer over the inflamed pleura, at first soft and readily detached, but gradually becoming firmer, and shreds or flocculi of fibrin, becoming separated, float in the exuded serum. When the inflammation has continued a short time, granulations appear on the inflamed surface, receiving their supply of blood from the subpleural capillaries, which have been prolonged. These granulations, when the serum is absorbed, uniting with those on the opposite side, form permanent adhesions.

Pleuritis, except when due to a local cause seated beneath the pleura, as tubercle or pneumonitis, extends rapidly, soon becoming general.

In a certain proportion of cases empyema occurs. The proportion of pleurisies in feeble and ill-conditioned infants which are or which become suppurative is very large. Hence empyema, as I have often noticed, is not infrequent in the institutions of this city where such infants are treated. Secondary pleuritis is more apt to be suppurative than is the primary inflammation. The pleuritis complicating or following scarlatina is usually so, being, therefore, often more dangerous than the primary disease.

Pleuritis has, for convenience of description, been divided into three stages: the first, extending from the commencement of the inflammation to the time when there is an appreciable amount of exudation; the second, from the time that the exudation is appreciable to the commencement of absorption; the third stage is that of absorption or convalescence. Absorption commences when the inflammation abates, and the rapidity with

which the fluid disappears varies greatly in different cases. As absorption occurs, the compressed lung gradually expands to occupy the place of the fluid. Sometimes absorption occurs more rapidly than the expansion, so that there is depression for a time of the thorax on the affected side, which gradually disappears. The serum is first absorbed, and then the fibrin, undergoing fatty degeneration and liquefaction, is also absorbed. Occasionally portions of the fibrin instead of being absorbed undergo calcification, after which there is no further change. Commonly, as the serum is removed, the two pleural surfaces become permanently adherent, as has been already stated, and the lobes are likewise united to each other.

In rare instances, in which there is a large amount of serous exudation, producing complete carnification of the lung, and absorption is slow, inflation never occurs, and the ribs of the affected side are permanently depressed. Respiration henceforth is performed entirely by the other lung, which increases somewhat in volume by hypertrophy of the air-cells. The compressed lung remains noncrepitant and firm, and its color somewhat lighter than the natural hue, from defective supply of blood and granular change in its anatomical elements.

In empyema, the patient cannot recover by absorption of the pus unless its quantity is small. If the quantity is small or moderate the liquor puris is first absorbed, and the pus-cells, becoming fatty and then liquefying, may also be absorbed and the patient recover. Indeed, in all cases of pleuritis, pus-cells may be detected in the exudation by the microscope. But if the pus predominates, or is in such quantity as to be apparent to the naked eye, recovery is slow and uncertain, and usually impossible by absorption. Empyema is, therefore, except when relieved by thoracentesis, commonly a lingering disease, attended by many of the symptoms of tuberculosis. Spontaneous cure occasionally occurs by discharge of pus into a bronchial tube, or externally through the walls of the chest. I have witnessed both these modes of termination. In certain instances, pleuritis on the left side becomes complicated with pericarditis, and, more rarely, pleuritis in the lower part of the right pleural cavity with perihepatitis, the inflammation extending in the one case through the pericardium, in the other through the diaphragm. I have met four cases of the former complication, and one of the latter in infants.

Symptoms.—The commencement of pleuritis is, in most instances, abrupt. Sometimes we observe a rigor or chilliness as the initial symptom, but this is in many cases not observed. An active febrile movement is suddenly developed, attended by headache, and perhaps vomiting. Sometimes the child screams violently at short intervals, as if from enteralgia or other severe pain. There is, usually, at this early stage, little or no cough, or other symptom characteristic of disease located in the chest. The symptoms of pleuritis obviously vary considerably in different cases,

according to the presence or absence of other diseases, the age and robustness of the patient, and the extent of the inflammation.

In acute primary pleuritis the pulse rises to 130 or 140 beats per minute, and in young children it is often more frequent, numbering 160 or 180. The frequency of the respiration is increased in a corresponding degree, and is accompanied by the expiratory moan. The temperature is probably at 102° or 103°. The face is more or less flushed and indicative of suffering. The child, if old enough to speak, complains of a stitchlike pain in the chest, which is most intense on inspiration and in coughing. Occasionally we can detect tenderness on pressing or percussing over the affected side. Sometimes the patient refers the pain to the epigastric region, on account of the distribution of some of the fibres of the intercostal nerves in this region. He assumes a certain position, as the erect, semi-recumbent, or the recumbent on one side, in which there is comparative ease of respiration, and his suffering is less. If disturbed or removed from this position he is fretful, his cough is more frequent, and the respiration is more painful. The cough is short, dry, or hacking, unless bronchitis coexist, in which case there is more or less expectoration. At the same time those symptoms are present which are common in all inflammatory affections, such as anorexia and thirst.

After some days the symptoms partially abate. The pulse and respiration are less frequent, though still accelerated, and the latter is less painful. Convalescence is more protracted in pleuritis than in ordinary pneumonitis. Several weeks frequently elapse before the liquid is fully absorbed, during which time there is apt to be more or less acceleration of pulse and elevation of temperature. Certain writers state a much shorter duration of the febrile movement, but in the cases which I have observed, which seemed to be most nearly typical, I think that the temperature did not fall to the normal standard before the close of the third week, or even later. The appetite and strength returned gradually.

The symptoms of pleuritis, though commonly so pronounced as to direct attention at once to the chest as the seat of the disease, have in other instances such mildness that the location of the inflammation in the thorax can only be ascertained by a careful examination of symptoms and physical signs. There is, indeed, every degree between severe and conspicuous symptoms, such as I have described, and latency.

Both primary and secondary pleurisies may be latent, latency being more frequent in infancy than childhood. The following is a not unusual example: A feeble infant, aged five months and twenty-eight days, died suddenly at the Nursery and Child's Hospital in December, 1870. The attention of the resident physician had not been called to it, as it was not supposed to be sick, although its general condition was bad, and the nurse who had charge of the ward stated that it had presented no symptom of disease, unless possibly a slight cough during the last three or four days.

Percussion over the right side of the chest of the corpse gave a flat resonance, and the right lung was found at the autopsy carnified, and covered with a loose, fibrinous layer, three-fourths of an inch thick in places, with but a scanty exudation of serum.

In empyema the symptoms may not differ materially at first from those in the ordinary form of pleuritis, but absorption occurs of only a portion of the liquor puris. The pus produces the ordinary effects of purulent collections in the system, namely, loss of appetite, hectic fever, emaciation, loss of strength. No improvement occurs except by discharge of pus, either by thoracentesis or through an ulcerative opening, after which the child usually slowly, but progressively, recovers. In fatal cases of empyema the vital powers gradually yield, the pulse becomes more frequent and feeble, the face and limbs pallid and cool, and death occurs from asthenia.

Physical Signs.—Skilful auscultators disagree, or are in doubt, in regard to the nature of certain of the abnormal sounds heard in the chest in cases of pleurisy. And this disagreement or uncertainty is greater in the examination of children than of adults; for in children, especially infants, many of the physical signs present peculiarities, so that they are less readily recognized or identified than in those who are older. Still, it is seldom difficult to make an accurate diagnosis by means of the physical signs even in the youngest child.

Auscultation.—In the very commencement of the inflammation auscultation affords but little information. Probably we only notice that change in the vesicular respiration which necessarily results from the hurried breathing. A little later we observe (but this is only noticed in certain cases, or when the visit is made at the proper moment), a dry rubbing sound at the seat of inflammation, which may be imitated by pushing the finger firmly across the dry palm of the hand. As the surface of the pleura becomes moistened by exudation this sound disappears. Next we observe, and this, too, only in certain cases, a moist friction-sound, heard near the surface of the chest. It may resemble closely the crepitant râle, for which it is sometimes mistaken, being a succession of fine friction-sounds. In other cases only one or two of these sounds are observed in each respiration, and they are well described by the term clicking. This crepitant, or clicking sound, may be heard through a considerable portion of the time during which the pleuritis continues, provided that there is but little liquid exudation, and the surfaces roughened by moist fibrin remain in contact. In other cases it is only heard for a brief period, disappearing when the contact of the surfaces is prevented by the liquid. After absorption of the liquid this sound may reappear, and in some cases it is heard only in the third stage.

It will be recollected that the explanation which Trousseau gives of the occurrence of this sound differs from that which is commonly accepted.

"This sound," says he, "which is met with in the great majority of cases of pleurisy is, in fact, a crepitant râle, and I have called it *the crepitant râle of pleurisy*. My interpretation of it is very simple. Just as we never have erysipelas without engorgement of the cellular tissue, there cannot be erysipelas of the pleura or pleurisy, without an irritative engorgement of the subpleural cellular tissue, or of the peripheric pulmonary parenchyma. This fluxion naturally carries with it into the pulmonary vesicles a serous exudation analogous to that of pulmonary œdema. We also meet with a fine subcrepitant râle, which is very often heard quite at the beginning of the pleurisy, and which likewise nearly always continues for some weeks, when the fluid being absorbed, there only remains subinflammatory œdema of the more superficial parts of the lungs." Perhaps this explanation may apply to certain cases, but there can, I think, be no reasonable doubt that the clicking sound to which I have alluded, since it is superficial and does not commonly disappear after coughing, is in some instances pleuritic.

When the second stage commences and the pleural cavity contains more or less liquid, the lung, unless adherent to the ribs, is carried inward and upward and compressed. The respiratory sound now disappears in children over the age of five years, but in a large proportion of cases in the first years of childhood, and usually in infancy, in which period the pleural cavity is small, respiration is heard when the ear is applied over the liquid. It is transmitted through the liquid from the bronchial tubes or from the opposite lung. Its character is bronchial, broncho-vesicular or vesicular. It varies in intensity according to the amount of the liquid, and the strength and rapidity of the respiration. When the inflammation is active, and exudation occurs rapidly, bronchial respiration may be heard as early as the second or third, or even on the first day, when the ear is applied in the scapular and infrascapular region. Rilliet and Barthez believe that it differs from the bronchial respiration of pneumonia, not only in its duration, but also in the character of its sound, being metallic. If the inflammation is mild, and the exudation occurs slowly, bronchial respiration is not observed till after the lapse of some days. When there is a very considerable amount of liquid exudation, bronchial respiration may be observed in the infraclavicular region as it so often is in adult cases. Ægophony is occasionally noticed in cases which are attended by a large effusion; it coexists with the bronchial respiration. It is heard in the inter- and infrascapular spaces. Its duration is commonly brief, disappearing in three or four days, or even in less time. Feeble vesicular respiration may be heard in one part of the chest, while in other parts the bronchial respiration occurs, and in other parts still, namely, at the base, no sound whatever is audible; or, without the bronchial respiration, we may hear a distant or faint vesicular murmur over the entire half of the chest, which is the seat of the disease. Such are the various combinations and modifications of the respiratory sounds noticed in these cases, sounds which pre-

sent variations in their presence and relative proportion as the disease advances.

Percussion.—Percussion in the commencement of pleuritis before there is any appreciable exudation gives a negative result. If dulness is observed, it is due to coexisting disease, commonly pneumonitis or tuberculosis. When exudation occurs, unless it is entirely fibrinous, percussion over the affected side gives at first a dull and then a flat sound, but above the level of the liquid the resonance is good, and occasionally tympanitic. The sensation communicated to the finger in percussing, is like that produced by a solid substance. The flat percussion-sound distinguishes the pleuritic exudation from the solidification of pneumonitis, for the percussion-sound in pneumonitis is dull, but not flat. In young children, in whom pneumonitis is catarrhal, and limited to a part of a lobe, the difference is very marked. Changes in the height of the flatness according to the position of the patient is sometimes observed in infancy and childhood, but this sign is less reliable than in adult life. Now and then we observe cases in which other physical signs do not indicate the presence of a liquid in the pleural cavity, and there is no pulmonary disease, and yet percussion gives a dull sound. In these cases the dulness is due to the fibrinous exudation, which often has a very considerable thickness, especially if its fibres are loosely arranged. I have related above a case in which the exudation was three-fourths of an inch thick. If the pleuritis depends upon tuberculosis or pneumonitis, the physical signs which characterize the primary disease are intensified by the exudation.

Inspection—Mensuration.—At first, if respiration is painful the movements of the affected side in breathing are somewhat restrained, and subsequently when there is a large effusion they are more limited than on the opposite side.

Bulging of the intercostal spaces, and distension of the thoracic walls from the fluid, are less frequently observed and less marked in young children than in adults. In the infant, especially if feeble, so readily are the lungs compressed, that incomplete carnification is apt to occur before the shape of the chest is materially altered. When there is a large pleuritic exudation with bulging of the intercostal spaces the circumference of the chest on the affected side is rarely more than three-fourths of an inch to one inch greater than that of the healthy side.

On account of the peculiarities as regards the physical signs and the mechanical effect of a liquid in the pleural cavity of a young child, physicians whose knowledge of pleuritic effusions is derived chiefly from the examination of adult cases are apt to err in diagnosis. Thus, in 1870, a carnified lung, covered with a thick pyogenic membrane from which granulations had arisen, was presented by myself to the New York Pathological Society, with the following history of the case. W., twelve months old at the time of death, was taken sick at the age of six months, with fever,

and a cough, which was slight and not frequent. At about eight months he first came under observation. The infant was then small for its age, pallid and thin. The two sides of the chest measured the same, and on both sides the intercostal spaces were somewhat depressed, but percussion over the right side produced a flat sound, showing that the air was wholly excluded from the right lung. The respiration upon the affected side was bronchial and distinct. Two well-known physicians of this city, thorough in their examinations, and usually accurate in diagnosis, examined this case in reference to the propriety of thoracentesis, and both expressed a decided opinion that the pathological state was not a pleuritis, but either collapse or interstitial pneumonitis, one of them observing, as he thought, in addition to the physical signs already stated, bronchophony. The febrile movement was moderate, and no decided hectic was observed. Death occurred from exhaustion. At the autopsy about half a pint of thick pus was found in the right pleural cavity, producing complete carnification of the lung. The pus, which, considering the stunted growth of the child and small size of the pleural cavity, was considerable, had evidently lost part of the liquor puris by absorption.

The following case, which shows how deceptive the physical signs may be in young children in cases of suppurative pleuritis, will repay perusal, since the life of the patient depends in great part on a correct understanding of his condition, so that appropriate measures will be employed.

Case.—H——, boy, four years four months old, was taken with scarlet fever in the latter part of May, 1868. It was severe, and was attended with inflammation of the glands and connective tissue of the neck, with suppuration on both sides. Purulent discharges from the abscesses continued through the month of June. The patient was gradually convalescing, when, about July 4th, pleuritis commenced on the left side, attended by the ordinary symptoms of acute forms of this inflammation. A few days subsequently the pleural cavity was ascertained by examination to be about half full of liquid.

Towards the close of July anasarca commenced about the ankles and gradually extended upwards. It was limited to the lower extremities and to the abdominal walls, and by the middle of August became excessive. The thoracic walls and the upper extremities were somewhat emaciated, and the face was pallid and anxious.

On the 7th of August a careful examination of the chest was made in reference to the propriety of thoracentesis. The intercostal spaces on the left side were not prominent, but rather depressed. Percussion over the lower third of the left pleural cavity elicited a flat sound, while above this the resonance was tympanitic. On account of the great restlessness of the patient, no useful information was derived from change of position. On auscultation distinct bronchial respiration was heard over nearly or quite the entire left side of the chest. The apex beat of the heart was on the right of the sternum. It was my opinion, as well as that of two other physicians, that the liquid was in process of absorption, and that the quantity present was not large. Thoracentesis did not, therefore, seem a proper measure. The aspirator was at this time little used.

The anasarca still limited to the lower extremities, and the abdominal walls continued to increase, and on the 25th of August, so great was the distension, that the skin broke in one or two places above the ankles. The mind remained clear, the kidneys were apparently not involved, and the appetite was pretty good. Death occurred August 27th.

Sectio Cadaver.—Head not examined; abdominal and right pleural cavities contained no effusion, and were in their normal state, except that the latter cavity was somewhat encroached upon by the heart and mediastinum; a great amount of œdema in the lower extremities and in the abdominal walls; abdominal walls towards the spine about three inches thick, in consequence of œdema; right lung of good size and presenting the ordinary appearance, except a greater amount than usual of hypostatic congestion; about three pints of pus (laudable) in the left pleural cavity; left lung completely carnified and lying against the vertebral column; its size about that of an orange, and its surface covered with a dense layer of fibrin; heart displaced, as already stated, to the right and a little downward, so as to compress and partially obstruct the circulation in the ascending vena cava; this vessel contained a continuous, firm, and yellow fibrinous clot, nearly filling its calibre; the femoral vein, examined on one side, was found to contain soft and dark clots. Compression of the cava opposite the heart and the formation of clots had evidently given rise to the anasarca.

An important negative sign, as we will see, is the absence of bronchophony and vocal fremitus over that portion of the chest where the liquid has accumulated.

Occasionally physical signs, which commonly indicate tuberculosis, are heard in children as well as adults on auscultating the chest which is the seat of a pleuritic attack. Attention has been called to this fact by Rilliet and Barthez, one of whom had diagnosticated tuberculosis from these signs, in a case which fully recovered, and afterwards by Trousseau, who says: "In cases of pleurisy we often meet with all the stethoscopic signs which belong to the third stage of tubercular phthisis. . . . . Amphoric respiration, gurgling, and cavernous voice are sometimes so well marked, that it is impossible to avoid attributing them to the existence of cavities in the luugs." The occurrence of these signs, however, in uncomplicated pleuritis is rare, but it is necessary to be aware of their occasional occurrence, in order that the diagnosis in cases in which they are observed be more careful and guarded.

It has been said by certain writers that displacement of the heart and the subdiaphragmatic organs by large pleuritic effusions is less frequent and less in degree in children than in adults. However this may be, it is certain that displacement of the heart to the right is common in pleurisy of the left side, even when the quantity of liquid in the pleural cavity is moderate. I have found this fact very useful in diagnosis.

Diagnosis.—This is in certain cases readily made, but in other instances is, as we have seen, attended with difficulty. Obscure or doubtful cases occur chiefly in infancy. Partial or circumscribed pleuritis, attended

with little or no serous exudation, is more apt to be overlooked than other forms of the inflammation, but, as it is ordinarily due to grave disease of the lungs, which requires the chief treatment, its detection is not very important. The points involved in its diagnosis are acceleration of pulse and respiration, increase of temperature, expiratory moan, friction-sound, and tenderness on percussion.

The diagnosis of acute general pleuritis in its commencement, before the stage of effusion, is attended with some difficulty. It is most likely to be mistaken for pneumonitis, since the prominent symptoms in the commencement of the two diseases are similar. There is, however, in pleuritis ordinarily greater acceleration of pulse and respiration, greater elevation of temperature, greater suffering, as indicated by the features, and a more decided expiratory moan. It will aid in the differential diagnosis, in children under the age of five years, to recollect that acute pneumonitis is in most instances preceded by bronchitis, which is not the case with acute pleuritis, except as a coincidence.

Pleuritis with effusion could only be mistaken for pneumonitis or hydrothorax. But the loss of resonance on percussion in cases of pleuritic effusion is much greater than when the lung is solidified from pneumonitis. The physical signs, which are involved in the differential diagnosis of these diseases in the adult, are important, also, for diagnosis in children, though, as we have seen, they are less constant and less reliable in young children than in adults. In children over the age of five years they are pretty uniformly present. The signs alluded to are bulging of the intercostal spaces, expansion and subsequently retraction of the chest, evidence of change in the height of the fluid by change in the position of the body, no bronchophony and fremitus as in pneumonitis, etc. The absence of bronchophony and vocal fremitus, as evidence of a liquid in the pleural cavity, needs to be emphasized. These physical signs may be observed in pleurisy, even when there is considerable effusion, provided that the examination is made over a point where the lung happens to be adherent to the ribs, but if it is made over the liquid they will not be observed. The presence or absence, therefore, of these signs aids materially in the diagnosis between a liquid and solidification of the lung. Hydrothorax in the child commonly results from one of the eruptive fevers, especially scarlatina, and its immediate cause is nephritic congestion or inflammation, or heart disease. Rarely it is due to obstruction in the pulmonary circulation, in consequence of enlarged bronchial glands. It is not, therefore, preceded nor accompanied by symptoms of inflammation referable to the chest, as in cases of pleuritic effusion.

Empyema may be diagnosticated from the fact that there is but little diminution in the amount of liquid after several weeks have elapsed, and from the febrile movement, loss of appetite, flesh, and strength, which attend all large purulent collections.

Prognosis.—Primary pleuritis, occurring in patients previously healthy, commonly ends favorably; but it is a serious disease if the general health has been much impaired. The prognosis is more favorable if, as is commonly the case with this form of pleurisy, the patient is over the age of three or four years.

Secondary pleuritis is, on the other hand, a grave affection, but the prognosis depends greatly on the character of the primary malady, and also on the age. Pleurisy resulting from and coexisting with pneumonitis commonly ends in recovery even in quite young patients. Pleuritis arising from scarlet fever is apt to be suppurative, and is, therefore, a serious complication or sequel, but a considerable proportion affected with it recover under judicious treatment. The prognosis in tubercular pleuritis and pleuritis occurring from the escape of pus into the pleural cavity is obviously unfavorable.

Tubercular pleuritis may be temporarily relieved, but it is apt to return. Suppurative pleuritis, or empyema, is also an unfavorable form of inflammation, characterized by the chronicity and many of the symptoms of tuberculosis. It is in time fatal unless the pus is evacuated. On the escape of the pus, whether spontaneously or by thoracentesis, there is usually progressive and complete restoration to health. In case the pus is evacuated, the prognosis is better in children than in adults.

Treatment.—The indications of treatment are, in the commencement of the inflammation, to diminish its intensity, and relieve pain; at a later period to promote absorption, and sustain the vital powers.

Pleuritis is one of the few inflammations in early life in which the abstraction of blood may be proper. It may be stated as a rule, that loss of blood is not only not required, but is an injudicious measure in all secondary pleurisies, and in the primary form after exudation into the pleural cavity has occurred. It is a useful measure at the commencement of acute primary pleuritis occurring in a robust state of system. One or two leeches should be applied directly over the seat of the inflammation, and bleeding may be encouraged for two or three hours subsequently by the application of cloths wrung out of warm water. Unfortunately the physician is, in many cases, not called at this early period; or, if called, he fails to make the diagnosis till there are evidences of exudation.

After bleeding has ceased, or in subacute and secondary pleurisies without the employment of leeches, a large rubefacient cataplasm should be applied over the affected side of the chest, and covered with oil-silk. A poultice consisting of one part of mustard and sixteen of flaxseed between two pieces of thin muslin and sufficiently wet answers the purpose. Moderate counter-irritation diminishes the pain, but vesication at this early period is injurious. A blister applied so near the seat of the inflammation may increase the afflux of blood towards it, and aggravate the disease.

Robust patients over the age of three or four years, are benefited by the use of cardiac sedatives in the commencement of acute pleuritis. The tincture of aconite root should be given, but its effects should be watched, and it should be discontinued or given less frequently when the pulse is reduced to nearly the natural number, or when sufficient exudation has occurred to produce the ordinary physical signs of liquid in the chest. It should be given cautiously in secondary pleuritis.

Opiates are required, as in other serous inflammations, according to the pain. Dover's powder, in doses of one to three grains, according to the age, may be given every two or three hours, or less frequently if the patient is inclined to sleep.

The following is a favorite prescription with me for a child of three years :—

℞. Tinct. ipecac. comp.
(Squibb's liquid Dover's powder), gtt. xvj–xxiv ;
Tinct. rad. aconit., gtt. viij ;
Syr. bal. tolut., ℥ij. Misce.
Dose, one teaspoonful every two or three hours.

Such is the treatment required in the first stage of acute primary pleuritis, or that preceding the effusion. Secondary pleuritis requires fewer and less depressing measures. The appropriate treatment, in a larger proportion of the cases of this form of the disease, consists in the use of an opiate, with rubefacient and emollient applications to the chest. Abstraction of blood is not required in this form of pleuritis, but the aconite is sometimes useful for a few days.

Pleurisies dependent on pulmonary disease, which are circumscribed and attended with little serous effusion, require no other therapeutic measures than those already mentioned. The judicious use of opiates, and rubefacient and emollient applications, suffice for their treatment.

In the treatment of other forms of pleurisy, which are attended by more or less effusion of liquid into the pleural cavity, measures designed to remove this liquid are required when the inflammation has abated, and antiphlogistics are no longer appropriate.

Liquids in the great cavities are best eliminated by hydragogue cathartics and by diuretics. For children, however, already weakened by pleuritic inflammation, cathartics are usually too depressing. Now and then a robust patient, over the age of five or six years, with pleuritic effusion, may be benefited by an occasional purgative dose of bitartrate of potassa, or by from one-twelfth to one-sixth of a grain of podophyllin. But such cases are exceptional. In a majority of children the loss of strength resulting from cathartics more than counterbalances the good result from the liquid evacuations which they produce.

Diuretics, on the other hand, are efficient remedies, and upon them our chief reliance must be placed.

The diuretics from which good results may be expected are digitalis with acetate of potash, and in certain cases iodide of potassium. In the adult I have observed rapid absorption of the liquid by the administration of from one to two drachms daily of the iodide, given in doses of ten grains, and a child can take a proportionate dose. Two to five grains, according to the age, may be given every three hours. At the same time it is advisable to restrict the drinks.

At this stage of the disease counter-irritation is appropriate, either by rubefacients or vesicants. The preferable mode of blistering the child is, in my opinion, by cantharidal collodion applied as recommended in the treatment of pneumonitis. I prefer, however, instead of vesication, the application by friction two or three times daily of the unguent. iodinii compositi of the Pharmacopœia.

In secondary pleuritis the diet should be nutritious, consisting largely of animal broths, through the whole period of the disease.

In primary pleuritis nutritious diet should be allowed after exudation has occurred. In some cases, more frequently in secondary than primary pleuritis, stimulants are required. In protracted pleuritis, or pleuritis occurring in a debilitated patient, tonics, both vegetable and chalybeate, are often serviceable, sustaining the strength while the process of absorption is going on.

Occasionally the measures which have been recommended above to promote absorption of the liquid in the pleural cavity do not have the effect which is desired. If there is no sensible diminution in its amount, and if the general health of the patient begins to fail, the performance of thoracentesis should be considered. We may accomplish by surgery what we fail to do by therapeutic means.

Thoracentesis is one of the oldest operations in surgery, having been practised by the school of Hippocrates, and being described in the writings of Galen, but till a recent period it was only performed in rare instances, and then hesitatingly as a last resort. "During the middle ages," says Trousseau, "it was discussed whether it were better to make the opening into the chest by steel or by fire, and the operation was rarely performed, except in surgical lesions." It was reserved for Trousseau, between 1843 and 1847, to convince the profession, amid considerable opposition, not only of the safety, but of the urgent need of the performance of thoracentesis in cases not only of purulent exudations, but also in many cases of extensive serous or sero-fibrinous exudations into the pleural cavity By a series of cases he was able to show the great risk in deferring the operation, when there is a large and increasing effusion which does not yield to remedial measures, for orthopnœa suddenly developed may carry off the patient.

Except Trousseau, Dr. Bowditch, of Boston, has done more than any other physician to remove all existing prejudices against thoracentesis, and

bring it into vogue. His statistics, as they are the most numerous, are the most satisfactory and convincing yet published. Previously to 1870 he had performed this operation "250 times in 154 persons, without once seeing any evil, or even any very distressing symptoms resulting from it, while on the other hand it has saved a large number of lives, that must otherwise have been sacrificed." Statistics show that thoracentesis, for the removal of pleuritic effusions, results favorably in a larger proportion of cases in childhood than in adult life. In my own practice during the last five years, this operation has been performed upon seven children with empyema, the result, in all instances, of the operation being favorable, except in one, in which there were, no doubt, tubercles, while during the same time in at least two instances, I have observed children perish of empyema without the operation.

One of the chief reasons why thoracentesis was formerly so seldom performed, was the dread of admitting air into the pleural cavity. It was thought that the contact of air with the pleura in cases of empyema caused a continuance or aggravation of the suppurative inflammation, effected decomposition of the pus, and gave rise to the formation of noxious gases within the chest, which increased the cachexia and depression of the patient. No doubt the contact of air tends to promote purulent decomposition, but if the pus is removed by the operation, as it should be, or if the opening remains fistulous, no harm results in a care of empyema from the admission of a moderate quantity of air, except so far as it prevents expansion of the lungs. Any possible ill effects from pus decomposition can certainly be prevented by washing out the pleural cavity with tepid water, to which a little carbolic acid is added. At the present time, I think, the profession generally agree that the entrance of a moderate amount of air into the pleural cavity in cases of empyema, does little or no harm, but there is a general apprehension that it may convert a serofibrinous into a suppurative pleuritis. The evil effects of the admission of air have evidently been misunderstood. Surgeons are not deterred from the removal of ovarian tumors by the fear of admitting air into the peritoneal cavity, and why its admission into the pleural cavity has been and is so much dreaded, it is difficult to understand. In the *London Lancet*, January 15th, 1831, the case is related of a man who suffered from heart disease, and was led to think that the pressure of a small quantity of air internally might be substituted for external pressure, which always gave relief. The idea occurred to himself, and he was his own operator. He employed a fine tube about as slender as a common pin, to which a bladder was attached containing common air. The point of this was thrust through the skin and subcutaneous tissues till it reached the cavity, and air was squeezed through it by compressing the bladder. Relief always followed, and improvement was effected in the patient's health. These experiments were continued two or three years. Dr. Lizars, who was

present at the meeting of the medical society before which this case was related, stated that he had performed this operation on four or five patients affected with aneurisms, with some apparent benefit, and in no case with injury.

In view of such facts it seems probable that the admission of a little air into the pleural cavity during the operation of thoracentesis can do little harm, whether the exudation, for the removal of which the operation is performed, is sero-fibrinous or purulent. However, with the mode of operating which is now commonly employed, namely, by the aspirator, the admission of air is prevented. It is probable, also, that some of the prejudice against thoracentesis resulted from the improper manner in which the operation was performed, with the faulty instruments employed previously to the last thirty or thirty-five years. Surgeons previously to this time advised puncturing in the anterior aspect of the chest, instead of in the well-known eligible point, under the angle of the scapula.

It is very important to be able to determine the circumstances under which thoracentesis should be performed. Dr. Anstie, in his article on pleurisy, in *Reynolds's System of Medicine*, lays down the following judicious rules for determining when to operate :—

1. "In all cases of pleurisy, at whatever date, where fluid is so copious as to fill one pleura, and begins to compress the lung of the other side; for in all such cases there is the possibility of sudden and fatal orthopnœa.

2. "In all cases of double pleurisy, when the total fluid may be said to occupy a space equal to half the united dimensions of the two pleural cavities.

3. "In all cases where the effusion being large, there have been one or more fits of orthopnœa.

4. "In all cases where the contained fluid can be suspected to be pus, an exploratory puncture must be made; if purulent the fluid must be let out.

5. "In all cases where a pleuritic effusion, occupying as much as half of one pleural cavity, has existed so long as one month, and shows no sign of progressive absorption."

The simplicity and almost painlessness of the operation is an argument in favor of its early performance, even in certain cases which might and probably would eventuate favorably with only medicinal measures, for the evacuation of the liquid will often greatly shorten the disease, and relieve the patient of much suffering. American physicians have not yet learned to operate as early as some of our transatlantic brethren, and there is no doubt more danger of our deferring the operation too long, than of operating at too early a period. Murchison tapped the chest of a boy, aged seven years, on the twelfth day of acute pleuritis, removing twenty-four ounces of nearly transparent serum, with the entrance of some air into the pleural cavity. The effusion had displaced the heart, and caused

slight dyspnœa and weakness of pulse. The patient did well, and in one month fully recovered.

If the exudation is purulent, unless the quantity is very small, the physician is indeed censurable if he defers tapping, for there is every probability that the state of the child will become daily worse, from the increasing cachexia, and the retention of pus in the system endangers the formation of tubercles. (Art. Tuberculosis.) Cases like the following, which perhaps an early resort to tapping might relieve, are not in my opinion very infrequent. In the latter part of November, 1873, I was asked to see an infant, aged 12½ months, who had pleuritis of the right side, commencing a few days previously. During December the temperature was usually from 101° to 101¾°, and pulse from 140 to 160 per minute. The physical signs indicated a small amount of liquid, no doubt purulent, in the inferior and posterior part of the right pleural cavity, and adhesion of the right lung laterally and anteriorly to the walls of the chest. The amount of liquid seemed so small, that it was deemed best, in consultation, to defer the operation, although there was progressive loss of flesh and strength. A few weeks subsequently, the symptoms and physical signs indicated the formation of tubercles, and early in the following spring death occurred.

On the other hand we sometimes meet cases in which there is considerable liquid effusion, with but little dyspnœa, loss of appetite, and constitutional disturbance. Under such circumstances, the general condition being good, thoracentesis may ordinarily be safely deferred. Medicinal agents may, and probably will, suffice for the cure.

The point for the puncture may be ascertained by the rules of Dr. Bowditch: "Find the inferior limit of the sound lung behind, and tap two inches higher than this on the pleuritic side, at a point in a line let fall perpendicularly from the angle of the scapula. Push in the intercostal space here with the point of the finger, and plunge the trocar quickly in at the depressed part; be sure to puncture rapidly and to a sufficient depth, or you may be balked by the false membrane occluding the canula." An eligible point for the operation is from one to two inches below the angle of the scapula, either upon the line drawn vertically through that angle or a little inside or outside of that line.

Having selected the point for the puncture, the hypodermic syringe should be introduced, and by slowly withdrawing the piston, we are able to ascertain the nature of the liquid, for even if it be very thick pus, a few drops will enter the instrument. If it be mainly serous, and we desire to remove it, it may be allowed to drip from the instrument, or it may be removed through the small point of the aspirator. If it be pus, it can be removed by employing the medium-sized point of the aspirator, or by establishing a fistulous opening, with a narrow bistoury introduced close to the upper edge of the rib, the skin being drawn up a little with the finger.

By either operation children ordinarily do well, though their restoration to complete health may be slow. The following case is interesting as showing a favorable result, from opening the chest with a bistoury in an infant, that seemed almost moribund at the time of the operation, and whose death had been predicted by experienced physicians. The records are condensed from my notes.

"December 8th, 1873. Mary B., aged 5 months, nursing, inmate of New York Infant Asylum, has had a cough for three weeks, but it has been more frequent and severe during the last three or four days than previously. Is pallid and weakly-looking. Dec 12th. Pulse, 120 per minute; temperature, 100¾°; has flat percussion-sound over the entire left side of the chest, and a pleuritic, clicking sound is observed in the left scapular region; respiration slightly abdominal, and accompanied by an expiratory moan; respiratory murmur on left side distant, and bronchovesicular or bronchial; no appreciable bulging of intercostal spaces on this side; circumference of left side of chest from half to three-fourths of an inch greater than that of the opposite side; he is gradually losing strength; and his features are pallid, and of a flabby appearance, notwithstanding the constant use of stimulants and tonics. Dec. 15th. Pulse, 144; temperature, 100°. Dec. 22d. Pulse, 168; temperature, 99¼°. Dec. 26th. Pulse, 160; temperature, 101¼°. Dec. 29th. Pulse, 144; temperature, 99½°. Jan. 8th, 1874. Pulse, 156; respiration, 60; temperature, 101°."

On this day (January 8th) the presence of pus in the pleural cavity having been ascertained by the hypodermic syringe, an incision was made through the walls of the chest with a narrow bistoury, about one and a half inches below the angle of the scapula. Thin pus, tinged with blood, perhaps two ounces, escaped, and some air entered the chest during the operation. The opening remained fistulous, discharging pus, which was often unhealthy-looking and offensive, with intermissions of a day or two, till about the middle of June, when the flow ceased, and she has since remained well.

I prefer, however, in general, the use of the aspirator for the removal of pus in the empyema of children. The removal of all the pus, which can be aspirated at a single sitting through an aspirator point of medium size, will ordinarily, I think, be sufficient to insure a favorable result, as in one of the cases detailed above; for, though there is some pus remaining, it will be absorbed, provided that the quantity is not too large. Washing out the pleural cavity with tepid water, to which a little carbolic acid is added, no doubt expedites recovery. It is especially useful when the pus is fetid, as in the case last related. If the child do not progressively improve, or if the physical signs indicate a refilling of the cavity with pus, I would then establish a fistulous opening. Thus, in the case of a child aged about three years, who was brought to my clinique at Bellevue in the spring of 1875, Dr. Ackerman and myself removed about eighteen

ounces of pus by aspiration. There was great relief, but a few weeks subsequently it was brought back with symptoms and physical signs almost as grave as at first, when the Doctor judiciously established a fistulous opening, after which the case progressed favorably.

Nervous Cough.

A nervous cough sometimes occurs in children, especially between the ages of two or three and ten years. It may result from disease of the brain, from the second as well as first dentition, from some irritant in the intestines, as worms, and also from spinal irritation. Occasionally there appears to be no local cause, but a state of anæmia, or a highly developed nervous temperament, to which it seems proper to ascribe the cough. Occurring under these last circumstances it corresponds with, and is sometimes accompanied by, functional disturbance in the action of the heart, as palpitation.

A nervous cough is short, painless, and without expectoration. It usually attracts little attention at first, but from its long duration the friends finally become anxious lest it betoken some serious disease. At times it may nearly subside if the patient lead a quiet life and the general health improve, and there are periods of recrudescence if the opposite conditions obtain. It may have a spasmodic character, especially in times of mental excitement, but in a less degree than the cough of pertussis. If not properly treated, it usually continues several weeks or months, disappearing as the general health and the tone of the nervous system improve. It is not in itself a serious disease, nor does it lead to any ailment or produce any injury of the respiratory organs, but it is an unpleasant malady, and is liable to be mistaken for incipient tuberculosis if it occur in one decidedly cachectic, and belonging to a family predisposed to phthisis.

Treatment.—If there is a local cause of the cough, measures calculated to remove this, or at least to palliate its effects, are obviously required. Especially should constipation, or any abnormality in the digestive function be corrected. But in many cases there is no apparent local ailment which produces the cough by its irritative effect, and the remedial measures must then be twofold, namely, measures designed to improve the general state, and secondly, measures designed to relieve the cough. Such measures are also required in most cases in which there is a local cause, provided that the cough do not cease when treatment calculated to remove this cause has been employed.

For constitutional treatment no remedy is so useful in ordinary cases as iron. The following example shows the benefit which may result from the use of this agent, since in this case it effected a cure without the aid of other measures. B——, aged 11 years, pallid and of spare habit, but ac-

tive, and with good appetite, had been treated for this malady by different physicians but without improvement. His mother had died of tuberculosis, and some at least of the physicians believed that he was in the commencement of the same disease. Finally he was placed under the care of the late Dr. Cammann, who, detecting the nature of the malady, wrote the following prescription:—

℞. Ferri. subsulphat., ʒss;
Acid. nitric., fʒss;
Aq. destillat., ℥ss. Misce.
Dose, three drops four times daily in sweetened water.

The cough disappeared in a surprisingly short time. If the appetite is poor the vegetable tonics are required in combination with iron.

If the cough is frequent and troublesome, medicines which exert a direct controlling effect upon it are required in addition to the medicines and measures employed to improve the general state. For this purpose no remedy is so useful as the bromides, employed alone or in combination with belladonna. If there is no decided anæmia, and no local cause of the cough, the bromides and belladonna usually effect a cure without the employment of constitutional measures, or if the case seem to require iron it may be given in the interval. The following is the prescription for a child of three years:—

℞. Tinct. belladonnæ, gtt. xxxij;
Potas. bromid.,
Ammon. bromid., āā ʒj;
Syr. simplic., ℥ij. Misce.
Dose, one teaspoonful twice daily.

In 1871 I was asked to prescribe for a German boy, aged 8½ years, who had a cough of this kind of two months' duration, which latterly had been frequent and annoying. Within a week he was entirely relieved without other remedy, by the employment of tincture of belladonna, drops v, and bromide of ammonium, gr. v, twice daily. Outdoor exercise, or country residence and other regimenal measures which improve the general health are useful in ordinary cases.

SECTION III.

DISEASES OF THE DIGESTIVE APPARATUS.

CHAPTER I.

SIMPLE STOMATITIS, ULCEROUS STOMATITIS, FOLLICULAR STOMATITIS.

Diseases of the digestive system are very frequent in infancy and childhood. They are for the most part readily recognized, and are more easily and quickly controlled by therapeutic agents, if rightly applied, than are the diseases of any other system. If misunderstood and improperly treated, they may, even when mild and very manageable in their commencement, become chronic and obstinate, or even fatal, or they may lead to other and more dangerous diseases. It is necessary, then, that the physician should understand thoroughly the pathology as well as therapeutics of the digestive system, that he may make timely and correct use of the required remedies.

The diseases of the buccal cavity in early life are for the most part inflammatory. The mildest is that known as

Simple or Catarrhal Stomatitis.

This form of catarrh occurs usually before the completion of first dentition, and it is most frequent under the age of one year. Giving rise in itself to no severe symptoms, and often being connected with other grave and dangerous maladies, it is, doubtless, in many cases overlooked. It is sometimes confined to a portion of the buccal surface, or is more intense in one part than in another. In other cases the catarrh is uniform, or nearly so, affecting the entire cavity of the mouth.

Causes.—The common cause of simple stomatitis in infants is the same as that of most cases of gastro-intestinal inflammation at that age. This is the use of indigestible and therefore irritating food, uncleanliness, personal and domiciliary; in fine, all those agencies which impair the general health, and enfeeble the digestive organs. Therefore, stomatitis, like entero-colitis, is more common in the city than in the country, and among the city poor than those in the better walks of life. Infants deprived of the mother's milk and given a diet which, with all care of preparation, is

a poor substitute for the natural aliment, are very liable to this disease. Beaumont ascertained from his experiments on St. Martin that irritative changes produced in the stomach by indigestible substances were soon followed by similar changes in the buccal mucous membrane. Since in young infants any kind of artificial food is less digestible than the breast-milk, it is evident why those who are prematurely weaned or are carelessly fed are so liable to stomatitis. This inflammation is also sometimes due to irritating substances taken in the mouth, as drinks habitually too hot or too cold. Stomatitis is also present in measles and scarlet fever. It then corresponds with the cutaneous eruption, and disappears when that subsides.

Another cause is dentition. The gum over the advancing tooth first becomes inflamed, and, other causes perhaps conspiring, the inflammation extends over more or less of the buccal surface. When due to dentition the stomatitis is more apt to be partial than when it arises from a constitutional cause. Mercury, in whatever form introduced into the system, excreted from the salivary glands, and flowing over the buccal surface, is an occasional though nowadays rare cause.

Symptoms—Appearances.—Stomatitis, like other mucous inflammations, is characterized by increased redness and more or less thickening of the inflamed buccal membrane, by rapid proliferation and exfoliation of epithelial cells, and by an increased functional activity of the muciparous follicles. The heat of the mouth is sometimes augmented in an appreciable degree. The gums in severe cases are swollen and spongy, and bleed easily if rubbed or pressed. The tongue is usually covered with a light fur, and the salivary secretion is augmented to such an extent sometimes as to dribble from the corners of the mouth. Often there is little suffering, but in other instances the patients are fretful, experience pain from the contact of solid food, and, if nursing, may even wean themselves from dread of pressure of the nipple.

Simple stomatitis is not difficult of detection, provided attention is directed to the mouth. Inspection informs us of its presence and extent. A favorable termination may be confidently predicted, unless there is a state of marked cachexia, or a grave coexisting disease. If circumstances are unfavorable, simple stomatitis may terminate in a more severe form, as the ulcerous or diphtheritic.

Treatment.—The physician should endeavor to ascertain the cause, and, if possible, should remove it by appropriate medicinal or hygienic measures. Sometimes no special treatment is required, as in measles or scarlet fever. When the primary affection terminates, the stomatitis disappears of itself. If dentition is the cause, and there is much fever and fretfulness, it has been the common practice to scarify the gums, but this operation is in my opinion seldom advisable. A few doses of the bromide of potassium relieves the fretfulness, and mucilaginous and mild

astringent lotions suffice for the catarrh. Borax is a good local remedy used either with honey or with glycerine and water; one part of borax to three of honey, or a drachm of borax to an ounce of glycerine and water. A weak solution of alum is also a useful topical remedy. With either of these remedies in a favorable condition of system, and without any serious coexisting disease, the stomatitis is relieved.

Ulcerous Stomatitis.

In ulcerous stomatitis, the anatomical characters are those of severe simple stomatitis, with the additional element which gives it the name by which it is designated.

The inflammation usually begins upon the gums and extends along the buccal surface. Wherever it commences, there soon appear little white points in the mucous membrane, producing slight prominence of it. These points, which are inflammatory exudations, mainly fibrinous, gradually enlarge. Some unite and give rise to large irregular ulcerations; others remain isolated, producing ulcers which are smaller and of more regular shape. There is, indeed, no uniformity as regards the size and form of the ulcers. In the folds of the buccal membrane they are apt to be elongated, while inside the lips, or where the surface is smooth, the circular or oval form predominates. It is a noteworthy fact that the exudation penetrates the mucous membrane as in the usual form of diphtheritic inflammation, so that the ulcer which results causes destruction of the mucous layer, and cure is effected by cicatrization.

Ulcerous stomatitis is usually confined to that part of the buccal surface which covers the gums, or is in their immediate vicinity, but in some instances it affects nearly every part of the cavity of the mouth.

If the disease is severe, there is considerable swelling around the ulcers, but the swollen part is soft and cushiony, and not very tender on pressure. The soft and yielding nature of the swelling serves as a means of diagnosis between this disease and the premonitory stage of gangrene, since in the latter affection the swollen part is more indurated.

If the disease grows worse, more ulcers appear, and those already present grow deeper and wider, and their edges more vascular.

If, on the other hand, there is improvement, the swelling subsides, the ulcers become more clean, their bases approach the level of the mucous membrane and present a granulating appearance. Finally the mucous layer is reproduced. A considerable time after the ulcers are healed, the new membrane which occupies their site has a redder hue than the adjacent surface.

Causes.—Ulcerous, like simple, stomatitis is most frequent in the families of the poor. Personal uncleanliness, poor food, a residence in apartments dirty, humid, or in other respects insalubrious, favor its de-

velopment. In fine, a cachectic condition, however produced, is a common predisposing cause. It frequently occurs when the system is reduced or enfeebled by acute diseases, as after the essential fevers and thoracic and intestinal inflammations. In protracted entero-colitis of infants, it is sometimes severe and obstinate, and a case in which this complication arises usually ends unfavorably. The abuse of mercury is an occasional cause of this form of stomatitis, as well as of simple catarrh. Jaccoud states that Bergeron established the fact that ulcerous stomatitis is propagated among soldiers by contagion, and he adds "it is very probable that it is the same in infants."

Symptoms.—The symptoms in ulcerous stomatitis are more severe than in the simple form. There is more pain, more salivation, and more fretfulness. The ulcerated surface is sometimes very tender, so that there is but little sleep. Drinks, unless bland and lukewarm, are painful, and, if the ulcers are on the lips or the front of the mouth, the infant nurses less eagerly than usual, and even with reluctance, sometimes weaning itself. Occasionally the submaxillary glands are tumefied, hard, and tender. The breath has an offensive odor. In mild cases in which the stomatitis is of limited extent, this odor may scarcely be noticed, but in severe cases it is almost like that exhaled from putrid substances. The febrile movement is usually slight.

Prognosis.—A favorable prognosis may be given unless the patient is in a decidedly cachectic condition, or there is a serious coexisting disease, under which circumstances the case may be protracted. If death occur, it is due to the cachexia, or to some pathological state quite distinct from the stomatitis, most frequently entero-colitis. Ulcerous stomatitis, when the ulcers are small and the inflammation of limited extent, is of course more easily cured than when it is extensive and the ulcers are large.

This disease is very liable to return, unless the general health is good.

Treatment.—The physician should endeavor to ascertain the cause of the stomatitis, and so far as possible should remove the patient from its influence. It is often necessary, in order to insure a speedy recovery, to recommend a change in regimen, especially as regards diet and cleanliness. If the patient live in damp, dark, and dirty apartments, the family should seek a better residence, and he should be taken daily in the open air.

Tonic remedies are generally required. The ferruginous preparations may be advantageously given, or the vegetable tonics, or the two in combination. In selecting the internal remedies we must regard the antecedent disease, if there be any, which the buccal inflammation complicates, and on which it depends. For that large proportion of cases in which there is chronic intestinal inflammation, the liquor ferri nitratis with tincture of colombo administered in simple syrup will be found useful. For local treatment Trousseau recommends occasional applications of nitrate

of silver or muriatic acid as a caustic, and in the intervals a wash of equal parts of borax and honey.

The chloride of lime is also considerably used in Paris. It is recommended by Rilliet and Barthez. It is applied dry to the ulcerated surface twice daily, and in the interval the mouth is washed with simple water. This treatment is continued till the ulcers present a healthy appearance and begin to cicatrize. Then a weak solution of chloride of lime is employed, one grain to forty-five of the vehicle. By this treatment a cure is usually effected. Bouchut prefers using chloride of lime with honey, one drachm to the ounce.

But painful applications are not required. The remedy which is most employed in this country and in Great Britain is chlorate of potassium. It often acts like a specific for this as well as other forms of stomatitis. It may be given dissolved in water with sugar, or with one of the syrups, to render it more palatable. The dose is from two to five grains every two hours. It should be allowed to run over the affected part, as it is believed to have a local action.

℞. Potass. chlorat., ℥j ;
Mellis, ℥ss ;
Aquæ, ℥ij.
One teaspoonful every two hours.

Of all topical remedies in common use, chlorate of potassium is probably the most efficacious. Some physicians prefer the chlorate of sodium, on account of its greater solubility. If this wash is too painful on account of the irritable state of the ulcers, it may be used less frequently, and borax applied in the interval.

Aphthous Stomatitis.

Aphthous stomatitis may occur at any age, but it is most frequent in childhood. It is sometimes designated follicular stomatitis, but the disease affects other parts of the mucous surface, as well as the seat of the follicles. At first a vascular injection is observed, and within a few hours a whitish exudation occurs immediately under the intact epithelium, and upon the corium, in small round or oval isolated spots. The smallest of these patches are not larger than a pin's head, but most of them have a diameter of one to two lines, and they cause slight prominence of the surface. In two or three days the exudation softens ; and the epithelium, which covers it, is thrown off, producing an ulcer, superficial, without induration of its edges, but sensitive to the touch. It heals in one to two weeks, leaving only a reddish spot or stain, which soon fades. Sometimes two or more aphthæ unite, forming a patch, and an ulcer of correspondingly large size. The seat of aphthous stomatitis is usually the internal surface of the lips and cheeks, the gums, tongue, and occasionally the roof of the mouth.

Causes.—Probably in most instances the exciting cause is some derangement of the digestive organs, which may not be appreciable. We sometimes observe it in cases of diarrhœa. Occasionally, especially in spring and autumn, two children in a family are affected, at the same time, or two or more in a school, so that it presents an epidemic character. Children surrounded by bad hygienic conditions, as in the tenement houses of the cities, are more liable to this as well as other forms of stomatitis, than are children who live in clean and airy localities, and have nutritious and wholesome diet.

Symptoms.—The constitutional symptoms in a large proportion of cases of aphthæ are slight. In twelve children affected with this disease Billard found the pulse from sixty to eighty beats per minute.

The ulcers are painful, as is indicated by the cries of the child when they are pressed, and its fretfulness. Solid food and even drinks, unless bland and unirritating, are badly tolerated. The salivary secretion is also augmented.

In those rare cases in which the ulcer becomes confluent or gangrenous, the state of the patient is really serious. There is then often gastro-intestinal disease. The symptoms indicate prostration. The pulse is feeble, the countenance pallid, and the body and limbs become wasted.

Diagnosis.—This is easy. The only disease with which it is liable to be confounded is ulcerous stomatitis. In the ulcerous form there is antecedent and accompanying stomatitis affecting a considerable part, if not the entire buccal cavity, while in the follicular form the inflammation is ordinarily confined to the immediate vicinity of the ulcers. The character of the ulcers serves also as a means of distinction. In ulcerous stomatitis there is great variety as to size and form, while in aphthous stomatitis there is great uniformity in both these respects. The small, circular ulcers are characteristic of the follicular inflammation. Before the ulcerative stage the circumscribed character of the eruption serves to distinguish this form of stomatitis from other local diseases affecting the cavity of the mouth.

Prognosis.—Aphthous stomatitis usually ends favorably; but, if the ulcers become concrete or gangrenous, the health is seriously affected, and a more cautious prognosis should be expressed. The unhealthy appearance of the mouth and the real danger are often more due to the depressing effect of some concomitant disease than to the stomatitis.

Treatment.—In ordinary aphthous stomatitis, which is discrete and attended by little or no constitutional disturbance, local remedies suffice to cure the disease. Demulcent drinks or applications to the mouth should be used, as the mucilage from gum acacia, marsh-mallow, or flaxseed. Mild astringent lotions with the demulcent are also beneficial. The mel boracis is one of the best and most agreeable applications. It may be placed in the mouth with a spoon, or applied with a camel-hair pencil. If there is

much tenderness of the ulcers, with restlessness, a small quantity of some opiate should be added to the lotion, or it may be administered separately.

With this simple treatment the ulcers generally soon heal, and the health of the patient is restored. If, however, the ulcers are quite painful, and not disposed to heal, or are healing tardily, they may be touched lightly with a pencil of nitrate of silver, or, as Barrier recommends, hydrochloric acid in honey of roses. This diminishes the tenderness and expedites the healing process.

If, as may in rare cases occur, the ulcerations are numerous, and are accompanied by considerable fever, there may be symptoms indicative of cerebral congestion, or even premonitory of convulsions. In such cases laxatives and the soothing effect of one of the bromides and sometimes of the warm foot-bath are required.

If there is an unhealthy appearance of the ulcers, if they gradually enlarge or become concrete, or gangrenous, indicating a cachectic state, tonics should be employed with nutritious and easily digested diet, and anti-hygienic influences should so far as possible be removed.

CHAPTER II.

THRUSH

The terms thrush, sprue, and muguet, the last from the French, are synonymous. They are used to designate a particular form of inflammation of mucous surfaces, the peculiar feature of which is the presence of points or patches of a curdlike appearance on the inflamed surface.

The usual seat of thrush is the buccal membrane, but occasionally it affects the faucial, pharyngeal, or œsophageal. It is very rare in the subdiaphragmatic portion of the digestive tube, but a few such cases have been reported by Billard and others. It never affects the membrane of the nostrils, larynx, or bronchial tubes, and it very seldom occurs in any other part of the alimentary canal without also being present in the mouth. Thrush, then, is a stomatitis, pharyngitis, or œsophagitis, or a gastro-enteritis, with the additional element which I have described.

Anatomical Characters.—The first stage of thrush is that of simple inflammation of the mucous surface. There next appear minute semi-transparent points or granules, which, increasing, soon become white and opaque. Some of them remain as points, while others, extending, and perhaps coalescing with those adjoining, form patches of greater or less extent. The white points or patches are unequally elevated. Their central part, which was first formed, is most raised, while their circum-

ference projects but little above the epithelium. Their highest elevation is not ordinarily more than a line above the surface. They are smaller in the pharynx and œsophagus than when occurring upon the buccal surface. They resemble closely, in color and consistence, portions of curdled milk, and the nurse often mistakes them for such, and neglects to call attention to the state of the mouth. They are readily detached by a little force, but are speedily reproduced. Their color in the first days of the sprue is white, and sometimes this color continues. In other cases they assume, if the disease is protracted, a yellow hue.

Their true nature, long unknown, was finally revealed by microscopy. They consist in part of epithelial cells, and in part of a vegetable growth. This parasitic plant is in most cases the oidium albicans. Like other confervæ, it consists of roots, branches, and sporules. The roots are transparent, and they penetrate the epithelial layer, sometimes even to the basement membrane. The branches divide and subdivide at an acute angle, and under the microscope they are seen to consist of elongated cells, with one or two nuclei. Around these branches are numerous sporules. In two or three instances I have examined the product of thrush removed from the œsophagus, and in both the parasitic plant was the penicillium glaucum, or a conferva closely resembling it.

In the mildest form of thrush, this morbid product is in points or small patches. If the patches are of large extent, especially if, as rarely happens, a considerable part of the buccal surface is covered by them, there is generally a state of great prostration and danger, from some antecedent or concomitant disease. Thrush is, indeed, often the sequel of some grave affection, as pneumonitis or gastro-intestinal inflammation. Its complication with the last-named disease is common in young, ill-fed infants, especially those deprived of the breast-milk, and such cases are very apt to be fatal.

Hence, some writers, who have observed infantile diseases in foundling hospitals, regard thrush as one of the most serious maladies of early life. Valleix, in a book of seven hundred pages relating to diseases of children, devotes more than one-third to the consideration of muguet. Of twenty-four cases, the records of which he publishes, twenty-two died, but their death was due to gastro-intestinal inflammation, which the author considered a part of the more general disease, muguet. Doubtless the same cause which produced the stomatitis, with the confervoid growth, in these infants, also produced the fatal gastritis or gastro-enteritis, occurring without this growth. Nevertheless it seems better to restrict the term sprue, thrush, or muguet to those inflammations of mucous surfaces which are accompanied by the parasitic growth. I reject, then, from my description of the anatomical characters of thrush, those subdiaphragmatic phlegmasias which some writers consider an important part of severe muguet, and regarded them as complications, unless indeed the case is one

of those exceptional ones in which the parasite has lodged and grown upon the gastric or intestinal surface. This explanation seems necessary in order to understand the different statements of writers in relation, not only to the anatomical characters of thrush, but also in reference to its mortality.

The frequent coexistence of thrush with gastro-intestinal inflammation, has been remarked in the hospitals of Europe, and in the Infant Asylum and the Child's Hospital, in this city. In the post-mortem examinations of those who have died in these last institutions, having thrush at the time of death or immediately prior to it, and who for the most part have been infants under the age of three months, I have frequently found evidences of inflammation in every division of the alimentary canal. The confervoid growth was, however, seldom found below the fauces, and never below the œsophagus.

Symptoms.—The symptoms in thrush are not different in most cases from those of simple inflammation. In the mildest cases they are chiefly of a local nature, such as have already been described in our remarks on simple stomatitis. If the inflammation is more extensive, especially if it affect the fauces and œsophagus, the infant becomes feverish and fretful, and the inflamed surface is hot, red, and tender. In the worst forms of thrush this surface not only presents the ordinary features of severe inflammation, namely heat, redness, and tenderness, but it is sometimes deficient in the natural secretion, so as to present a dry or parched appearance. It is in these cases that there is often a more extensive inflammation than that of the buccal or œsophageal membrane. The sub-diaphragmatic portion of the digestive tube is inflamed. In these severe cases thirst, loss of appetite, restlessness, vomiting, and frequently diarrhœa occur. The countenance is anxious and pale; there is rapid emaciation, and, if the disease is not arrested, a state of extreme prostration soon arrives. The twenty-four severe cases related by Valleix, already alluded to, twenty-two of which were fatal, were examples of this severe form.

Causes.—Thrush is most apt to occur in those who are constitutionally feeble, or who are enfeebled by disease, or by unfavorable hygienic conditions. Cachexia is a cause common to thrush and most other subacute inflammations of the alimentary canal. The most obvious and common of the unfavorable hygienic conditions alluded to is the continued use of indigestible and improper food. It is, therefore, a common disease among foundlings, in institutions where these unfortunates are received, since they not only breathe an atmosphere which is often impure, but are deprived of the mother's milk, and are so frequently given a diet which is a poor substitute for it. Among the poor of the cities thrush is common, since with them, from necessity or choice, there is the greatest neglect of sanitary requirements. Exposure to humidity, to variations in temperature, increases the liability to the disease, though in less degree than defective

alimentation. Billard and Valleix agree that thrush is more frequent in the warm months than in the cold, that its maximum frequency is in the months of July, August, and September. Cases in the Infant Asylum and Child's Hospital, of this city, have appeared to me to correspond in this respect with those related by Billard and Valleix. Various writers have mentioned the age at which thrush is most apt to occur, as one of the predisposing cases. Uncomplicated thrush is not common above the age of six months. Most cases occur under the age of three months. Infants of the age of one or two weeks, if in addition to lactation they are spoon-fed by nurses over-anxious that they should thrive, are apt to take the disease. Thrush is not uncommon in children under the age of eighteen months who are suffering from exhausting diseases. It is then an unfavorable prognostic sign.

Diagnosis.—This is easy so far as thrush in the mouth is concerned, for simple inspection by one familiar with the disease is all that is required in order to discover it. The presence of thrush in portions of the alimentary canal hidden from view cannot be positively ascertained.

The vomiting, diarrhœa, pain or fretfulness, emaciation, and rapid sinking, which sometimes accompany severe forms of thrush, indicate gastro-intestinal inflammation, to which the attention of the practitioner should be chiefly directed.

Prognosis.—The duration of thrush varies according to its intensity, and the favorable or unfavorable condition of the child. If it is slight and the health of the infant otherwise good, it may often be cured in two or three days. Under other circumstances it may continue as many weeks or even longer, before it is entirely removed.

When thrush occurs in connection with gastro-enteritis, the mortality is very great. It has been already stated that in Valleix's twenty-four cases twenty-two were fatal. M. Auvity estimates the mortality of such cases at nine in ten, and M. Godinat at two in three.

Treatment.—As one of the most common causes of thrush is the use of indigestible or improper food, the physician should ascertain the nature of the infant's diet, and if it is faulty should direct a better. In many cases the infant is bottle-fed. It should be given only the mother's milk if practicable, or that of a healthy wet-nurse. This change of alimentation often removes the sole cause of thrush in the young infant, so that it rapidly recovers.

If artificial feeding is necessary, such diet should be advised as is directed in our remarks on the treatment of the diarrhœal maladies. There is often in thrush an excess of acidity in the digestive tube, and an alkali is required. Trousseau recommends the addition of saccharate of lime to the milk. Children with this disease should also be taken from filthy and damp apartments, to those in which the air is pure and dry, and their mouths and persons should be kept clean.

The remedy in common use in the treatment of thrush, and which is usually effectual, is borax. This, if applied sufficiently often to the affected membrane, not only destroys the parasitic growth, but prevents its reproduction. It is commonly employed with honey, or in a powder with sugar or dissolved in water. The official mel boracis, consisting of one part of borax to eight of honey, is so much used in families that it may be considered almost a domestic remedy. There is, however, an objection to using any application for the removal of thrush which contains either sugar or honey, since either substance remaining in the mouth would rather promote the growth of the parasite. Still, it is desirable to employ a wash of such consistence that it will remain a longer time in contact with the buccal surface than will a simple solution in water. I know no better vehicle for the borax than glycerin, which has the advantage of consistence, does not undergo any chemical change, and has no unpleasant flavor. The borax may be used dissolved in glycerin, with or without some flavoring ingredient :—

℞. Sodæ borat., ʒj ;
Glycerinæ, ʒij ;
Aquæ ʒvj. Misce.

Borax should be used four or five times daily, and continued for a time after the disease has disappeared from sight, since the roots of the plant must be destroyed or the branches are rapidly reproduced. It should be applied by a camel-hair pencil, or with a soft cloth upon the finger or a stick. It should be so freely used, in extensive and severe forms of the disease, that the infant will swallow some, as the entire œsophagus is apt to be affected in such cases. In the intervals between the applications of borax, if the buccal surface is hot, dry, and tender, so as to increase the fretfulness of the infant, it is well to use mucilaginous washes, as the mucilage of acacia or mallows. If the disease continue notwithstanding the use of these measures, the mouth should be occasionally washed with a weak solution of nitrate of silver or sulphate of zinc :—

℞. Zinci sulph., gr. ii–iv ;
Aq. rosæ, ʒij. Misce.

In many cases, however, the treatment of thrush is of less importance than that of the disease which the thrush complicates. The remedial measures which I have mentioned then become subordinate to those employed for the graver disease. When this disease is relieved and the general health improves, thrush is more easily and permanently cured than during the state of feebleness and ill-health.

CHAPTER III.

GANGRENE OF THE MOUTH.

The diseases of the mouth which we have been considering are attended by little danger, but the one which we are next to consider, is among the most fatal of early life. It is gangrene of a portion of the cheek or gums, or of both. It is described by writers under various names, as cancrum oris, noma, necrosis infantilis, aqueous cancer of infants.

Anatomical Characters.—Gangrene of the mouth is sometimes preceded by ulceration of the mucous membrane, at the point where it is about to commence, but in other cases this membrane is entire. The tissues at the point of attack, which is most frequently the inside of the cheek, become inflamed, thickened, and indurated. The induration extends, and soon the purple hue of gangrene appears and increases. The next stage in the progress of gangrene is sloughing of the portion the vitality of which is lost.

The slough does not present the appearance of uniform decay. While the color is generally dark, there are in the mass fibres of connective tissue or even bloodvessels, which remain unchanged or are but partially decomposed. After separation or sloughing of the part where the vitality is first lost, the surface of the excavation, if the disease is not checked, has a dark, jagged, and unhealthy appearance. Commencing with the mucous membrane and the tissue immediately underlying it, the disease extends on the one side towards the skin, and on the other towards the deeper-seated structures of the jaw. According to Billard, the swelling which precedes and surrounds the gangrene is in great part œdematous.

This disease is occasionally primary, but in a large proportion of cases it is secondary. Occurring secondarily, its symptoms are often masked by those of the antecedent and coexisting affection. Under such circumstances attention is sometimes first directed to the mouth, by the loosening of one or more of the teeth, or the appearance on the skin of a livid circular spot, which indicates the approach of the disease to the cutaneous surface. The mucous membrane presents a dark-red appearance to the distance of a few lines beyond the point of gangrene. It covers tissues which are inflamed and indurated and about to become gangrenous.

The tongue is usually more or less swollen, unless the disease is mild; an offensive odor arises from the gangrene, due to the evolution of sulphuretted hydrogen and other gases. There is great difference in the

extent of the destruction, and the gravity of the disease, in different cases. It may sometimes be arrested by proper applications and a favorable change in the general health of the child at an early period, when there is little loss of substance. In other cases it extends till it perforates the cheek, or even destroys a considerable part of the side of the face, and, extending inwards, attacks the periosteum of the maxillary bone, destroying the gum and teeth, and denuding the alveoli. Recovery, if it take place at all under such circumstances, is with the loss of a portion of the bone, and with deformity.

The duct of Steno is sometimes included in the gangrenous portion, but it commonly resists the destructive process, and remains pervious.

Age.—The age at which gangrene of the mouth occurs is usually between two and six years. In twenty-nine cases collated by Rilliet and Barthez, twenty-one were between the ages of two and six years, and the remaining eight were from six to twelve years old. Of the cases which have fallen under my observation, all were between the ages of two and six years. It is seen that the period of greatest frequency of gangrene of the mouth is different from that at which the ordinary forms of stomatitis occur.

Gangrene of the mouth may, however, occur under the age of one year. Billard reported three cases under the age of one month, but in two of these the disease does not appear to have been sufficiently marked to render it certain that they were genuine cases.

Causes.—Gangrene of the mouth usually occurs in those whose systems are reduced or cachectic. It is, therefore, more frequent among the poor than those in comfortable circumstances; in the city than in the country. It is more frequently observed in asylums for children than in private practice. Half the cases which I have seen have been in these institutions. If the constitution is naturally good, it can only occur in those long deprived of pure air and wholesome nutriment, or those enfeebled by disease.

Among the diseases which have been known to terminate in or be followed by gangrene of the mouth, are the pulmonary and intestinal inflammations, hooping-cough, and the fevers, both eruptive and the non-eruptive. Rilliet and Barthez have published a table of ninety-eight cases in which gangrene resulted from other diseases. In forty-one of these the antecedent disease was measles, in five scarlet fever, six hooping-cough, nine intermittent fever, nine typhoid fever, seven mercurial salivation, and five enteritis. It is seen that the essential fevers were the most frequent cause of the gangrene. Of forty-six cases collected by MM. Bouley and Caillault, the antecedent disease was measles in all but five. In this city, also, a larger number occur from measles than from any other disease.

One reason why so many cases of gangrene occur as a sequel of measles

is probably because this disease is accompanied by stomatitis. Simple or ulcerous stomatitis often precedes gangrene.

Diseases sometimes terminate in gangrene of the mouth chiefly in consequence of injudicious treatment, which has lowered the vitality of the system. Rilliet and Barthez mention the case of a child four years old, in whom gangrene commenced at the twenty-ninth day of primitive pneumonia. This child had been reduced by the application of twelve leeches, three scarifications, a large blister, and by the use of absolute diet.

The misuse of mercury was once a much more frequent cause of gangrene than at present, at least in this country, since this agent was formerly much more employed than now. In fact most of the affections of infancy and childhood in which mercurials were formerly employed are now treated without it.

Symptoms.—Gangrene of the mouth so often occurs in connection with other diseases, that its symptoms are in a large proportion of cases blended with those which arise from a distinct pathological state.

Fig. 24.

There is usually prostration more and more pronounced as the gangrene extends. The features are ordinarily pallid, but occasionally their normal color is preserved for a time; the expression of the face is melancholy, but composed. Sometimes the child is fretful, if disturbed; at other times it will quietly consent to an examination. The suffering is not proportionate to the gravity of the disease. There is less pain often than in some of the forms of stomatitis which are unattended with danger.

As the disease advances, the body and limbs gradually waste, the eyes are hollow, or, if the gangrene is near the orbit, the eyelids become œdematous, the lips are infiltrated, and both the lips and nostrils are often incrusted. If the cheek is perforated, alimentation is rendered more difficult, and the appearance of the child is melancholy in the extreme.

The tongue is usually moist; it is occasionally swollen. The saliva flows from the mouth, either pure or mixed with offensive sanguinolent matter. Unless the disease is slight, there is the peculiar gangrenous odor. The appetite is sometimes poor, at other times it is preserved through the whole sickness. There is no vomiting or looseness of the bowels, unless from a complication. The thirst is usually great, and the pulse is accelerated and feeble, except in mild cases.

The skin in the commencement of gangrene is hot. When the vital force is much reduced, and especially as the disease approaches a fatal termination, the face and limbs become cool, and the surface generally presents a waxen or ashy appearance. There is no derangement of the respiratory system. Those cases which are attended by a cough or accelerated respiration are really cases of bronchitis or pneumonitis, coexisting with the gangrene.

Diagnosis.—Gangrene of the mouth is easily diagnosticated. In those cases in which ulceration precedes the gangrene, it might be mistaken in its first stages for that form of ulcerous stomatitis in which the ulcers assume an unhealthy appearance. The following are the distinguishing features of the two affections: Around the ulcer where gangrene is about to commence the tissues are greatly thickened and indurated, or œdematous, while ulcerous stomatitis begins with a submucous deposit of fibrin, and is attended by little thickening of the surrounding parts, and little or no induration or œdema. In ulcerous stomatitis the skin over the seat of the disease presents its normal appearances, whereas in gangrene it presents a distended and shining appearance. The destructive process in ulcerous stomatitis is also more limited than in gangrene. Deep ulcerations do not occur, or are rare. Ulcerous stomatitis is more readily healed, and it leaves no eschar, contraction, or deformity.

The differential diagnosis of gangrene of the mouth from those cases of follicular stomatitis in which the ulcers occupying the seat of the follicles assume a gangrenous appearance, must be made by a consideration of the same facts or particulars which serve to distinguish it from ulcerous stomatitis.

Malignant pustule, of rare occurrence in the child, resembles this disease in some of its features. But the pustule always begins on the skin, while gangrene is a disease of the mucous surface primarily. In gangrene, therefore, the chief destruction is of the mucous membrane and of

the submucous tissue, while in malignant pustule the chief destruction is of the skin and the subcutaneous tissue.

Prognosis.—This depends not only on the extent of the gangrene, but the nature of the disease, if there be one, which gave rise to it, and the degree of cachexia. If it occurs in connection with or as a sequel of one of the least debilitating diseases, and there is considerable vigor of system, it may often be arrested when it has destroyed only the mucous and subcutaneous tissues, so that no deformity results. The friends may congratulate themselves if the case terminate so favorably. In the graver cases, when the gangrene extends till it destroys the periosteum of the maxillary bone on the affected side, and perhaps perforates the cheek, if the child recovers it is with the permanent loss of teeth, tedious separation of the necrosed bone, and a cicatrix, which is apt to interfere with the free use of the jaw. Death is, however, the more common termination of severe cases. Occasionally the gangrene destroys the continuity of a bloodvessel, causing abundant hemorrhage, and accelerating the fatal result. In most cases, however, there is little or no hemorrhage, in consequence of coagulation in the vessels.

Another serious complication occasionally arises, namely, gangrene of other parts, as of the external genital organs. The English editor of Bouchut's treatise on diseases of children, relates the following interesting case, from the *Transactions of the Edin. Medico-Chir. Society* :—

An infant eight months old became affected with gangrene of the face, head, and hands. "The right ear and the entire hairy scalp were of an intensely black color, and on both cheeks patches existed about the size of a half-crown piece. The right thumb and the backs of both hands were similarly affected. The child was noted to have been restless and feverish on May 22d, and on the 23d a slightly darkened ring was found to have formed round the thumb, about the middle of the first phalanx; in a few hours the whole thumb was gangrenous, and the dorsum of the hand became involved. On the ear the gangrene commenced with the appearance of a fleabite, and subsequently extended rapidly to the scalp, assuming a remarkable regular form, and giving to the child the appearance of wearing a black skullcap. The pulse was observed to be very feeble. . . . Death took place in twelve hours from the first appearance of gangrene on the thumb, the child being sensible and continuing to suck well, up to a few minutes before death."

Rilliet and Barthez state that pneumonitis is apt to arise in the course of gangrene of the mouth. Such a complication evidently diminishes materially the chance of recovery.

Whether the result be favorable or unfavorable, it is evident, from the nature of the disease, that the duration is very different in different cases. The physician's attendance may be required for a week or two or for several weeks.

TREATMENT.—As gangrene of the mouth is eminently a disease of debility, all anti-hygienic influences should be removed, and the most nourishing diet, together with tonics, be recommended. The ferruginous preparations or the bitter vegetables are required.

As soon as the physician is called, he should endeavor to arrest the gangrene, accelerate the detachment of the slough, and produce a healthy and granulating state of the surrounding tissues. This is best effected by applying a highly stimulating or even escharotic agent to the inflamed surface underneath and around the gangrene. For this purpose a great variety of substances have been used by different physicians, such as acetic, sulphuric, nitric, and hydrochloric acids, nitrate of silver, the acid nitrate of mercury, chloride of antimony, and even the actual cautery.

M. Taupin recommends, after removing a considerable part of the gangrenous substances with scissors or some instrument, the application of strong muriatic acid, and, when the slough is detached, of dry chloride of lime.

Rilliet and Barthez advised the use twice daily of muriatic acid or the acid nitrate of mercury, applied by a brush upon and around the slough, followed immediately by the application of dry chloride of lime, when the mouth is to be thoroughly washed with water from a syringe. They direct in the interval frequent ablution with water. After the slough has separated, the escharotic is to be discontinued, and the chloride of lime used alone. If gangrene extend to the skin, a crucial incision is to be made and the escharotic applied, after which powdered cinchona is introduced and retained by a plaster. This treatment is to be continued till the gangrene is arrested and the decayed portion removed. Barrier, Valleix, and most French writers, recommend essentially the same treatment, namely, the application of undiluted escharotic agents.

A safer, less painful, and, in my opinion, preferable treatment, is that employed by many British and American physicians, namely, the use of escharotic agents diluted, or, if applied in their full strength, such as are least active and penetrating. Some employ from the first topical treatment which is astringent and stimulating rather than escharotic, and they report satisfactory results.

Dr. Gerhard believes "the best local applications are the nitrate of silver, if the slough be small in extent; if much larger, the best escharotic is the muriated tincture of iron, applied in the undiluted state. After the progress of the disease is arrested, the ulcer will improve rapidly under an astringent stimulant, such as the tincture of myrrh, or the aromatic wine of the French Pharmacopœia."

The local treatment recommended by Evanson and Maunsell I believe to be preferable to that advised by any of the writers from whom I have quoted. I have seen it so successful, that I should employ it in all ordinary cases from the first visit. A knowledge of this treatment will be best

imparted by quoting from the authors (*Diseases of Children*, 2d Amer. edit., page 188): "The lotion which we have found by far the most successful is a solution of sulphate of copper, as employed by Coates in the Children's Asylum. His formula is as follows:—

"℞. Cupri sulph., ʒij;
Pulv. cinchonæ, ℥ss;
Aquæ, ℥iv. M.

"This is to be applied twice a day very carefully to the full extent of the ulcerations and excoriations. The addition of the cinchona is only useful by retaining the sulphate of copper longer in contact with the edges of the gums. A solution of the sulphate of zinc, ʒj to an ounce of water, by itself or combined with tincture of myrrh, Dr. Coates found to be also useful in some cases."

A moment's reflection will show us that the above treatment is far preferable, provided that it is equally effectual in arresting the gangrene, to the treatment by the strong escharotics which some of our best practitioners employ.

Take, for example, the use of pure nitric or muriatic acid, which physicians of experience recommend. This agent causes such pain that it occasions restlessness of the child, and such stout resistance that the use of chloroform has been recommended to facilitate its application. The pain occurring from it and from the inflammation which it excites doubtless reduces the strength which it is very necessary to preserve. If the acid come in contact with the teeth, as it generally will, it injures them irreparably, and it sometimes attacks the jaw-bone. Dr. West, who advocates the use of the acid (*Diseases of Infancy and Childhood*, 4th Amer. edit., page 467), says: "In one of the cases that I saw recover, the arrest of the disease appeared to be entirely owing to this agent, though the alveolar processes of the left side of the lower jaw, from the first molar tooth backwards, died and exfoliated, apparently from having been destroyed by the acid." No such result follows the use of the solution of sulphate of copper, and of its efficacy I can speak confidently. In one of those severe cases in which the disease resulted from scarlet fever, and in which there was so much debility that an unfavorable prognosis was made, I succeeded in arresting the disease by the use of Dr. Coates's prescription. The child recovered with the loss of two teeth and the corresponding portion of the maxillary bone. From the good effects which I have observed from iodoform, as an application for gangrenous vulvitis following measles, it has occurred to me that it may also be useful in gangrene of the mouth.

The application should be made twice a day till the gangrene is arrested and healthy granulations appear.

The gases arising from the gangrenous mass are not only highly offensive to others, but they are doubtless injurious to the patient, who is constantly inhaling them. To remove the fetor, chlorine or carbolic acid, properly

diluted, should be occasionally used between the applications of the sulphate of copper. Labarraque's solution, one part to eight or ten parts of water, is an eligible form for its use. When the gangrene is removed, and the granulations present a healthy appearance, all danger is usually past and convalescence is fully established. Then no energetic topical treatment is required. A mild stimulating lotion, like the tincture of myrrh, as recommended by Dr. Gerhard, suffices, with the aid of tonics and nutritious diet.

CHAPTER IV.

DENTITION.

The opinion formerly entertained in the profession, and now prevalent in the community, that many infantile maladies arise directly or indirectly from dentition, is erroneous. Still there are physicians of experience who believe that teething is a common cause of certain maladies, especially of functional derangements, even of organs remote from the mouth. On the other hand, equally good observers, and the number is increasing, almost wholly ignore the pathological results of dentition. They say that, as it is strictly a physiological process, it should, like other such processes, be excluded from the domain of pathology.

A moment's reflection will show how important it is to understand the exact relation of dentition to infantile diseases. Every physician is called now and then to cases of serious disease, inflammatory and others, which have been allowed to run on without treatment, in the belief that the symptoms were the result of dentition. I have known acute meningitis, pneumonitis, and entero-colitis, even with medical attendance, to be overlooked and the symptoms attributed to teething during the very time when appropriate treatment was most urgently demanded. Many lives are annually lost from neglected entero-colitis, the friends believing the diarrhœa to be symptomatic of dentition, a relief to it, and therefore not to be treated. Such mistakes are traceable to the erroneous doctrine, once inculcated in the schools, and still held by many of the laity, that dentition is directly or indirectly a common cause of infantile diseases and derangements.

I shall endeaver to point out what is really ascertained in regard to the pathological relations of dentition.

First dentition commences at the age of about six months and terminates at the age of two and a half years. The corresponding teeth of the two sides pierce the gum at about the same time. The two inferior central incisors first appear at about the age of six or seven months, followed, in the order in which they are mentioned, by the upper central incisors, upper

lateral incisors, lower lateral incisors, the four anterior molars, the four canines, and lastly, the four posterior molars.

The incisors usually appear in rapid succession, so that all are in sight by the age of one year. From the age of one year to sixteen months the anterior molars appear, from the age of sixteen to twenty-four months the canines, and from twenty-four to thirty months the posterior molars.

This order is not always preserved. Sometimes the upper central incisors appear before the lower, and sometimes the lower lateral before the upper lateral. In rare cases there have been teeth at birth. I have seen but one or two infants with such premature dentition. Retarded dentition is much more common. Those who have rickets, or are feeble either constitutionally or by disease, often have no teeth till considerably after the usual period. In such the first incisors may not appear till the age of twelve months, or even later.

Pathological Results of Dentition.—The evolution of the teeth is commonly attended by more or less turgescence around the dental bulbs. This is greater with some of the teeth than with others. Thus, the superior incisors cause more swelling than do their congeners of the inferior jaw. The turgescence, although attended by more or less congestion, is physiological within certain limits, and not a disease.

But sometimes there is an unusual amount of swelling around the dental follicles; the afflux of blood to them is greatly augmented; they are the seat of such a degree of tenderness and pain that the infant is fretful. It carries the finger often to the mouth, indicating the seat of its suffering. The surface over the follicles presents greater redness than in ordinary dentition, and the salivary secretion is considerably increased. There is now actual gingivitis.

Occasionally the inflammation affects a greater extent of the buccal surface than that lying directly over the follicles, so that most writers speak of stomatitis as one of the results of dentition. In a few cases I have known such a degree of inflammation over the advancing tooth, that a small abscess formed, producing much pain and restlessness, till it was opened by the lancet.

The pathological results of dentition which I have mentioned, though they may interfere more or less with the nursing or feeding are not dangerous. They are easily detected. They result directly from the rapid growth and augmented sensibility of the dental follicles.

There are other supposed accidents of dentition occurring in distant parts of the system in consequence of that mysterious relation and interdependence of organs which exist through the system of nerves.

Some children, previously to the eruption of the teeth, are affected with diarrhœa, occasionally accompanied by irritability of stomach. Certain writers have supposed that gastro-intestinal catarrh is present in these cases; others that there is simply a hypersecretion, an increased ac-

tivity of the intestinal follicular apparatus, that it is, in other words, one of the forms of non-inflammatory diarrhœa. Barrier believes that the diarrhœa of dentition depends usually on what he calls a "subinflammatory turgescence limited to the gastro-intestinal follicular apparatus." He believes that, in occasional cases, it is due to defective or altered innervation. It would then be analogous or similar to that form of diarrhœa which occurs in the adult from the emotions. Bouchut calls the diarrhœa of dentition nervous diarrhœa. It is certain, however, that in most cases of diarrhœa which are attributed to dentition there are other causes, such as unsuitable food, or residence in an insalubrious locality. It is certain, as regards city infants, that the chief causes of diarrhœa during the period of dentition are strictly anti-hygienic, dentition being quite subordinate as a cause, and probably often not operating at all as such. But when, as sometimes happens, at each period of dental evolution, the infant is affected with diarrhœa, the influence of teething is apparent. Such cases enable us to see that teething may really sustain a causative relation to certain diseases not located in the buccal cavity.

Among the most common pathological results of difficult dentition, are certain affections referable to the cerebro-spinal system. Eclampsia is one of the admitted results. Barrier attributes convulsions in the teething infant to excitement of the nervous system arising from the pain which is felt in the gums, and to a determination of blood to the dental apparatus, in which afflux the whole vascular system of the head participates.

In most cases of convulsions occurring during the period of dental evolution, a careful examination discloses other causes in addition to the state of the gums. Difficult dentition must then be considered, not so frequently a direct as a co-operating or predisposing cause, producing a sensitive state of the nervous system, or possibly an afflux of blood to the head, of which Barrier speaks, and which, by an additional stimulus, perhaps trivial in itself, ends in convulsions. In exceptional instances eclampsia occurs mainly from dentition, or, if there are other causes, they are quite subordinate. This may happen when several teeth penetrate the gum at or about the same time. Infants who are burnt or scalded are very liable to clonic convulsions. This is, in fact, the chief danger as regards life from such accidents. So, the swollen and tender gum, if several teeth are about emerging, may affect the cerebro-spinal system like the burn or scald, and produce the same nervous phenomena. Thus, in a case already alluded to in the chapter on convulsions, five incisors pierced the gum within about two weeks, and in this period there were two attacks of eclampsia with an interval of a few days. The attacks were not severe, and the most careful examination could discover no other cause than the simultaneous development of so many dental follicles. Previously, and since, the infant has been well.

Dentition sometimes, though rarely, occasions also tonic convulsions.

The following case occurred in the practice of Dr. A. S. Church, of this city, the history of which he has so kindly communicated, as follows:—

"H., seven months old, was first visited April 3d, 1863. The patient had been fretful for several days, but about daylight on the morning of my first visit it commenced crying, and had not ceased for a moment at the time of my visit, 9 A. M. The bowels were somewhat constipated and tympanitic; abdominal muscles very tense. The pain was supposed to be in the abdomen, and a brisk cathartic, to be followed by an anodyne, was ordered. Some relief followed, but, on the ensuing and for several consecutive mornings, the pain returned, each day lasting longer, until the child only ceased crying while under the influence of a full anodyne. The gum over the upper incisors was considerably swollen, hot, and dry, but the parents would not consent to have it scarified. For the first week there was no fever, no vomiting, and not the least indication that the nervous system was suffering. About the 10th the thumbs were noticed to be flexed during the attack of pain, and about the 15th the flexors of the toes were contracted and the hands were turned backwards and outwards, but only while the child was awake. About the 20th there was constant contraction of the flexors of both extremities, with opisthotonos, and constant rolling of the head, loss of appetite, progressive emaciation, coated tongue, and highly inflamed gums. Consent was, finally, obtained to relieve the inflamed gum, and free incisions were made, and the following night the child slept comfortably for three hours without opiates. In three days the gums were freely cut again, and the teeth soon made their appearance. All symptoms of disease had now ceased, the child became playful, and on the 30th the patient was discharged."

The opinion has been prevalent in the profession, that painful and difficult dentition is one of the chief causes of infantile paralysis, but it is now commonly admitted that it is only a subordinate or remote cause, if indeed it is proper to consider it as a cause at all. (See Art. Paralysis.)

Some writers express the opinion that acute meningitis occasionally results from teething. The facts, however, that are relied upon to prove this are uncertain. The occurrence of meningitis during dentition is probably in most instances a coincidence.

Teething less frequently disturbs the respiratory system than either the digestive or cerebro-spinal. A cough occurs in some infants at each period of dental evolution. It is attended by little expectoration, but appears to be associated with, in at least certain cases, an inflammatory turgescence of the bronchial mucous membrane.

Acceleration of pulse is often observed at the time of greatest swelling and tenderness of the gum. It subsides with the protrusion of the tooth. The febrile movement of dentition is irregular, sometimes presenting a remittent form, like remittent fever or the fever premonitory of meningitis. Eczema and certain other cutaneous diseases are common during dentition, but their dependence on it as a cause has not been demonstrated.

Diagnosis.—The accidents of dentition which are located in the mouth are easily diagnosticated, except the odontalgia which writers describe, and

which is not necessarily attended by any perceptible anatomical alteration of the gums. Those accidents which pertain to remote and concealed organs are usually detected with ease, though it is often difficult to determine with certainty their relation to dentition.

When similar symptoms arise at each epoch of teething, and subside with the subsidence of the gingival turgescence, teething must be regarded as the cause. Or, if the disease is such as is known to be produced occasionally by difficult teething, and if, after a careful examination, we can discover no other cause, while the gums are swollen, especially over two or more advancing teeth, it is proper to refer the malady to dentition.

It is evident that we must often be in doubt whether the disease which we are treating is due at all to the state of the gums, or, if so, whether directly or indirectly, or to what extent; but, as a rule, if any other cause is apparent, we may properly regard the influence of dentition as quite subordinate.

TREATMENT.—It is obvious that remedial measures in cases of difficult dentition must be twofold, namely, those directed to the state of the gums, and those designed to relieve the derangements or diseases to which dentition has given rise. If there is diarrhœa, this should be controlled by proper remedies, so as to reduce the number of evacuations to two or three daily. It is well to state to the friends of the child, who believe that diarrhœa is salutary during the period of teething, that this number is quite sufficient, and that more frequent evacuations will endanger the safety of the child.

The nervous affections, as convulsions, require such soothing and derivative measures as are recommended in our remarks on diseases of the nervous system. The bromide of potassium I have found especially useful and safe in cases of fretfulness and nervous excitement due to dentition. The rational employment of therapeutic measures requires strict attention to be given to the causes of disease. Therefore, the physician called to treat an ailment, believed to be due to dentition, should not fail to examine the state of the gums, and adopt such measures as will mitigate the intensity of the cause—in other words, diminish the tenderness if not the swelling of the gum. Demulcent and soothing lotions are sometimes useful. The infant should be allowed to hold in the mouth an India-rubber or ivory ring, which, by pressure on the gum, gives considerable relief.

Mothers will often attempt to "rub through a tooth," as they term it, by means of a ring or thimble. This should be discouraged. So great friction cannot fail to have an injurious effect, by increasing the swelling and inflammation, unless the tooth has already reached the mucous membrane.

We come now to a subject which has engaged the attention of many of the ablest and most experienced physicians, and in reference to which

there is still a difference of opinion among the highest authorities in medicine. I refer to scarification of the gums.

The gum-lancet is now much less frequently employed than formerly. It is used more by the ignorant practitioner, who is deficient in the ability to diagnosticate obscure diseases, than by one of intelligence, who can discern more clearly the true pathological state. Its use is more frequent in some countries, as England, under the teaching of great names, than in others, as France, where the highest authorities, as Rilliet and Barthez, discountenance it.

It is well to bear in mind, as aiding in the elucidation of this subject, the remark made by Trousseau, that the tooth is not released by lancing the gum over the advancing crown. The gum is not rendered tense by pressure of the tooth, as many seem to think, for, if so, the incision would not remain linear, and the edges of the wound would not unite, as they ordinarily do by first intention within a day or two. This speedy healing of the incision, unless the tooth is on the point of protruding, is an important fact, for it shows that the effect of the scarification can only last one or two days. The early repair of the dental follicle is probably conservative so far as the development of the tooth is concerned. It may help us to understand how active, how powerful, the process of absorption is, if we reflect that the roots of the deciduous teeth are more or less absorbed by the advancing second set, without much pain or suffering from the pressure. If the calcareous particles of the teeth are so readily absorbed, what is the foundation for the belief that the fleshy substance of the gum is absorbed with such difficulty? Too much importance has evidently been attached to the supposed tension and resistance of the gum in the process of dentition.

Follicles in the period of development are especially liable to inflammation. We see this in the follicular stomatitis and enteritis, so common when the buccal and intestinal follicles are in the state of most rapid growth. Does not this law in reference to the follicles hold true of those by which the teeth are formed, so that the period of their enlargement and greatest activity, which corresponds with the growth and protrusion of the teeth, is also the period when they are most liable to congestion and inflammation? This fact affords a better explanation of the frequency of the so-called laborious or difficult dentition than that it is due to the resistance which dental evolution encounters from the gums.

If there are no symptoms except such as occur directly from the swelling and congestion of the gum, the lancet should seldom be used. The pathological state of the gum which would, without doubt, require its use, is an abscess over the tooth. As to symptoms which are general or referable to other organs, as fever and diarrhœa, the lancet should not be used if the symptoms can be controlled by other safe measures. All co-operat-

ing causes should first be removed, when in a large proportion of cases the patient will experience such relief that scarification can be deferred.

If the state of the infant is one of immediate danger, as in convulsions, and it is not quickly relieved by the ordinary remedies, scarification may not only be proper but required to insure safety. For in such cases all measures, provided they are safe and simple, which can possibly give relief should be employed without delay. But I can recall to mind only two accidents of dentition which would be likely to be benefited by scarification, namely, suppurative inflammation in the dental follicle and convulsions. But since the bromide of potassium has come into use as a nervous sedative, and as an efficient remedy for clonic convulsions, scarification of the gums is much less frequently required, for even severe eclampsia commonly yields to this medicine, if the condition of the bowels is attended to. Cutting the gums is now abandoned as a means of relief in infantile paralysis, for this malady is known to be due to other causes than dentition.

Second Dentition.

The fact is well established, though often overlooked in practice, that second dentition occasionally deranges the functions of organs, and gives rise to pathological symptoms. Rilliet and Barthez mention particularly neuralgic pains, rebellious cough, and diarrhœa, as effects which they have observed. Rilliet relates the case of a girl, eleven years old, who had a very obstinate and protracted cough, the paroxysms lasting often half an hour to one hour. This cough immediately and permanently disappeared when the molars pierced the gums.

Dr. James Jackson, in his *Letters to a Young Physician*, says: "I have seen persons between twenty and thirty years of age much affected by a *wisdom tooth* not yet protruded, and distinctly relieved by cutting the gum. But I think the most common period of suffering from the second dentition is from the tenth to the thirteenth year. The most characteristic affections are wasting of flesh and nervous diseases. The boy loses his comeliness, and his complexion is less clear, while emaciation takes place in every part, though mostly, perhaps, in the face. The nervous symptoms are various, but the most common are a change in the temper and a loss of spirits. With these there is some loss of strength. The patient is unwilling to engage in play, and soon becomes tired when he does do it. Among the distinct symptoms which are not uncommon, I may mention pain in the head and in the eyes. The headache is not commonly severe, but it is such as inclines the patient to keep still. The eyes are not only painful, but are often affected with the morbid sensibility to which these organs are subject. I have known boys truly anxious to pursue their studies obliged to give them up on this account; and these, not having the disposition to play, will of choice pass the day with their mothers, and in-

crease their troubles by the want of air and exercise. Nervous affections of a more severe character are sometimes manifested."

Whether the symptoms which have been attributed to second dentition have always been due to this cause, is questionable. Practically, however, it matters little, whether we recognize dentition as the cause, or assign something else. Hygienic and medicinal measures to improve the general health will usually suffice to relieve the patient. Elsewhere I have related the case of a boy, of nervous temperament, about seven years old, who recovered immediately from a cough which had lasted for several weeks, by taking a mixture of iron and nitric acid. Many do well without medicine, simply by hygienic measures. Dr. Jackson says: "The remedies which I have found most useful are as follows: First, a relief from study or from regular tasks, yet using books so far as they afford agreeable occupation or amusement. Second, exercise in the open air, preferring the mode most agreeable to the patient, and in more grave cases the removal from town to country."

CHAPTER V.

CATARRHAL PHARYNGITIS, PERI-PHARYNGEAL ABSCESS, ŒSOPHAGITIS.

Children of all ages are liable to inflammation of the pharynx. In its mildest form it often, doubtless, escapes detection in the young infant. In older patients it is revealed by pain in swallowing solid food, and more or less tumefaction below the ears, apparent to the sight. It is said to be less frequent in infancy than in childhood. In the adult, and in children over the age of four or five years, inflammation of the pharyngeal surface is often confined to the portion of membrane which covers or immediately surrounds the tonsils. It occurs in connection with inflammation of these glands. But in infancy and early childhood this limitation is comparatively rare. Catarrhal inflammation of the fauces at this age is ordinarily general, the tonsils participating in the morbid state.

Pharyngitis is primary or secondary. The secondary form occurs in measles, scarlet fever, bronchitis, croup, pneumonitis, and occasionally in other affections. As these diseases are common, physicians are oftener called to treat patients who have the secondary form than the primary. Rilliet and Barthez met eighty-three secondary to sixteen primary cases.

Anatomical Characters.—The pathological anatomy of pharyngitis is ascertained by depressing the tongue and inspecting the fauces. The faucial surfaces is seen to be redder than in health, with more or less swelling, according to the intensity of the inflammation. In the primary

inflammation the color is commonly bright red, almost like that of arterial blood. If, on the other hand, the inflammation occurs in connection with a constitutional malady, the hue is apt to be darker. In grave cases of scarlet fever or measles, it is sometimes even livid, indicating a vitiated state of the blood, a condition of real danger. The tonsils are tumefied so as to project, though not to the extent which we often observe in the adult. They are then less firm than in the normal state. The follicles of the throat are enlarged and active, pouring out a muco-purulent secretion. This is sometimes seen in a layer over the tonsil or the posterior portion of the fauces. In a case of primary pharyngitis examined after death by Rilliet and Barthez, the tonsils were softened, infiltrated with pus, and slightly enlarged. A layer of bloody mucus lay on the pharyngeal surface, which was dark-red, thickened and glandular. The submaxillary glands were also swollen and somewhat softened.

If the inflammation is intense, the deep-seated portions of the tonsils become involved, and even sometimes the adjacent connective tissue. In such cases, by applying the fingers in the hollows below the ears, the tonsils can be felt.

Causes.—The usual cause of primary pharyngitis is exposure to cold. It also occasionally occurs from the use of drinks too hot or containing some irritating substance. I have met it in the most intense form caused by swallowing boiling water, and, in one case, from acetic acid taken through mistake. When it occurs in the eruptive fevers, it is usually part of a more extensive phlegmasia, in which the buccal and perhaps laryngeal and nasal surfaces participate.

Symptoms.—Fever, with thirst and loss of appetite, is common, and is usually proportionate, in intensity, to the extent and severity of the inflammation. At first there is dryness of the faucial surface, and this is succeeded by a more or less abundant viscid secretion. Swallowing is painful, except in mild cases. The muscles of the anterior half arches, which by their contraction, close the opening from the pharyngeal to the buccal cavity, and those of the posterior arches, which close the opening to the nasal cavity, both which sets lie a little under the mucous membrane, are often so infiltrated with serum that their contractile power is diminished, and if the same happen with the constrictor muscles, which carry downward the food, swallowing becomes difficult, and in the attempt, more or less of the ingesta is apt to return into the mouth, or enter the nostril. During health the air passes through the nostrils in the pronounciation of two letters only, namely, N and M, but in severe pharyngitis, in consequence of the swelling, and the impairment of the action of the muscles concerned in speech, the air passes through the nostrils with the utterance of many words, producing the nasal tone of voice. Sometimes the inflammation traverses the Eustachian tube to the middle ear,

causing earache, which may be relieved by the escape of pus down the tube, or by perforation of the drum into the external ear.

The breath is foul, but not fetid ; the respiration normal, or but slightly accelerated ; there is commonly no cough, but it is sometimes present, due to the extension of the inflammation to the upper part of the larynx, or to the collection of mucus around the aperture of the glottis. In most cases of pharyngitis there is a light fur upon the tongue, and stomatitis of a mild grade is present, as shown by redness of the buccal surface, and an increased mucous secretion.

Chronic pharyngitis, which is so common in adults, and which is produced in some by gastric derangements, and in others by excessive smoking, or the prolonged use of intoxicating drinks, and in others, still, by the syphilitic or mercurial cachexia, is comparatively rare in children.

Prognosis.—In mild cases of pharyngitis convalescence commences within a week. If the inflammation is dependent on a constitutional malady it may continue considerably longer, especially if the glands of the neck, and the connective tissue are much involved. The prognosis in secondary pharyngitis is less favorable than that of the primary form. In fatal cases there is usually a vitiated state of the blood, either from the coexisting constitutional disease, or from previous cachexia.

Pharyngitis may, however, become dangerous from complications to which it gives rise. The proximity of the inflammation to the brain, or its effect upon the cerebro-spinal axis through the medium of the nerves, sometimes gives rise to clonic convulsions. In a recent case of primary pharyngitis in my practice, repeated and violent convulsions occurred in an infant, about one year old, from this cause. They commenced at the inception of the inflammation, and constituted the only real danger. Pharyngitis may interfere materially with nutrition in consequence of the dysphagia, but in most cases of primary pharyngitis this symptom does not continue sufficiently long to endanger the life of the patient. In grave constitutional affections, as scarlet fever, the difficulty of swallowing, and the consequent innutrition, augment the danger. As regards, therefore, the prognosis in catarrhal pharyngitis, whether primary or secondary, it may be stated as a rule, that it is not, *per se*, a fatal disease, but is only so from complications, or from aggravating the primary malady with which it is associated.

Diagnosis.—This is not difficult provided that attention is directed to the throat; but the physician often fails to discover it at his first visit, from neglecting to examine this part. In many cases the local symptoms are not well-marked, and in the absence of these the febrile reaction may at first be referred to some other cause than the true one. Inspection not only reveals the presence of inflammation, but enables us to determine whether it is simple pharyngitis, or diphtheritic, or ulcerative. In some instances, simple pharyngitis resembles the diphtheritic, from the presence

of confervoid growths upon the inflamed surface, usually the leptothrix buccalis. The differential diagnosis is based on the easy removal and soft pultaceous character of the confervæ, and the appearance under the microscope.

TREATMENT.—*Mild* cases of simple pharyngitis require little treatment. With moderate counter-irritation over the throat, and the use of laxative medicines, the inflammation soon subsides. The linimentum camphoræ may be occasionally rubbed over the throat, and retained upon it by flannel. The effect is increased by the application, once or twice daily, of mustard or tincture of iodine, or by adding to the liniment one-fourth or one-third of its quantity of turpentine.

Some children seem to be most relieved by a muslin compress frequently wrung out of cool water, and retained upon the neck by a dry cloth bandage. Frequently rubbing the neck with warm oil or camphorated oil, and binding upon it a rind of salt bacon, are popular modes of treatment, and no doubt are productive of benefit.

In the severe forms of this inflammation, occurring independently of any other disease, more acute measures are sometimes required.

If there is stupor or restlessness, with unusual heat of head, and starting or twitching of the limbs which threaten convulsions, two to five grains of the bromide of potassium given every two or three hours, produce an excellent calmative effect.

Diaphoretics and sometimes cardiac sedatives are also indicated, such as liquor ammoniæ acetatis, spiritus ætheris nitrosi, ipecacuanha, and aconite. Medicines of this kind may be variously combined according to the age and condition of the patient, and the severity of the disease.

As the symptoms abate, the intervals between the doses may be increased.

In cases of much tenderness and dysphagia great relief is often obtained by emollient poultices applied over the throat.

Topical treatment of the pharynx is recommended by most authors. Rilliet and Barthez use for this purpose nitrate of silver or powdered alum. The former has been most employed by physicians. It may be applied in the proportion of ten grains to the ounce two or three times daily. I prefer the following mixture, used with the hand atomizer every two to four honrs:—

℞. Acid. carbolic., gtt. xxxij;
Potas. chlorat., ℥iij;
Glycerinæ, ℥iij;
Aquæ, ℥vj. Misce.

This can of course be used as a gargle by those old enough, or more continuously by the steam atomizer, if diluted with twice as much water.

The treatment of secondary pharyngitis will be described in connection with the treatment of the diseases which it complicates. Suffice it here

to say that this form of inflammation must not be treated by those depressing remedies which are useful in certain cases of idiopathic pharyngitis.

Peri-Pharyngeal Abscess.

Every practitioner should bear in mind the fact that an abscess occasionally forms between the pharynx and vertebral column (retro-pharyngeal), or upon the side of the pharynx in the submucous connective tissue. This constitutes a disease which is apt to be fatal, but which can ordinarily be promptly relieved by the surgeon.

Yet, if we look over the records of peri-pharyngeal abscess, we shall see that in a large proportion of fatal cases, the disease was supposed to be something else, and so treated until its nature was revealed by post-mortem examination. The most complete monograph on this malady with which I am acquainted was published by Dr. Allin, of this city, in the *N. Y. Jour. of Med.* for November, 1851, under the title of retro-pharyngeal abscess. To this paper I am largely indebted for facts.

Age—Cause.—This abscess may occur at any age, but it is most common in infancy and childhood. It is more frequent in the first two years of life than at any other period. Of the cases collated by Dr. Allin, in which the age is stated, twenty were under ten years, and twenty-one over this age. The abscess occurs in some patients from caries of the vertebral column, and, in others, from inflammation developed in the connective tissue or small lymphatic glands lying immediately outside the pharynx, or from a catarrhal pharyngitis. Whichever the cause, there is usually a scrofulous or reduced state of system.

Writers describe two kinds of peri-pharyngeal abscess, the primary and secondary. This distinction is based on the fact, whether or not the inflammation which leads to the abscess is dependent on an antecedent pathological state.

In the primary form the cause is usually atmospheric, or it is some irritating substance which has been swallowed, and which, lodging in the pharynx, produces phlegmonous pharyngitis.

The cause is mentioned in twenty cases of the primary form, collated by Dr. Allin, as follows: exposure to cold, ten cases; lodgment of bone in pharynx, eight cases; blow with a fencing-foil, one case. In the last case the button of a fencing-foil passed through the right nostril into the pharynx.

The secondary form occasionally occurs after measles and scarlet fever. The inflammation of the pharynx, common in those diseases, extends to the subjacent connective tissue, and, aided by the discrasia of the patient, becomes suppurative. Such cases have been observed by Rilliet and Barthez. The most common cause of the secondary form is, however, caries, occurring in the cervical vertebræ.

When thus occurring it is similar, both as regards cause and nature, to lumbar abscess. It would follow the same chronic course, and would properly be described in connection with it, were it not for its proximity to the air-passages, which renders the symptoms so urgent and dangerous. In a few recorded cases the abscess was a sequel of erysipelas. In nineteen cases of secondary abscess, in Dr. Allin's collection, the cause is assigned as follows: erysipelas of face, two; inflammation following a fall upon the inferior maxilla, one; after cerebritis, one; syphilis, four; caries of the cervical vertebra, six; scrofula, five.

The plausible opinion is expressed by Mr. Fleming (*Dublin Journ. of Med. Sci.*, vol. xviii.), that the suppuration begins, in a large proportion of cases, in the small lymphatic glands which lie in the connective tissue external to the pharynx. The late Prof. Geo. T. Elliot has recorded the case of an infant of seven months (*Obstet. Clinic*, N. Y., Appleton & Co., 1868) in whom peri-pharyngeal abscess immediately followed, and was apparently due to parotiditis.

In rare instances the abscess, or the local disease which leads to it, appears to exist from birth. Thus, Dr. E. O. Hocken relates, in the *Prov. Med. and Surg. Journ.*, 1842, the history of an infant who died at the age of nine weeks. It had always, when taking the breast, thrown back its head as if nearly suffocated. The walls of the abscess were thick and firm, described by the writer as cartilaginous. Occasionally there is no apparent cause of the abscess, except the strumous or cachectic state.

Anatomical Characters.—The seat of the abscess is not the same in all cases. The swelling can ordinarily be seen on examining the fauces, but occasionally it is so low as to be really peri-œsophageal, and, therefore, invisible. The size of the abscess varies; sometimes it is large, pressing inward the wall of the pharynx even against the velum palati and into the posterior nares, if the abscess have a high location, or, if lower, against the larynx, so as to embarrass respiration. Sometimes the abscess is so large or has such lateral extension that there is external swelling along the side of the neck. In a few cases on record the pus, instead of being discharged into the pharynx, made its way down the neck between the muscles and the connective tissue to the pleural cavity, which it entered, producing fatal pleuritis.

The walls of the abscess have been found in a different state in different cases. Sometimes the sac, at the projecting point, is so thin that it seems as if there might have been a spontaneous cure, could life have been preserved a few hours longer. In other cases the sac is so thick and firm that its rupture, for many days, would be impossible.

Symptoms.—The precursory symptoms differ in different cases, according to the nature of the cause, whether it be phlegmonous pharyngitis or simply adenitis or vertebral caries. If the abscess proceed from caries, it

is preceded by deepseated pain, greatly increased by movements of the head, and probably by induration along the sides of the vertebra.

The patient with this disease is restless, his mouth hot and dry; tongue furred; deglutition more or less difficult. Sometimes after suppuration has occurred there are alternations of rigors and fever. The symptoms indicate approximately the seat of the inflammation, but on examination we do not find that degree of redness of the mucous surface which we had been led to expect. The tissues which are chiefly involved in the inflammation, being submucous, are hidden from view. We observe redness of the pharynx, but it is disproportionate to the intensity of the symptoms. Sometimes there is a sensation of chilliness through the entire period of the abscess, though greater at one time than at another, and occasionally convulsions occur, especially in young infants. In ordinary cases embarrassment of respiration occurs early, and is the cause of the chief danger. It becomes more and more marked as the abscess increases. It is noticed both during inspiration and expiration. The dysphagia also increases, sometimes to such a degree that drinks are taken with difficulty, and solid food refused. The respiratory symptoms bear considerable resemblance to those in protracted laryngitis, for which this disease has been mistaken. While the respiration becomes impeded or whistling, the voice is also feeble or indistinct, from the pressure of the tumor.

But the symptoms described above are not all present in every case. They vary according to the size and location of the abscess, whether it be high or low, posterior or lateral. I have met the disease in a child old enough to express its subjective symptoms, in whom there was little or no dysphagia, and others report similar cases. When the tumor has attained such a size as to produce well-marked symptoms and jeopardize the life of the patient, it, or a part of it, can ordinarily be seen on depressing the tongue, but usually its location and condition can be better ascertained by exploration with the finger. The dyspnœa increases as the abscess enlarges, and, after a time, unless it bursts spontaneously or is opened by the surgeon, imperfect oxygenation of the blood results. In some patients paroxysms of dyspnœa occur, so as to threaten immediate suffocation; coughing or attempts to swallow induce these paroxysms, and the patient is forced to remain in an erect or semi-erect posture. The tongue is protruded, the head thrown back, the pulse is frequent and rapid, the limbs become livid and cool, and finally death occurs from dyspnœa. Occasionally, when death seems inevitable, the abscess breaks during the struggles of the child, and the patient is restored to health. In rare cases the result is different. The trachea and bronchial tubes are deluged by the purulent discharge, and immediate suffocation occurs. The following was an example: In May, 1871, a boy two years and five months old, was brought to the class at Bellevue, who had had the symptoms of an abscess for three months. The head was carried on one side, its rotation caused pain, and a laryngeal

râle accompanied respiration. The upper part of the tumor could be detected by the finger, but, on account of its low location, it was impossible to open it with the bistoury. The temperature was 103°, pulse 156. The case was kept under observation, but in a few days the dyspnœa suddenly became so urgent that death was imminent, when the attending physician of the class, Dr. Swezey, broke the abscess with his finger, and pus was ejected on the floor; death, however, occurred almost immediately.

A correct appreciation of the symptoms and the nature of peri-pharyngeal abscess will be best obtained by relating a case. I select the following from the *Trans. of the Lond. Pathol. Soc.*, Oct. 20, 1846:—

A female infant died at the age of seven months, having had difficult breathing three weeks, and extreme dyspnœa during the last days of life. The dyspnœa was constant, and was aggravated by mental excitement, by movements of the body, and by exposure to cold. During the paroxysms, a peculiar, croupy sound accompanied inspiration. There was no dysphagia through the entire sickness, and death occurred from apnœa.

The sac of the abscess was of the size of a pigeon's egg, and was situated between the upper cervical vertebræ and the back of the pharynx. The abscess was flattened in front, so as not to cause any decided prominence of the wall of the pharynx. From the sac a second small cyst extended forwards, forming a nipple-like swelling in the pharynx, which completely closed the orifice of the glottis. Its aperture of communication with the body of the abscess admitted the point of the little finger, and the whole swelling was freely movable and perfectly translucent at its extremities and sides. The abscess might have been easily punctured, with probably the preservation of life.

The *duration* of this malady is very different, according to the severity of the inflammation, the rapidity with which the abscess enlarges, and the direction which it points. A lateral or downward extension is not so immediately dangerous to life as the anterior.

The time when the abscess begins to form cannot be precisely ascertained, and most writers, in determining its duration, compute from the first appearance of symptoms which are referable to the pharynx. Dr. J. Bryne relates, in the *Amer. Journ. of Med. Sci.*, 1838, a fatal case in which the disease had apparently continued only about one week. The patient was an infant one year old, and its death was from apnœa. The abscess was large, extending from the base of the skull to the thorax, and pressing both on the larynx and trachea. M. Besserer (*Archiv Gén. de Méd.*, 1840) gives the history of an infant four months old, who died in the same way after thirteen days. An infant nine months old, whose case was published by Dr. W. C. Worthington, in the *Prov. Med. and Surg. Journ.*, 1842, lived nine days. The abscess occurred from exposure to cold; the patient was treated for croup, and died from suffocation. The anterior wall of the abscess was very thin. Since the first edition of this

book was published, I have met four patients with this disease in whom the pus was evacuated when the dyspnœa had become urgent. In two the symptoms indicated a continuance of the disease from two to four weeks, and in the third case four months. The fourth case is interesting on account of the short duration of the severe symptoms. The following is the record of it: M. E., aged 7 months, female, nursing, inmate of the New York Foundling Asylum, was observed to have difficult breathing for the first time, on March 28, 1875. Since about March 8, some swelling had been noticed along the side of the neck, but it gave rise to no marked symptoms and she had not seemed ill, till the obstruction in the respiration commenced. At my visit on the evening of the 28th, the infant was pointed out to me as in a dying condition. She was lying in a state of stupor, pallid, and gasping for breath, with a temperature of 103°, and very feeble pulse, numbering about 200 per minute. On carrying the finger into the throat an abscess could be readily detected, situated in the walls of the pharynx on the left side posteriorly. This was easily opened by a curved bistoury, around which adhesive plaster was wound to within half an inch of the point. The breathing immediately began to improve. On the following day the infant was playing in the mother's lap, with a pulse of 140, but a normal temperature. With the use of cod-liver oil and the syrup of the iodide of iron, its health was soon fully restored.

When the abscess grows slowly, and presses lightly on the air-passages, the case may continue for months. Such a one was observed by Professor Willard Parker. (Allin.) This infant was one year old; it suffered from pharyngeal symptoms nine months, was treated for tonsillitis, and death occurred as usual from apnœa. The abscess was two inches long, and there was no disease of the vertebræ. The same surgeon saved the life of another patient four years old, in whom the disease was protracted, by puncturing the abscess; and Professor Post, of this city, also treated successfully a case which had continued three months. (Allin.)

Diagnosis.—The diagnosis of this disease is ordinarily easy, provided that the physician examine carefully and bear in mind the occasional occurrence of such an abscess. In a large proportion, however, of the recorded fatal cases, the true nature of the disease was not recognized during life. Especially is the diagnosis difficult when the cerebro-spinal system is early implicated, and symptoms arise which divert attention from the throat to the brain.

The maladies with which peri-pharyngeal abscess is most frequently confounded are laryngitis and simple but severe pharyngitis. From laryngitis, for which it has been most frequently mistaken, it may be distinguished by the dysphagia and by the character of the initial symptoms. In laryngitis there is usually the peculiar cough from the first or very early, while in abscess there is an initial period of several days or even

weeks before respiration is materially affected. This is the period of inflammation which precedes suppuration.

In abscess pressure of the larynx backward is badly tolerated, greatly increasing the dyspnœa, while in pharyngitis and croup this effect is not so marked. In abscess the horizontal position aggravates the dyspnœa, but not in pharyngitis and croup. The character of the voice will also aid in diagnosticating abscess from laryngitis, since in the former it is apt to be nasal, and in the latter hoarse or whispering. The decisive test is afforded by inspection and digital exploration. The tumor is seen, or, if situated too low to be seen, is felt, upon the walls of the pharynx.

If the symptoms of abscess are masked by those arising from the cerebro-spinal system, as by convulsions, the priority of the pharyngeal symptoms will serve to aid in determining the true disease.

In a case of suspected abscess the physician should not only carefully inspect the fauces, but should employ digital examination. The finger will often detect fluctuation when no evidence of an abscess or uncertain evidence is presented to the eye.

Prognosis.—With proper treatment the result is usually favorable, but, if the disease is not recognized, many die. In Dr. Allin's cases, of those under the age of twelve years nine died, while ten recovered by the opening of the abscess by the lancet, trocar, or finger, and one by its spontaneous rupture.

If the abscess is due to disease of the spinal column, death may occur immediately after the sac is opened, the caries of the intervertebral cartilages producing, according to Dr. Allin, dislocation of the vertebræ. Death may also occur, though rarely, from pleuritis, in consequence of the bursting of the abscess into the pleural cavity. Even in caries, if the sac is properly opened, and if need be reopened, recovery is possible, as in a case treated by Prof. Post.

Treatment.—The proper treatment of peri-pharyngeal abscess is simple, consisting in breaking or puncturing the sac by the finger, the lancet, bistoury, or pharyngotome. Each method has been successfully employed. In the majority of cases the proper way to open the abscess is by the ordinary curved scalpel or bistoury, which should be covered by a strip of adhesive plaster to within a half inch of the point. If the abscess is post-pharyngeal, it should be opened in the median line. A single incision suffices to evacuate the pus. If the abscess points or is elastic, there is little danger of wounding any important vessel or producing dangerous hemorrhage if the operation is properly performed. It may be necessary to open the abscess more than once, as in a case reported by Dr. Post, and another which I saw with Dr. Livingston, of this city. In certain cases, when the knife can not be readily employed, the abscess may be opened by pressure with the finger nail or the edge of a teaspoon.

Patients with this disease ordinarily require constitutional treatment,

especially the use of tonics, ferruginous and vegetable. The citrate of iron and quinine, the citrate of iron and ammonia, and in strumous cases the syrup of the iodide of iron with cod-liver oil, are eligible preparations. Nutritious diet and often alcoholic stimulants are required.

Œsophagitis.

Disease of the œsophagus in infancy and childhood is comparatively rare, inflammation being the most frequent affection of this portion of the digestive tube in these periods, and, indeed, the only one which claims attention. It is most common in infants under the age of three or four months, who are deprived of the breast-milk, and are given a diet which is with difficulty digested, and perhaps taken too hot or too cold. It is, therefore, most common in foundling hospitals. I have frequently observed it in the Infant's Hospital, and the Nursery and Child's Hospital, of this city, chiefly at the autopsies of bottle-fed infants, under the age of six months, whose symptoms had indicated disease or derangement of the digestive function. Many of them had diarrhœa, and died in a state of emaciation. Œsophagitis in these cases was associated with simple or gangrenous stomatitis, thrush, or with gastritis or entero-colitis. Sometimes all these inflammations coexisted. In a few cases the confervoid growth of thrush had extended from the mouth to the œsophagus. It occurred in small hemispherical masses, scarcely as large as a pin's head. Swallowing corrosive or strongly irritating substances, as the acids or alkalies, is an occasional cause of œsophagitis, the irritant at the same time producing stomatitis and gastritis.

Anatomical Characters.—The inflamed surface sometimes presents a uniformly injected appearance. Usually, however, there is greater intensity of inflammation in streaks or patches than over the surface generally. I have frequently observed at autopsies a greater degree of inflammation in the lower than upper half of the œsophagus, even when the infant had stomatitis at the time of death.

Œsophagitis occurring from faulty regimen or anti-hygienic conditions is not accompanied by as much thickening of the walls of the tube as often occurs in some other portions of the digestive canal, as, for example, in the colon. Diphtheritic inflammation of the œsophagus is accompanied by so great infiltration of the mucous membrane and underlying connective tissue that I have seen the œsophageal walls three or four times the normal thickness.

Occasionally ulcerations of the œsophageal mucous membrane are observed in the lower part of the tube, and Billard describes the ulcerative form of œsophagitis. At the first autopsies at which I observed these ulcers, I supposed that they were pathological, and indicated a severe grade of inflammation; but a more extended observation has convinced me that they are usually post-mortem, and are not at all dependent on in-

flammation of the œsophagus. The solvent power of the gastric juice not only causes ulceration in the stomach, but entering the œsophagus may and not infrequently does produce a solvent action on the mucous tissue there. At the meeting of the London Pathological Society, March 4th, 1852, Dr. Graily Hewitt presented a specimen in which the gastric juice had not only eaten entirely through the coats of the œsophagus an inch above the stomach; but had even attacked the left lung. Over the age of six months inflammation of the œsophagus is rare.

The symptoms of œsophagitis, in those young and emaciated infants in whom it ordinarily occurs, are not well-pronounced. Pain in deglutition, or tenderness on pressure over the œsophagus, if present, is ordinarily not appreciable. Nor have they seemed to me to vomit oftener than other infants of this class who suffered from indigestion and gastro-enteritis, without œsophagitis. It is, therefore, difficult to diagnosticate œsophagitis in them. It is, according to my observation, oftener present than absent in spoon-fed infants of three months or under who have persistent stomatitis and entero-colitis.

Treatment.—In the œsophagitis of foundlings and ill-nourished infants, which arises, as has been stated, from faulty regimen, no treatment is required apart from that designed to relieve the stomatitis or entero-colitis with which it occurs. Attention must be directed mainly to the diet and hygienic management. The remedial measures are more fully detailed in our remarks on entero-colitis. Œsophagitis produced by swallowing corrosive or highly irritating substances requires the same treatment as in the adult, namely, poultices, demulcent drinks, etc.

CHAPTER VI.

INDIGESTION, CONGESTION OF STOMACH, GASTRITIS, FOLLICULAR GASTRITIS, DIPHTHERITIC GASTRITIS, POST-MORTEM DIGESTION, SOFTENING.

Indigestion is more common during infancy than in any other period of life. While the digestive organs in the adult easily assimilate a great variety of food, it is necessary for the well-being of the infant that its diet be simple and carefully prepared. Departure from this rule leads to indigestion and ulterior diseases.

After the age of two years a mixed diet is readily assimilated, the digestive function less frequently disordered, and indigestion presents few peculiarities to distinguish it from that of the adult.

Indigestion in some children is habitual; in others the digestive process

is ordinarily well performed, but, from some temporary derangement of system or error of diet, an acute attack of indigestion occurs. Hence, two forms of this ailment may be described: first, acute, referring to temporary attacks; secondly, chronic, referring to the habitual state.

Causes.—The causes of indigestion are twofold: first, the condition of the digestive function independently of the aliment; secondly, the unwholesome or improper character of the ingesta. Anything which lowers the vital powers may be a predisposing cause of indigestion, by impairing the function of the organs which assimilate the food. Impure air and personal uncleanliness, protracted hot weather, and previous disease, are among the common predisposing causes. The strong country child can thrive upon a diet which, given to the more feeble child of the city, would produce deleterious results. During the summer months it often happens that an infant in the city cannot digest properly any food given to it except the mother's milk; and from this results much of the infantile sickness and mortality which make this season of the year so much dreaded by parents. There is a natural difference in children, as regards liability to disordered digestion. Some do well upon a diet which given to others similarly situated occasions vomiting, gastralgia, and flatulence.

In the majority of cases of indigestion, however, the fault does not exist in the child. It is fed too often or irregularly, or upon a diet that is unwholesome or indigestible. It is well known that the milk of the mother or the wet-nurse is liable to changes which render it for the time unsuitable for the infant. Her food may be of such a quality, or her mind so excited, or some function of her system so disordered, as to effect a temporary change in the constitution of the milk. The occurrence of the catamenia, or of a gestation, in mothers who are suckling, not infrequently produces this unfavorable result.

Indigestion is most common in those infants who, deprived of the mother's milk, are intrusted to wet-nurses, or fed from the bottle. The milk of the wet-nurse, from not agreeing with the age of the infant, from irregularity in her mode of life, from the acescent nature of her food, or from other causes which are not appreciable, may disagree with the infant, and be imperfectly digested.

The most common cause of indigestion in the infant is artificial feeding. This, in the cities, is productive of a great amount of gastric and intestinal derangement and disease. The younger the infant, the less frequently does it thrive if brought up by hand.

Whatever care may be bestowed in the preparation of its food, whether cow's or goat's milk, or farinaceous substances be used, there is seldom that healthy nutrition which is observed in infants who receive the natural aliment. The "swill milk" in common use among the poor families of this city is totally unfit for the feeding of infants, and is apt to cause flatulence, acidity, and indigestion. Acute indigestion occurs in children of

any age from food unsuitable in quality or quantity, which produces gastralgia and other symptoms to be detailed hereafter. Those who suffer habitually from mal-assimilation are especially liable to such acute attacks.

In the period of childhood, chronic indigestion is much less frequent than in infancy, but children are, perhaps, more subject than infants to the acute form. This is induced by ingesta taken in too large quantity, or of a kind which is with difficulty digested. Cherries, currants, raisins the parenchyma of oranges and lemons, dried fruits and confectionery, which are so often heedlessly given to children, are common causes of acute attacks of indigestion. These substances, being but partially digested or not at all, and sometimes accumulating for days in the stomach or intestines, may lead to a very serious and dangerous condition.

Symptoms.—The *nursing* infant, if the milk continually disagree with it, is fretful. It has a discontented aspect. It seldom smiles, and is not amused by playthings, or is only amused for a short time. Its features are pallid, and bear the appearance of faulty nutrition. Its body and limbs are more or less wasted, or are soft and flabby. Vomiting is frequently present, and sometimes a large mass or masses of caseum are ejected, which have evidently lain a considerable time in the stomach. The bowels may be constipated or loose, and the evacuations are unhealthy. This state of the infant continuing prevents the necessary rest of the mother, and may affect unfavorably her health, so as to reduce the quantity of her milk, or render it still more unwholesome.

In addition to the habitual indigestion, these infants sometimes have acute attacks, similar to the acute dyspepsia of adults, and which have been described by writers as gastralgia or enteralgia. Their countenance indicates suffering; they utter sharp cries, their thighs are often drawn over the abdomen, notwithstanding attempts made to amuse them. Flatulence is common. By vomiting or an evacuation from the bowels, the offending substance is removed, and the pain subsides.

Indigestion in the *spoon-fed* infant is similar to that in the infant who nurses, except that it is ordinarily accompanied by symptoms of greater gravity and persistence, and there is in such infant more liability to the acute attacks.

In those who have advanced beyond the age of infancy, chronic indigestion is less frequent than in infants, but as the diet of such children is prepared with less care, and is less restricted, they are very liable to attacks of temporary indigestion. These come on suddenly, and sometimes are so severe as to endanger life. The child, previously well, is suddenly seized with languor; the pulse becomes accelerated, the face flushed, and surface hot. Drowsiness compels him to seek the bed, where he lies with his eyes shut. He sometimes has headache, and a sensation of oppression in the epigastrium. The nervous system is not infrequently affected, as shown

by tenderness of a neuralgic character of the body and limbs, sudden twitching of the limbs premonitory of convulsions, and occasionally severe and repeated convulsions. These alarming and really dangerous symptoms speedily subside on the removal of the cause. One of the most severe attacks of eclampsia which I have seen occurred in a boy eight or ten years old, induced by swallowing the parenchymatous portions of oranges which he had been in the habit of eating, and which had accumulated in the stomach and intestines. The expulsion of the offending substance gave immediate relief.

Sometimes, but not often, the symptoms of acute indigestion closely resemble those of pneumonitis. For example, an infant, whom I once treated, was seized at night with fever, hurried respiration, and the expiratory moan, which writers consider almost pathognomonic of pneumonitis or pleuritis. These symptoms subsided when the bowels were freely opened, and currants, which had been eaten the previous day, were expelled.

As the child advances in years and its general health improves, the digestive function is less frequently disturbed. After the age of three or four years indigestion is much less frequent than in infancy and early childhood.

Indigestion leads to some of the most common and serious affections of early life. In the infant, if it continue a considerable time, inflammation of the buccal, œsophageal, or gastric mucous membrane, or of some part of the intestinal tract, ordinarily occurs. In the young infant thrush soon makes its appearance, and, whatever the age, the cachexia which results from continued indigestion increases the liability to organic maladies. Eclampsia is, as we have seen, a serious, and at the same time a not infrequent, result of temporary or acute indigestion.

Prognosis.—In simple indigestion this is good. It is doubtful or unfavorable when ulterior diseases occur, and in proportion to their gravity.

Treatment.—The first indication in treatment is obviously the removal of the cause. In *acute* indigestion, when there is reason to believe that there is some offending substance in the stomach or intestines, if the symptoms occur soon after the substance is taken, an emetic may be administered, and ipecacuanha, in syrup or powder, is safe and usually efficient. If several hours have elapsed a purgative should be given, as castor oil, either alone or in combination with syrup of rhubarb.

If the symptoms are urgent, especially if convulsions are threatened, we should not wait for the slow action of a purgative, but should resort to enemata to open the bowels. Sometimes the pain in acute indigestion is such as to require the use of opiates. In the infant there is often an excess of acid in the stomach and intestines, which is best treated by alkaline remedies, as lime-water in combination with the opiate. The following mixture will be found useful in such cases :—

℞. Tinct. opii deodorat., or liq. opii composit. (Squibbs), gtt. xij;
Magnes. calcinat., gr., xij;
Sacch. alb., ʒij;
Aq. anisi, ℥iss. Misce.

Dose, the bottle being first shaken, one teaspoonful every two hours to a child a year old, until relief. If there is much pain, it is well to add a little chloroform or Hoffman's anodyne to the mixture.

Or the following mixture:—

℞. Tinct. opii deodorat., or liq. opii composit., gtt. xij;
Bismuth. subcarbonat., ʒiss;
Syr. Simplic., ℥ss. Misce.
Aq. Cinnamomi, ℥j.
Shake bottle thoroughly and give one teaspoonful.

If in the acute indigestion of infants there is diarrhœa, the camphorated tincture of opium, in combination with chalk mixture, may be given, fifteen drops of the one to a teaspoonful of the other, or the above mixture. Infants, whose diet consists largely of cow's or goat's milk, digest with most difficulty the caseum, which is apt to pass the bowels in an imperfectly digested state, or to collect in a large and firm mass in the stomach, causing gastralgia and rendering the child fretful till it is vomited. I have elsewhere recommended, as important to prevent these attacks of acute dyspepsia, the use of the upper third of the milk which contains less than the average caseum, and the addition of an alkali to the milk, which retards the coagulation till it begins to be acted upon by the gastric juice, and tends to prevent the formation of large and firm caseous coagula in the stomach.

In *chronic* indigestion the means of relief are different. They are twofold: first, as regards change of diet; secondly, measures to improve the digestive function. Spoon-fed infants, suffering from habitual indigestion, require the utmost care as regards the character of their food, its preparation, and the times of feeding. Often it is best, if practicable, to procure a wet-nurse, and sometimes removal to a more salubrious locality is followed at once by improvement in the digestive function. If the infant is already wet-nursed, the milk should be examined microscopically and otherwise, and inquiry should be instituted in reference to the health and diet of the wet-nurse. Sometimes a change of wet-nurse is advisable. For facts and considerations bearing on this point the reader is referred to the chapters relating to regimen.

Children with chronic indigestion are occasionally much benefited by the moderate and judicious use of alcoholic stimulants. They should be given sparingly with their food, and should be discontinued as soon as the digestive function is fully restored. M. Donné and some other French writers recommend the habitual use of wine for infants even in a state of

health, but there are reasons, moral as well as physical, why alcoholic stimulants should only be used as medicines, and not in a state of health.

If the case is one of simple or uncomplicated indigestion, tonics, either the mineral or vegetable, may be employed. In many instances, however, especially in infancy, gastro-intestinal inflammation has supervened, and in such cases those tonics should be employed which exert a favorable, or, at least, not an unfavorable effect on the hyperæmic and irritable surface over which they pass.

When indigestion is simple, or accompanied by no serious complication, wine of iron, citrate of quinine and iron, and the elixir of calisaya bark, may be mentioned among the safe and efficient agents to improve the digestive function. The following is also a good formula for cases of simple indigestion :—

℞. Ferri et ammon. citrat., gr. xvj ;
Bismuth. et ammon. citrat., gr. xlviij ;
Aquæ, ℥ij. Misce.

Dose, tablespoonful three or four times daily to a child of two or three years.

The ferruginous preparations are most efficacious in cases which are attended by signs of anæmia.

Among the useful vegetable stomachics and tonics may be mentioned the compound tincture of cinchona, compound tincture of gentian, infusion of columbo, fluid extract of columbo, and fluid extract of cinchona.

If chronic indigestion is complicated with gastro-intestinal inflammation, subacute or chronic, for this is the form which is usually present, there are still certain tonics which may be advantageously administered. Columbo and the compound tincture of cinchona are often useful in these cases, and of the chalybeates wine of iron or the citrate of iron and ammonia or the liquor ferri nitratis may be safely administered.

I have not alluded to the use of pepsin as a remedial agent in indigestion. The theory of its employment in atonic states of the stomach is good, but physicians in this country have, in most instances, failed to observe that benefit from its use which they had been led to expect, and which seems to have followed its employment in the practice of some of the European physicians. Perhaps the result would have been better had fresher and better preparations of pepsin been prescribed. Boudault's pepsin from Paris has been most used in this country, but the American preparations are probably equally good. I have prescribed it in doses of two or three grains, several times daily, to foundlings from one to three months old, and in proportionate doses to older infants, but I am not able to speak confidently of its effects, as I have commonly given it with bismuth.

The American pepsin, prepared under the intelligent supervision of experienced chemists, can be obtained in the shops in the form of a powder or liquid. From its freshness and unobjectionable taste it possesses advantages.

Infants affected with diarrhœa from indigestion often improve under the use of powders consisting of equal parts of subnitrate of bismuth and pepsin. An infant of three months can take three grains of each every three hours.

Dyspepsia often rapidly disappears by hygienic measures without the use of medicines, as by removal from the city to the country, outdoor exercise, or, if the patient is an infant, by being carried into the open air daily. In infants, also, marked improvement is often observed on the approach of the cool and bracing weather of autumn and winter.

Congestion of the Stomach.

Passive congestion of the stomach is described among the diseases of this organ by Billard; but it is a pathological state of little importance in itself. It occurs in new-born infants, asphyxiated at birth and with difficulty resuscitated. In these cases there is generally intense capillary congestion throughout the system. The mucous membrane of the stomach is injected, but not more than that of the mouth or intestines. If circulation and respiration are fully established, this injection of the capillaries subsides. No treatment is required, except measures to promote the circulatory and respiratory functions. In cyanosis and atelectasis there is often general congestion of the capillaries of the systemic circulatory system, on account of the obstruction to the flow of blood through the heart in the one disease and through the lungs in the other. There is in these cases passive congestion of the stomach, but not more than of the other organs.

Gastritis.

Inflammation of the stomach, except when produced by the direct contact of some irritant, is rare in infancy and childhood, independently of disease in some other portion of the intestinal tract. Cases have, however, been reported in which it was not known that any irritating ingesta had been taken, and in which a careful examination revealed a healthy or nearly healthy state of other portions of the digestive tube. The subjects were, for the most part, young infants. The following is an example related by Billard:—

An infant, four days old, remarkable for the color of his face and firmness of flesh, refused the breast and vomited yellow, acid matter. On the following day the vomiting had increased, the legs were œdematous, face pale and pinched, respiration difficult, skin cold, pulse slow and irregular, and pressure on the epigastric region produced cries indicative of pain.

Third day: general sinking; face thin and expressive of great pain; stools natural.

Fourth and fifth days: condition the same. Death occurred on the sixth day, and the autopsy was made on the day following.

With the exception of slight pneumonitis, no disease was discovered in any part of the system besides the stomach. The mucous membrane of this organ was intensely vascular near the cardiac orifice and along the lesser curvature. It was also tumefied, and could be easily raised with the nail. In the remainder of this organ there was strongly marked capilliform injection.

This case is interesting as showing what may happen, though rarely. A nursing infant is seized with gastritis without apparently having taken any irritating ingesta, and without other disease of the digestive apparatus. It is probable, however, that, in cases like the above, the cause, if ascertained, would be found in the ingesta: perhaps drinks too hot, perhaps elements of colostrum, or pathological elements in the milk, which might produce gastritis in young infants in whom the mucous membrane is delicate and sensitive.

Gastritis is not uncommon in infancy in connection with inflammation of the intestines. The latter inflammation is sometimes apparently subordinate to the former, and, if such patients die, the fatal result is due mainly to the gastric disease.

Cause.—Gastritis, as I have observed it in infants, has been in most cases due in great part to the continued use of improper food, of food not suitable to the age of the child, and which was, therefore, with difficulty digested. Milk, acid, or otherwise unwholesome, farinaceous substances, stale or of an inferior quality, and not properly prepared, drinks too hot or too cold, may be specified among the causes. Therefore, this disease is most common in bottle-fed infants, and is comparatively rare in those who receive abundant and wholesome breast-milk. Anti-hygienic agencies, apart from the diet, no doubt exert some influence in the production of gastritis, as they do of stomatitis. Uncleanliness, and residence in damp and dark apartments, or in an atmosphere loaded with noxious gases, produce a condition of system which strongly predisposes to these inflammations, if, indeed, they may not be enumerated among the direct causes.

Rilliet and Barthez have called attention to the fact that certain medicinal substances given to children occasionally cause gastritis. They have observed this effect from the use of tartar emetic, Kermes mineral, and croton oil. Gastritis occurring in this way may or may not be associated with inflammation in contiguous portions of the digestive tube. Elsewhere I have related a case in which gastro-enteritis occurred in a child nine years old, after having taken a considerable quantity of kerosene oil for spasmodic croup.

Inflammation of the stomach is thought by some to accompany measles and scarlet fever during the eruptive period, but this opinion is probably

incorrect. If it occur, it corresponds with the stomatitis and dermatitis of those diseases, and disappears as they subside. It is mild, and accompanied by few symptoms. I have, as stated in the remarks on scarlet fever, examined in certain instances the stomachs of those who had died during the eruptive period of these diseases, and found them free from any appreciable inflammatory lesion.

Age.—From the records of about seventy cases of inflammatory disease of the digestive mucous membrane which I have preserved, it appears that gastritis is rare over the age of six months. On the other hand, it is not uncommon in infants under the age of three months who are deprived of the breast-milk. I have met it chiefly in foundlings fed with the bottle, and having at the same time entero-colitis and often also stomatitis and œsophagitis. In these cases there is sometimes continuous or almost continuous injection and thickening of the mucous membrane, from the lips to near the pyloric orifice of the stomach, and even beyond this orifice in the intestines. The following is an example of gastritis as it frequently occurs in foundling institutions :—

Case.—R. W., female, two weeks old, was admitted into the New York Infant Asylum, August 24th, 1865, anæmic and somewhat emaciated. It was in part wet-nursed, and in part bottle-fed. The emaciation increased, and nearly the entire buccal cavity became covered with the confervoid growth of thrush. On September 4th, diarrhœa commenced. Borax was used for the mouth, and alkalies and astringents to check the diarrhœa, but without material improvement.

The following was the record for September 7th : "Cries almost constantly, with feeble or whining voice ; still has thrush ; nurses and does not vomit ; stools five or six daily, and green ; pulse 136, feeble." Death occurred September 8th.

Autopsy September 9th.—Mouth and fauces not examined ; mucous membrane of œsophagus vascular in its whole extent, with slight thickening, but without ulceration ; mucous membrane of stomach injected like that of the œsophagus, and somewhat thickened, except in its pyloric extremity, where the appearance was natural, or nearly so ; the color in the central part of the inflamed gastric membrane was deep red ; no thrush was noticed, except on the buccal surface during life ; along the great curvature of the stomach were white flakes, resembling those of thrush, but which were found by the microscope to consist mainly of oil-globules and epithelial cells, without the cryptogamic formation ; mucous membrane of small intestines healthy in their whole extent, except slightly increased vascularity in a few places in the ileum ; mucous membrane of colon much injected throughout, except near the ileo-cæcal valve, where the vascularity was slight ; in the transverse and descending colon, the redness was pretty uniform ; and the membrane was thickened, but not ulcerated ; solitary gland and Peyer's patches somewhat elevated.

The observations of Valleix show how frequently gastritis is associated with severe attacks of thrush. In twenty-three of his cases of the latter disease, in which the condition of the stomach was noted after death, this

organ presented inflammatory lesions in seventeen, and in three others appearances which may or may not have been due to inflammation.

Symptoms.—A difficulty exists in isolating and defining the symptoms of gastritis, from the fact that it commonly coexists with other inflammation of the digestive tube. Though we may never be able to diagnosticate this catarrh as certainly as we can croup or pneumonitis, still, there are symptoms which arise directly from the gastritis, and with care we may be able to distinguish them from those symptoms which are due to other pathological states.

If gastritis is acute, pain is present. In the above case from Billard, as well as in a case observed by myself and related under the head of gelatinous softening, there were frequent cries, and the countenance indicated much suffering, until the stage of collapse. If there is less intensity of inflammation, and the disease is more protracted, as is ordinarily the case, the pain is not so severe, and it may be so slight as not to attract attention. Sometimes there is tenderness, so that pressure upon the epigastric region is badly tolerated. Vomiting is regarded as one of the most constant symptoms. The infant after nursing seems in distress till the milk is returned, but it nurses with avidity in consequence of the thirst, if it is not too exhausted or feeble. The dejections may be quite regular throughout the disease, as in the case from Billard. There is ordinarily, however, diarrhœa from the presence of entero-colitis. The pulse is sometimes accelerated, and sometimes nearly natural. The emaciation in gastritis is rapid, since not only the milk is in great measure vomited, but the digestive function, so far as the stomach is concerned, is seriously impaired. The features become wrinkled and senile, the eyes hollow, the limbs attenuated, and the cranial bones uneven. Death occurs from exhaustion.

Anatomical Characters.—Simple gastritis may affect the entire mucous surface of the stomach, or be limited to a certain part. The part which is most likely to escape is that towards the pyloric orifice. This portion of the organ is sometimes found in nearly or quite the normal state, while the cardiac half or two-thirds is inflamed. The vascularity of the diseased surface is not uniform. In one place there is simple arborescence; in another intense continuous redness, and between these two extremes are different grades of vascularity. The mucous membrane is somewhat thickened, softened, and the secretion of mucus increased. Extravasation of blood is not infrequent under the mucous membrane, usually in points, and the mucus may be mixed with more or less blood. Small shreds or portions of coagulated milk are often found with the mucus attached to the gastric surface. I have observed, though rarely, small superficial ulcers at the point where the inflammation had been most intense.

Diagnosis.—In protracted cases, when entero-colitis is present, it is difficult to make a positive diagnosis. Our opinion must then be little more than a plausible conjecture. In the acute attacks we can diagnosticate the gastritis with more certainty. If a young infant affected with thrush is seized with pain, and it vomits often; if emaciation is rapid, and there is no diarrhœa, or diarrhœa not sufficient to account for the prostration; if the buccal mucous membrane, dotted with the points of thrush, presents a dry appearance and the deep-red color of severe stomatitis, there can be little doubt of the presence of gastritis. The diagnosis is rendered more certain by signs of tenderness when pressure is made upon the epigastric region.

Prognosis.—Like other inflammations, gastritis is probably sometimes so mild that it does not materially increase the suffering or danger of the child. This mild form of the disease under favorable circumstances soon subsides. In other cases, by the continuance or increase of the cause, the inflammatory process becomes more severe and extensive, resulting even in disintegration of the mucous membrane. Those cases are especially severe and likely to end fatally, which are protracted and accompanied by severe thrush, with a desiccated appearance of the buccal surface, or with entero-colitis. Pain, vomiting, and rapid emaciation in such children indicate the speedy approach of death. Improvement in the stomatitis or entero-colitis is a favorable indication, but these inflammations may improve without corresponding improvement in the gastritis.

Treatment.—All food or drinks, except those of a bland and unirritating nature, should be forbidden. If practicable, the young infant should take no nutriment except the mother's milk or that of a wet-nurse. As there is an excess of acid in inflammation of the mucous coat of the digestive tube, lime-water may be advantageously given in combination with the breast-milk. Opium is required to relieve the pain and quiet the action of the stomach. The camphorated tincture of opium, in doses of four or five drops to a child a month old, or the syrup of poppy, tincture of opium, or liquor opii compositus, in proportionate doses, may be administered. If there is thirst, a little gum-water should be given frequently. If there is much emaciation and the vital powers are failing, it will be necessary to resort to the use of stimulants. Stimulating enemata are preferable to stimulants given by the mouth. Much benefit may be anticipated from local measures. Irritation should be produced upon the epigastrium by mustard or other means, followed by fomentations. It is rarely, perhaps never, proper to use leeches, if the patient be a young infant. Death occurs from exhaustion, and it is, therefore, important that the vital powers should not be reduced. If the child is weaned, the diet at first should be restricted to arrowroot, rice-water, barley-water, or similar bland substances. In advanced stages of gastritis, animal broths and jellies may be required.

Follicular Gastritis—Diphtheritic Gastritis.

The pathological character of *follicular* gastritis is similar to that of follicular stomatitis. It is an inflammation affecting the gastric follicles and ending in their ulceration. It is not a frequent disease; it occurs in young infants. Billard observed fifteen cases. The symptoms in these patients were similar to those in simple gastritis of a severe form. The emaciation and prostration were rapid, and death occurred early. We can only diagnosticate the gastritis without determining its follicular character. How many recover it is impossible to ascertain, but the disease is apt to be fatal on account of the intensity of the inflammation, not only of the follicles but of the intervening mucous membrane. The treatment is that of gastritis.

Diphtheritic gastritis is infrequent. It occasionally occurs during epidemics of diphtheria. Allusion is elsewhere made to a case treated in the Nursery and Child's Hospital of this city, in December, 1859. The patient, eighteen months old, previously had had protracted entero-colitis, and died exhausted after a brief attack of diphtheria. There were lesions referable to the entero-colitis, and the body was much emaciated. The diphtheritic exudation was found covering the fauces, epiglottis, glottis, to the rima glottidis, the entire œsophagus, and almost the entire stomach. The mucous surface underneath was injected; that of the œsophagus and stomach especially was very vascular, softened and thickened, and the submucous connective tissue was infiltrated.

The pseudo-membrane, taken from the epiglottis and examined under the microscope, presented an amorphous appearance: no cells were noticed in it, and fibrillation was not distinct; that from the stomach was found to consist almost entirely of cells, the plastic corpuscles of some writers, the pyoid of others. The digestive process, so far as the stomach was concerned, had evidently been almost if not entirely suspended, and hence in part the sudden prostration. Diphtheritic gastritis probably does not occur without general infection of the system with the diphtheritic virus.

Post-mortem Digestion, Softening.

It is now many years since the attention of the profession was directed to disorganization of the coats of the stomach, which is sometimes observed at post-mortem examinations. John Hunter first ascertained that the gastric juice begins to have a solvent effect on the tissues of the stomach soon after death. Though Hunter erred, when he stated that the coats of the stomach are more or less digested in all or nearly all cases, it is certain that post-mortem digestion does take place in many cadavers, so that a few hours after death the gastric mucous membrane is destroyed to a greater or less extent, and occasionally the stomach is perforated or is even

severed from its connection with the œsophagus. I have seen several examples of this post-mortem perforation in infants.

Some of the cases of supposed pathological softening of the stomach reported by the older observers, seem to have been such as I have described, namely, cadaveric. Yet there are two other kinds of softening occurring in children, which are strictly pathological, the one designated white, the other, by Cruveilhier, gelatinous.

White softening of the gastro-intestinal mucous membrane results from deficient alimentation. It has been observed only in anæmic and ill-nourished children. The mucous membrane in such loses its firmness, and is easily separated from the subjacent tissue. This disorganization has no connection with any inflammatory process. It is simply a disintegration of the mucous membrane in consequence of the low vitality of the patient, whether or not there are co-operating causes. I believe that, in a large proportion of infants whose systems have been reduced and blood impoverished for a considerable time, the gastro-intestinal mucous membrane will be found after death less firm and resisting than in those who have been habitually robust. Probably acids which collect in the primæ viæ, have much to do with this softening.

A vague opinion exists in the minds of most physicians as to the nature and even appearance of the so-called *gelatinous* softening of the stomach, and the following observations will be cited in order to give a clearer idea of it.

Billard has recorded two cases with his usual minuteness, and adds: "What inference shall be drawn from the preceding facts and considerations? None other than that the gelatinous softening of the stomach consists in a disorganization of the mucous membrane of this viscus, caused by an acute or chronic phlegmasia; that this disorganization is characterized by an accumulation of serum in the walls of this organ; the intumescence and gelatinous consistence of the mucous membrane in a part usually circumscribed, situated more frequently in the greater curvature, and about which the membrane exhibits more or less evident traces of an acute or chronic phlegmasia. . . . The softening now under consideration must not be confounded with another kind of softening" (white) "which does not usually suceeed an acute phlegmasia."

Billard believes that, while gelatinous softening results from inflammation of the mucous membrane, its proximate cause is an afflux of serum to the part in which the disorganization occurs. In one of the two cases which he reports, he thinks that the inflammation was acute, but in the other chronic, and, therefore, presenting less vascularity.

West, in speaking of gelatinous softening, says: "Softening of the stomach varies in degree from a slight diminution in the consistence of the mucous membrane, to a state of complete diffluence of all the tissues of the organ. . . . When the change is not far advanced, the exterior of

the stomach presents a perfectly natural appearance, but on laying it open a colorless or slightly brownish tenacious mucus, like the mucilage of quince-seeds, is found closely adhering to its interior, over a more or less considerable space at the great end of this organ."

Cruveilhier says: "This softening often proceeds from the interior towards the exterior. There is at the beginning simple separation of the fibres by a gelatinous mucus, and in consequence the parietes are thickened and semi-transparent. . . . If the transformation be complete, the disorganized portions are removed layer after layer, those which remain becoming gradually thinner. The peritoneum alone resists for some time, but at length it is attacked, worn, and gives way, and perforation of the stomach results. The parts thus transformed are colorless, transparent, apparently inorganic, completely deprived of vessels, and exhaling an odor resembling that of milk."

Bouchut remarks: "Softening of the mucous membrane of the stomach in children at the breast is not a special disease which it is necessary to describe by itself. This alteration is always connected with other diseases, and is especially with disease of the large intestine, the knowledge of which fact has been too long neglected. It is the consequence of the acidity of the liquids contained in the digestive tube of young children, liquids which are very acid in the disease we have above referred to."

Dr. Carswell states that there is a pathological softening of the mucous membrane of the stomach, and that when it occurs the symptoms may be those of gastritis or enteritis.

Rokitansky says of this form of softening: "If we consider, in addition to the above remarks, the uniform localization of the disease, that in none of its stages it presents, either at the point of the softening, or in its vicinity, hyperæmic injection or reddening, and that we are still less able to demonstrate upon the inner surface of the stomach or in the tissue of its coats the products of inflammation, we are constrained to infer the non-inflammatory nature of the affection."

Without extending these extracts, it is seen that eminent authorities not only disagree in reference to the cause of gelatinous softening of the stomach, but that they also differ in their description of its appearance. This diversity of opinion is most likely attributable to the fact that the two kinds of softening have been confounded. Rokitansky and Bouchut probably refer to cases of white softening, which occurs in atonic states of the tissues in feeble infants, and, therefore, have concluded that softening of the stomach is not inflammatory. I believe, from my observations, that the opinion of Billard is correct, and that true gelatinous softening is the result of gastric inflammation, sometimes chronic, sometimes acute. But I have seen appearances which led me to think that the immediate causes of the softening continue to operate after death, so that its amount is less at the time of death than a few hours subsequently.

The following case, which was watched by myself with great interest, from beginning to end, is an example of inflammatory softening:—

CASE.—G. S., male, robust, was born July 10, 1865. The mother not being able to suckle the infant, and the danger of artificial feeding in the warm months being well understood, a wet-nurse was procured. About the 14th of July, this wet-nurse having insufficient milk, another was procured temporarily, who suckled the infant till July 20th, when a third wet-nurse was engaged, whose child, healthy and thriving, was six weeks old. Previously to this time the infant appeared well. It had uniformly nursed vigorously and seemed satisfied.

On the 22d of July, thrush, apparently mild, was observed in the mouth, and a powder, supposed to be borax, and labelled such, was obtained at a drug store, to be used as a wash for the mouth. This powder was afterwards ascertained to be alum. About five grains were dissolved in as many teaspoonfuls of water, and the mouth of the child was swabbed occasionally with it. A piece of linen, folded so as to resemble the tip of a nursing bottle, was occasionally dipped into the solution, and the infant was allowed to suck it. The use of the alum was commenced about 6 P.M. In the first part of the evening the infant slept considerably, and of course did not nurse often, but about 8 P.M. it began to be very fretful, and it then nursed more frequently. It vomited once between 8 and 10 o'clock P.M. In order to quiet the infant, the tip soaked in the solution was often applied to the mouth, but there was scarcely any intermission in its crying Through the night it vomited again once or twice, and about the middle of the night had one free liquid stool, which was passed with much tenesmus. The countenance of the infant was indicative of suffering, and its thighs were repeatedly flexed over the abdomen, as if that were the seat of its distress. Paregoric in two-drop doses was several times given through the night, and flannel soaked with hot whisky was applied to the abdomen.

July 23d. In ignorance of the cause of the child's sickness, another wet-nurse was obtained early in the morning, and one-sixth of a drop of liq. opii compos. was given every hour, with the effect of inducing a little sleep. The tongue was very red, desiccated, and studded with more numerous points of thrush than on the previous day. It now refused to nurse, apparently from soreness of the tongue. At each attempt of the nurse to induce it to take the nipple, it rubbed the mouth across the breast, crying either from pain or disappointment. The alum was not used in the latter part of the night of the 22d, but late in the morning of the 23d it was resumed, the mistake of the druggist not being discovered till midday, when it was estimated that about five grains had been used. Occasionally a little of the solution was placed in the mouth with a spoon so as to be swallowed, in the belief that the thrush affected the œsophagus. The infant continued to suffer much during the day, sleeping at times a few minutes. Its strength was evidently failing; its respiration regular; pulse about 140; its alvine discharges yellow, of natural consistence and frequency.

Evening 23d. Surface hot; is very restless; pulse 150 to 160; tongue dry, intensely red, and dotted with points of thrush. Is treated with opiates, a little lime-water, and fomentations.

24th. In the first part of the day, nursed pretty well; in the latter part, could be induced to draw the breast only once or twice. The symptoms

to-day were the same as yesterday, with the exception of greater emaciation and prostration; cranial bones uneven, and features pinched.

25th. Pulse 140 to 148; strength rapidly failing, but it cries at times loudly. The milk of the nurse, placed in the mouth with a spoon, is often held a considerable time before it is swallowed, and deglutition seems difficult. Respiration in the first part of the day and previously, natural; in the latter part of the day, accelerated; dejections natural; no vomiting; appearance of tongue more natural than yesterday.

26th. Died to-day in a state of collapse at 12½ P.M. The hands were cold several hours before death, and the milk given it was regurgitated.

Autopsy twenty-two hours after death.—Much emaciation; no rigor mortis; cranial bones uneven; the upper part of the pharynx injected to the extent of about half an inch; but from this point to the stomach membrane healthy; mucous membrane covering the cardiac two-thirds of the stomach disintegrated, almost diffluent, and in places detached from the subjacent tissue; mucous coat of the pyloric third of the organ nearly healthy; along the edge of the softened portion the mucous membrane was vascular to the extent of a few lines; the muscular and serous coats of the stomach underneath the softened portion were easily torn; the mucous membrane of the small intestine presented in places that degree of vascularity known as arborescence; there was no destruction or softening of its mucous membrane; the colon was healthy; the stomach was nearly empty; the contents of the small and large intestines were natural in color and consistence; the other viscera were healthy; in the left pleural cavity was about one ounce of transparent serum, and a less quantity in the right cavity.

It cannot be doubted that the softening in the above case was pathological. The weather at the time was warm, but the infant was placed on ice, and a pan containing ice was kept upon the abdomen. This infant died evidently of gastritis, the accompanying inflammation being subordinate, and in fact insignificant. At first it was a question with me whether the alum might not have caused the gastritis, so that the case should be properly placed in the category of deaths from swallowing corrosive substances. In order to determine this point, I administered alum daily to two kittens, commencing when they were seven days old. The quantity given to each was ten grains daily in two doses for three consecutive days, and on the two following days five grains. The only uniform result noticed was an increased flow of saliva, which washed some of the alum from their mouths, and occasionally slight vomiting. There was not even any apparent inflammation of the buccal membrane from the alum.

Post-mortem appearances as in the above case, and similar ones are recorded by Valleix and others, in which gelatinous softening coexisted with evident lesions of gastritis, render it highly probable, if indeed they do not demonstrate, that the softening is a result of the inflammation at the point where it occurs.

In Valleix's twenty-four cases of what he terms fatal muguet, softening of the mucous membrane of the stomach was one of the most common lesions, and at the same time, which is the point of interest, there were signs which showed conclusively the presence of gastric inflammation.

The common coexistence of the lesions of gastric inflammation, such as redness and thickening, with gelatinous softening of the stomach, is certainly most reasonably explained on the supposition that the one results from the other.

I am not prepared to accept nor reject the theory of Billard, that the immediate cause of the softening is the afflux of serum, nor that of Bouchut, that it is an excess of acid.

In has been said that M. Baron was able to diagnosticate gelatinous softening. The symptoms are those of the severe forms of gastritis. The vomiting, great pain, restlessness, sudden and progressive emaciation, and, finally, collapse preceding the fatal result, are the symptoms on which the diagnosis is based. The treatment should be directed to the gastritis. (*Amer. Jour. of Med. Sci.*, January, 1841.)

CHAPTER VII.

DIARRHŒA.

Diarrhœa is frequent during the whole period of infancy. The French writers describe several varieties according to the character of the evacuations, as acescent, mucous, and serous. M. Rostan even describes fourteen distinct kinds. But the tendency of medical science in these modern times is to simplify the nomenclature of diseases—to describe under a single name those affections which are essentially the same though differing somewhat in their features. Now, all the forms of diarrhœa in the infant may be so grouped as to reduce the number to not more than three or four. In this way repetition and prolixity are avoided, as well as an unnecessary refinement.

Non-Inflammatory Diarrhœa.

The most common form of diarrhœa is that enunciated in our heading, which writers sometimes designate by the term simple or spasmodic. But often a diarrhœa which is non-inflammatory at first, becomes a catarrh. Thus the simple diarrhœa of infancy may become an entero-colitis from the continued use of improper diet.

Causes.—These are various. Conditions or agencies which have no appreciable effect in the adult often increase the number of evacuations in young children. Food which imperfectly digests, and some of which perhaps ferments, stimulates the intestinal follicles to excessive secretion, and increases the peristaltic movements by its vitiating property, thus

causing diarrhœa. Too frequent and abundant feeding is another cause, especially in young infants, some of whom may vomit the surplus food and remain well, but others do not. Food which cannot be assimilated becomes an irritant in consequence of fermentative changes, and produces frequent and unhealthy evacuations. The late Dr. James Jackson, of Boston, directed attention to this cause of diarrhœa in his *Letters to a Young Physician*.

The mother's milk or the milk of the wet-nurse may disagree, either from some temporary derangement of her system, or continued ill-health, or from causes which are not understood. Non-inflammatory diarrhœa in the nursling is the immediate result, with perhaps subsequent inflammation. The milk in these cases frequently contains the elements of colostrum.

Fright or strong mental impressions will also in some children increase the number of evacuations. This cause being transient, the diarrhœa soon subsides.

Another cause is exposure to cold. Children who are insufficiently clothed in the winter season, who are taken from a heated room into a cool one without sufficient precaution, or who lie uncovered at night, are very subject to diarrhœal attacks from the impression of cold on the system.

The cause of non-inflammatory diarrhœa may exist in the child itself. In some children the evolution of the teeth is attended by a relaxed state of the bowels, which ceases when the gum is pierced. Worms in the intestines may also operate as a cause. Diarrhœa is occasionally salutary within certain limits, and of course it is not strictly correct to call it a disease when it is a means of relief. If occurring from excessive or irritating ingesta, it is obviously conservative.

Symptoms.—Non-inflammatory diarrhœa may come on suddenly; at other times there are precursory symptoms continuing for some days. Whether or not there are antecedent symptoms depends chiefly on the cause. If this be exposure to cold, or the use of improper aliment, it commonly occurs immediately.

Among the prodromic symptoms sometimes present are restlessness, disturbed sleep, transient abdominal pains, nausea or vomiting, and other symptoms of indigestion. The stools in simple diarrhœa differ much in color and consistence in different cases, and perhaps at different periods in the same case. In infants they are apt to be green. This color, which is a source of anxiety to the inexperienced, and especially to the parents, is often produced by trivial causes. Slight indigestion will produce it, and so will excess of food, even when bland and unirritating. The stools in infantile diarrhœa often contain particles of coagulated casein, but in children advanced beyond the period of first dentition, they do not differ materially in appearance from the evacuations of the adult. They are

usually passed easily, but if they are acid or in any way irritating, there may be more or less tenesmus, especially in infants. Sometimes before the evacuations, there is a sensation of fulness in the abdomen. In that form of diarrhœa which has been designated acescent, not only are the stools acid, but matters vomited have an acid odor, and give an acid reaction.

During the quiet hours of sleep, when no food and drinks are taken, the diarrhœa diminishes. If the complaint is slight, there is little thirst; but if the stools are frequent and thin, especially if they approach the serous character, the patient is thirsty. The appetite varies, the tongue is moist, and covered with a light fur, and there is often more or less meteorism, but no abdominal tenderness.

The features in this disease are pallid. In a few days, if the evacuations continue, there is evident loss of weight and flesh. The rotundity of the limbs is gradually lost, and the tissues become soft and flabby. But in most cases, when the malady has reached this stage, its original character is lost, and it has become inflammatory.

There is no constant fever in true non-inflammatory diarrhœa. Sometimes the pulse is accelerated in the latter part of the day, but usually only for a short time.

Certain epiphenomena, as Barrier terms them, occur at times in non-inflammatory as well as in inflammatory diarrhœa, as for example a sympathetic cough, or, which is more serious, cerebral complications. Convulsions or stupor, indicating the supervention of spurious hydrocephalus, may occur in either form of diarrhœa. This disease is described elsewhere.

Anatomical Characters.—It is obvious from the nature of this malady that it is attended by little or no structural changes perceptible to the anatomist. In cases supposed to be non-inflammatory, which have ended fatally either from the diarrhœa or an intercurrent disease, the most marked lesions observed have been more or less tumefaction of the internal glands, with perhaps diminished firmness and resistance of the mucous membrane. Cases like the following, which have usually been regarded as non-inflammatory, are not infrequent, but it seems to me probable that in at least a certain proportion of such cases the intestinal follicular apparatus has passed beyond the physiological state of an exaggerated functional activity, and that the disease should be designated a catarrh or inflammation. Inasmuch as non-inflammatory diarrhœa, if protracted, is very apt to become inflammatory, it is often difficult to determine whether the malady has undergone this change, even when the case is fatal, and post-mortem inspection is allowed.

On the 7th of July, 1865, a foundling, one month old, died at the Infant Asylum. It was much emaciated, with eyes sunken and features pinched, at the time of its death. It was wet-nursed towards the close of its life

but the nurse's milk was insufficient. It did not vomit; did not have any marked acceleration of pulse (128 per minute), and its evacuations were about four daily, and thin. The stomach and intestines were pale throughout. The solitary glands, particularly those in the colon, and the patches of Peyer, were tumefied so as to be visible, and somewhat raised above the surrounding surface. There was probably slight thickening of the mucous membrane, and tumefaction of the muciparous follicles, but these changes were not clearly ascertained.

Niemeyer, with others, describes even the mildest forms of diarrhœa under the term catarrhal inflammation, and he appears to consider the transient effects of a purgative as an incipient catarrh. But it seems to me preferable, in the present state of pathological knowledge, to regard all those diarrhœas which immediately abate with the removal of the cause, and which are attended by no marked anatomical change, as non-inflammatory.

Prognosis.—In a large proportion of cases, non-inflammatory diarrhœa is not dangerous. With the adoption of suitable measures to remove the cause, and the use of medicines to control the discharges, the patient recovers. The remark already made may be repeated here, that occasionally diarrhœa is salutary within certain limits, as when there is a foreign substance in the intestines, either irritating mechanically or by its chemical properties, and which the diarrhœa serves to remove.

The danger arises from complications, as spurious hydrocephalus, or from the emaciation and exhaustion, or from its eventuating in inflammation.

If the rotundity of the figure and firmness of the tissues are preserved, showing that alimentation is still sufficient, and no complication arises, the diarrhœa is not as a rule dangerous. In infants that over-nurse and do not vomit the surplus milk, the evacuations are sometimes green and frequent, and yet fulness of figure is preserved, and the development of the body proceeds as usual. On the other hand, diarrhœa attended by emaciation or softness or flabbiness of the flesh, involves danger, and requires immediate treatment.

Treatment.—It is necessary, in order to treat diarrhœa in infancy and childhood successfully, to ascertain the cause, and, so far as possible, to remove it. It is not till the cause ceases to operate, that we can expect a satisfactory result from medication. The disease may be temporarily relieved by medicine, but it usually returns at once when treatment is omitted, unless the patient is removed from the influence of the agencies which produce it. These remarks are especially applicable to the diarrhœa of infants. With them very generally, when affected with this complaint, there is some fault as regards the quantity or quality of food. Attention to this matter will show the need of a change of wet-nurse, or, if the infant be spoon-fed, a change in the character of its food or the mode of preparation or even in the quantity given. Sometimes by change in the diet, and the adoption of hygienic measures, the complaint ceases, so as to require

no medication. If medicines are needed, and the symptoms are not urgent, it is occasionally advantageous to commence treatment by the use of some of the milder purgatives in small doses. In the *infant*, in whom the dejections are so generally acid, an alkaline laxative, or a laxative conjoined with an alkali, often has a good effect as preliminary treatment. Half a teaspoonful to one teaspoonful of castor oil, or a proportionate dose of calcined magnesia, removes any acid or irritating substance from the intestines, and is followed by a diminution in the number of stools. The improvement, however, without subsequent treatment, is usually only for a day or two. In this city a purgative dose of castor oil is often given as a domestic remedy in infantile diarrhœa, the beneficial effect from it having popularized its use for this purpose. Trousseau usually gave Rochelle salts, but this medicine is too severe and dangerous for the treatment of infantile diarrhœa, especially in warm months.

If there has been previous constipation, and the diarrhœa has just commenced, a purgative is obviously indicated. West says: "Provided there be neither much pain nor much tenesmus, and the evacuations, though watery, are fecal, and contain little mucus and no blood, very small doses of the sulphate of magnesia and tincture of rhubarb have seemed to me more useful than any other remedy:—

℞. Magnesiæ sulphatis, ʒj;
Tinct. rhei, ʒj;
Syr. zingiberis, ʒj;
Aquæ carui, ʒix. Misce.
ʒj ter die for children one year old;

and I seldom fail to observe from it a speedy diminution in the frequency of the action of the bowels, and a return of the natural character of the evacuations."

In diarrhœa of infants, due to indigestion, and attended by acidity, the following prescription is sometimes useful. By improving digestion and correcting acidity, it has a beneficial effect on the diarrhœa. The cases are, however, in my experience exceptional in which this is the proper remedy:—

℞. Pulv. ipecacuanhæ, gr. ss;
Pulv. rhei, gr. ij;
Sodæ bicarb., gr. xij. Misce.
Divide in chart. No. xij. One powder every four to six hours to an infant one year old.

The effect of laxative medicines, employed for the purpose of correcting the functions of the gastro-intestinal surface, is uncertain. If there is no improvement from their use within two or three days, they should be omitted. We must rely on astringents, opiates, and, in infants, also on alkalies. If the symptoms are urgent, if the evacuations are frequent and exhausting, these agents should be employed from the first. Much harm

is often done, and precious time lost, by prescribing laxative mixtures when opiates and astringents are required. I have known them to aggravate the complaint, when, by change of measures, there was immediate improvement. The majority of cases of non-inflammatory diarrhœa, at the period when the physician is called, are best treated by the use of astringents and opiates exclusively, proper directions at the same time being given in reference to the diet and hygienic management.

In the diarrhœa of infants the compound powder of chalk and opium is an excellent medicine, containing, as it does, an astringent with the opiate and alkali. It may be given in doses of three grains, to a child one year old, every three hours. I ordinarily employ it with double its quantity of subnitrate of bismuth, and know no better remedy for ordinary cases. The following is a convenient formula for administering substantially the same medicines in the liquid form :—

℞. Tinct. opii deodorat., gtt. xvj ;
Bismuth. subnitrat., ℥ij ;
Syr. simplic., ℥ss ;
Mistur. cretæ, ℥iss. Misce.
Give one teaspoonful from three to four hours.

In a large majority of cases I employ this prescription or one similar to it, from my first visit. If the patient is not relieved by the opiate, alkali, and bismuth, and by proper regimen, in all probability there is inflammation of the intestinal mucous membrane. In patients over the age of two or three years simple diarrhœa approaches in character that of the adult, and the treatment appropriate for the adult is proper in these cases, allowance being made for the difference of age. In infants, in whom this disease, if protracted, is very liable to eventuate in spurious hydrocephalus, alcoholic stimulants are often required at an early period, on account of the prostration and feeble power of endurance.

CHAPTER VIII.

INTESTINAL CATARRH OF INFANCY.

It is customary with writers to treat of inflammation of the small and large intestines in infancy as a single disease, for the following reasons: First, the symptoms of colitis, at this period of life, do not ordinarily differ, in any marked degree, from those of enteritis. The tormina, tenesmus, and abdominal tenderness, which characterize colitis in childhood and adult life, are ordinarily lacking, or are not appreciable by the

observer; and the muco-sanguineous evacautions are oftener absent than present. On account of this absence of symptoms, Bouchut says: "Dysentery is a very rare disease amongst young children. Its existence might even be denied, if it had not been observed at the period of some severe epidemics of dysentery." If Bouchut refers, by the term dysentery, to the ordinary phenomena of that disease, his remark is correct; but, as regards the leisions, it is erroneous, for colitis is a common infantile malady. Billard, after analyzing eighty cases of intestinal inflammation in infants, says: "From this calculation, it is evidently very difficult to make a correct diagnosis of inflammation of the intestinal tube in sucking infants, yet it would seem as if the proper signs of enteritis or ileitis were the rapid tympanitis of the abdomen, the diarrhœa, accompanied with vomiting; while in colitis, diarrhœa alone, without tympanitis, is the most frequent." And again: "In consequence of the impossibility we have found to exist of tracing with exactitude the series of symptoms proper to inflammation of the different portions of the digestive tube, we shall content ourselves with presenting an analytical sketch of the causes, symptoms, and ordinary course of inflammation of the mucous membrane of the intestines in general."

The frequent absence of any pathognomonic symptom or sign, by which to determine the exact seat of intestinal inflammation in the infant, is admitted by recent observers as well as Billard.

The second reason why intestinal inflammation in the infant is described as a single disease is, that enteritis and colitis in the majority of cases coexist. This will be seen when we come to speak of the anatomical characters.

Intestinal catarrh is one of the most common and fatal of infantile maladies. It is the great summer epidemic of the cities, in this country. Unfortunately for a correct understanding of its prevalence and mortality in this city, and perhaps elsewhere, it is very generally in the summer months when obstinate, and especially when fatal, called cholera infantum, although, in its symptoms and nature it is very different from that disease. It usually has a mild beginning and is often protracted, while true cholera infantum begins abruptly, is characterized by violent symptoms, and rapid and extreme exhaustion.

The 1500 fatal cases of so-called cholera infantum, reported every summer in this city, are, with now and then an exception, cases of inflammation, generally protracted. Moreover, the excess of reported cases of infantile marasmus, in the second half of the year, over those reported in the first half, should be added to the statistics of intestinal catarrh, for this excess, which is noticed every year in the mortuary tables of this city, is due mainly to the death of those wasted infants who have lingered with entero-colitis from the summer months. Their marasmus is simply a result of the protracted inflammation.

Causes.—Catarrh of the intestines in infancy, I have said, is most frequently a summer malady—at least, in the cities. Occasionally it is observed in the winter, and it is then, when not due to error of diet, produced by exposure to cold. Infants who are taken from warm to cold rooms, or into the open air, by heedless nurses, or who sleep uncovered at night, are especially liable to it, whether residing in the city or country. In cases occurring from such exposure the inflammatory process may not commence suddenly. There is often a premonitory stage of simple diarrhœa, the first effect of the impression of cold.

The influence of the summer season in causing intestinal catarrh in young children is forcibly shown by the statistics of this city (New York), in which I found from the mortuary tables which I consulted a few years since, that during five years over 9000 young children, chiefly infants, perished from the diarrhœal maladies between the first of June and last of October. Indeed there is no disease, except tuberculosis, so prevalent and fatal as infantile entero-colitis, during the period of its epidemic occurrence in the summer months, and so far as I have been able to ascertain, the same remark is applicable to most of the other large cities of the Union.

The epidemic commences about the middle of May. From this time there is a gradual increase in the number affected, till the months of July and August, when the disease attains its maximum prevalence and mortality. During the months of September and October, the number of seizures and of deaths gradually abates till the epidemic character is lost. It is thus seen that the prevalence of intestinal inflammation of infancy in the city bears a close relation to the degree of summer heat. That the high temperature of summer is not in itself sufficient to produce entero-colitis is, however, obvious. In elevated localities in the country there may be intense and long-continued heat, and yet in such places this malady in infants is not common. It is no doubt the noxious inhalations from various sources with which the atmosphere is loaded, as a consequence of the heat, which render the disease so prevalent in certain localities in the summer months. The diarrhœa which affects students in the foul air of the dissecting room appears in some respects similar. The exact character of these exhalations or vapors is not fully known, but the following facts are clearly established by many observations.

Infantile entero-colitis occurs most on low grounds near the seashore. Thus, it is common in many parts of Long Island, on Staten Island, and on the flats of Westchester County. Experienced and observing physicians of this city do not send infants affected in the summer months with entero-colitis to these localities, but to the high grounds west of the Hudson, and to the hilly parts of New Jersey, where there is comparative immunity from the disease, and recovery is more certain and speedy.

But the state of atmosphere which is most favorable for the develop-

ment of intestinal catarrh is found only in the cities. The filthy streets containing more or less decaying animal and vegetable matter, the crowded and unclean tenement houses, the neglected privies, the slaughter-houses, pig-pens, bone-boiling establishments, and the like, are so many sources of the most deleterious effluvia, which, inspired by the infant, produce diarrhœa and intestinal inflammation. Those squares of the city where sanitary regulations are most neglected are the very ones where the mortality from this cause is largest.

In the year 1864, the Citizens' Association of the City of New York effected a complete and thorough sanitary inspection of New York island, and it was interesting as well as painful to note the facts observed by the inspectors in reference to the prevalence of the so-called cholera infantum (chiefly entero-colitis) along the streets and in the alleys where the causes of insalubrity were most abundant.

Thus, one inspector says of this disease, it "has probably consigned many more to the grave during the past summer than all other diseases in my inspection district. In every case examined, I have found it associated with some well-marked source of insalubrity. Vegetable and animal decomposition has been the most prominent cause." Another inspector says of the same disease: "It was found between the —— and —— avenues, where the street, at every visit, was found in an indescribably filthy state, in consequence of deposits of garbage and slops. This was particularly noticed in front of the premises where cholera infantum had occurred." Such was the uniform testimony of all the inspectors. In the tenement houses and in portions of the city occupied by the poor, where the sources of insalubrity are most numerous, I believe, from personal observation, that a majority of the infants are more or less affected with diarrhœa, often of an inflammatory character, during the months of July, August, and September. In the more salubrious localities of the city, there is less of this disease, but even here the liability to it is great, on account of the proximity of so many sources of impure air.

But there is another and an important element in the causation of intestinal inflammation in the infant. I refer to the diet. Many an infant that now falls a victim would escape the disease, but for some fault in the character of its food. Those infants in the city who are bottle-fed from birth rarely go through the summer without being affected with diarrhœa, and a majority of such, if under the age of six months when the warm weather commences, are saved from dangerous if not fatal inflammation only by removal to the pure air of the country.

In the families of the poor the food which is given as a substitute for the mother's milk is very apt to disagree with the feeble digestive powers of the infant. The milk of cows stabled in or near the city, their food often being scanty and of poor quality, is unwholesome and deficient in nutritive properties, and this milk is in common use in the tenement houses. In-

fants to whom this and other improper articles of diet are given are the first to suffer with diarrhœa as warm weather commences, and finally with entero-colitis.

It is seen that the causes of intestinal inflammation of infancy as it prevails in the cities during the summer are mainly twofold, atmospheric and dietetic—an insalubrious state of the air which the infant breathes, and unsuitable food. Among the poor of the cities, both these causes conspire to produce the diarrhœal maladies. It is easy, then, to see why there is so much intestinal disease and so great mortality among the infants of the city poor, who on account of their feeble powers of resistance and endurance are especially liable to be affected by and to succumb under morbific agencies.

It is a common belief that dentition is one of the chief causes of infantile diarrhœa, whether inflammatory or non-inflammatory. There is, indeed, great liability to this disease during the period of dental evolution. The following statistics, which were mostly collected during my term of service in one of the city dispensaries, and which comprise all the cases of diarrhœa under the age of about five years which were brought into that institution for treatment during the summer months of my attendance, show the preponderance of cases in the time of teething. Most of these diarrhœal cases were evidently inflammatory.

Stage of dentition.	Number of cases.
No teeth	47
Cutting incisors	106
" anterior molars	41
" canines	40
" last molars	20
Having all the teeth	28
Total	282

It is seen that although a large majority of the above cases occurred during dental evolution, yet in a certain proportion, about one in four, teething could not operate as a cause. My own opinion is that dentition is an occasional cause of simple diarrhœa, though a subordinate one, but that it does not of itself produce inflammation. The diarrhœa of dentition is non-inflammatory, terminating in inflammation, if such a result follow by the co-operation of other and distinct causes. This subject is treated of in our remarks relating to dentition.

An important predisposing cause of intestinal inflammation in infants is the rapid development of the intestinal crypts and follicles. This development, which increases the liability to organic diseases of the intestines, is coincident with dentition. Another important cause remains to be notified, namely, weaning. Weaning is a subject to which less attention is given than its importance demands. The summer succeeding the change

of diet is always in the city a time of great danger to the infant from diarrhœal affections. Mothers uniformly speak with dread of the second summer. In this city, nearly every infant taken from the breast between the months of April and October very soon becomes affected with diarrhœa which, if not inflammatory in its commencement, soon becomes such. Weaning in the cool months involves less danger, but even then the succeeding summer is one of peril. I have memoranda of the time of weaning in forty-six infants who were affected with diarrhœa apparently from its duration and obstinacy of an inflammatory character.

Weaned in spring or summer	35
" " autumn or winter	11
	46

The reader is referred, for other particulars in reference to weaning, to the chapter devoted to this subject.

The above facts and statistics, to which more might be added, suffice to show the causative relation of foul atmosphere and injudicious feeding to the intestinal inflammation of infancy.

This catarrh also occurs as a complication of certain diseases, especially the eruptive fevers. It is the opinion of some, that in measles and scarlatina there is often mild catarrh of the intestinal mucous membrane, coexisting with the eruption upon the skin, and disappearing with it. But in a proportion of cases, most frequently in measles, a more intense inflammation arises, constituting a serious complication. The peculiar intestinal catarrh in typhoid fever is well known.

AGE.—My observations in reference to the age at which this disease occurs were made in the summer months, and, therefore, relate to the summer epidemic. The cases embraced in the following table were nearly all observed between the months of May and October inclusive :—

Age.	Number of cases.
5 months, or under	58
From 5 months to 12	212
" 12 " 18	174
" 18 " 24	93
" 24 " 36	36
Total	573

This table shows that the infant under the age of six months is less liable to entero-colitis than between the ages of six months and two years. The small comparative number, however, affected under the age of six months, I attribute to the fact that most of the infants under this age were wet-nursed. Observations made in the institutions of this city in which foundlings are received show that, the younger the infant is, the more liable it is to be affected with this disease, under unfavorable conditions of atmosphere and diet. Thus, in the New York Infant Hospital,

prior to the adoption of wet-nursing, a large proportion of the foundlings received died of well-marked entero-colitis in the first and second months, and very few lived till the age of six months. A similar fact was observed in the New York Infant Asylum in Bloomingdale.[1] During my term of service in this institution I preserved notes of forty-nine fatal cases, which I diagnosticated entero-colitis, and in many of which post-mortem examinations were made. Of these cases eighteen were one month old or under, fifteen from one month to three, eight from three to six, and only eight over the age of six months.

Symptoms.—Intestinal catarrh in the infant is announced by the occurrence of lassitude, febrile movement, and perhaps fretfulness, soon followed by diarrhœa. The stools are thinner than in health, and their color is yellow, brown, or green. Infants having a milk diet are apt to pass green and acid stools containing particles of undigested casein.

The tongue in the commencement of this malady is moist and covered with a light fur. At a more advanced stage it may be moist, but is often dry, and in dangerous forms of the malady is accompanied by prostration. The buccal surface is red, the gums more or less swollen and sometimes ulcerated, and sprue often appears upon the gums, tongue, and contiguous parts. Vomiting is a common symptom, commencing in some cases early, but in others not till the diarrhœa has continued a few days. Sometimes it appears to be a symptom of indigestion produced by the imperfectly digested or fermented and acid food in the stomach. Occurring at a late period it may have a cerebral origin from commencing *spurious hydrocephalus*, or it may be due to impaired function of the kidneys in consequence of which urea is retained in the system, and is excreted in the stomach. The matter vomited, when the vomiting is due to irritating substances in the stomach, has a sour odor, and produces a decidedly acid reaction with the appropriate tests. It contains coagulated casein, and undigested particles of whatever food has been given. I found from observations made in 1863 and 1864, in reference to the summer intestinal catarrh of infants, that vomiting commenced in less than one week after the diarrhœa, in a majority of the cases which I observed in those years.

The stools sometimes continue during the whole course of the malady of nearly the same character as at first. In other patients they vary in color and consistence at different periods, this change being due partly to the nature of the food. In the same case they may be brown and offensive at one time, green like mashed vegetables at another, and again they may contain masses of a putty-like appearance, the partly digested casein. They may consist largely of mucus, with or without blood, such stools

[1] This institution was discontinued within a year after its establishment, all connected with it becoming discouraged from the great mortality of the foundlings, who were chiefly bottle-fed.

indicating a predominance of inflammation in the colon. The malady, which Barrier designated mucous diarrhœa, is chiefly a colitis. The stools are sometimes yellow when passed, but become green by exposure to the air, or from chemical reaction due to admixture with the urine.

The microscopic examination of the stools in this malady is interesting; I have found in them undigested casein, unaltered or slightly digested fibres of meat, crystalline formations, epithelial cells, single or arranged in clusters as if just detached from the villi, mucus, sometimes blood and pus cells. The stools in some infants continue, during the whole course of the entero-colitis, of nearly the same character as at first. In other cases they vary, at different periods, in color as well as consistence. They sometimes have a putty-like appearance, from the partly digested casein; at other times they are brown and offensive. A very common appearance is that which has been likened to spinach or chopped vegetables; occasionally the stools consist largely of mucus, with perhaps a little blood—the mucous diarrhœa of Barrier. This occurs when colitis is a principal part of the disease. The evacuations are seldom so watery as in true cholera infantum.

Occasionally they are yellow when passed, but become green on exposure to the air, or from chemical reaction resulting from admixture of the urine.

The *microscopic* character of the stools in entero-colitis is interesting. Aside from undigested casein, I have found unaltered fibres of meat, crystalline formations, epithelial cells, single or arranged regularly in clusters, as if detached from the villi, mucus, sometimes blood, and, in one case, an appearance resembling three or four crypts of Lieberkuhn united. If the stools are green, colored masses of various sizes, but mostly small, are also seen with the microscope. The microscopic elements, then, are the excrementitious substances, particles of undigested food, inflammatory products, and epithelial cells or fragments of the mucous membrane, thrown off by the inflammatory process.

The *pulse* in entero-colitis is accelerated. There is, frequently, increased heat of surface in the commencement, but, as the disease continues, the vital powers soon become reduced, and the surface is either of the natural temperature or cool. As death approaches, the pulse gradually becomes more frequent and feeble, and the extremities, sometimes for hours before life is extinct, have a cadaverous pallor and coldness. The skin, in intestinal inflammation, is generally dry, and the urinary secretion diminished. In severer forms of the disease, attended by frequent evacuations from the bowels, the infant does not pass its urine oftener than once or twice daily. The imperfect action of the skin and kidneys is a noteworthy feature of the inflammation. The advanced stages of entero-colitis are apt to be complicated by two cutaneous affections, namely, erythema between the thighs, probably produced by the acid and irritating

character of the stools, and boils upon the forehead and scalp. The latter sometimes extend down to the pericranium, and leave permanent depressed cicatrices. The external irritation caused by the furuncular affection has often seemed to me conservative, as it occurs at the time when there is danger from passive congestion of the brain and serous effusion. When entero-colitis is protracted, and the patient is much reduced, remaining constantly in the recumbent position, except when held in the arms of the mother or nurse, another symptom frequently arises, namely, a dry cough, which continues till the close of life, if the case be fatal, and subsides slowly if the disease terminates favorably. The complication which gives rise to this symptom will be considered hereafter. As death approaches, the infant sometimes becomes more fretful; it turns peevishly from playthings, rolls its head, or the head has an unsteady movement; and often the stomach becomes more irritable. The experienced physician rightly interprets these symptoms as the forerunner of cerebral accidents. In other cases there is too great prostration even for the exhibition of restlessness, and the patient lies quiet. As death approaches the infant becomes drowsy. The limbs are cool. It refuses to nurse, or, if spoon-fed, takes nutriment apparently without relish. The pupils are contracted, and insensible to light. The eyes are bleared, and a puriform secretion occasionally collects between the lids. The stools are less frequent, and the vomiting, if previously present, ceases. Death occurs quietly.

Sometimes, however, convulsive movements precede death, generally slight, as of one arm, or of the limbs or one side. Uræmia may be the immediate cause of death in certain cases.

In chronic entero-colitis there is extreme emaciation for a considerable time before death. The skin of the extremities lies in wrinkles; the joints, from contrast, appear enlarged, and the fingers and toes elongated; the angular projections of the bones are prominent. The hollowness of the cheeks and eyes causes the infant to appear much older than it really is. Death occurs in a state of extreme exhaustion.

The above description applies to infantile entero-colitis, as it so frequently occurs in the cities. It is sometimes much more violent, attended by much greater febrile reaction, and is more speedily fatal. Especially is this the case when it is due to the impression of cold: such cases are not infrequent in the winter months, in the country as well as city.

Instead of the mild and gradual commencement which I have described, infantile entero-colitis may be preceded by violent symptoms—a true cholera morbus in which vomiting and purging, more or less severe, precede the inflammation. Among my records are cases which commenced in the summer season from eating gooseberries, currants, cherries, and cheese: the choleraic symptoms produced by these indigestible substances ending in protracted inflammation.

Anatomical Characters.—Billard says: "In eighty cases of inflammation of the intestines that I examined with great care, there were thirty of entero-colitis, thirty-six of enteritis, and fourteen of colitis." M. Legendre, in twenty-eight cases of diarrhœa, found colitis alone in nine, and in the cases in which enteritis occurred, colitis was also present. Rilliet and Barthez state that in certain rare instances almost the entire digestive tube is affected; that in exceptional cases the principal lesion is found in the small intestines, while, on the other hand, the large intestine is the part of the alimentary canal which is most frequently and intensely inflamed. Billard describes four kinds of intestinal phlegmasia: first, erythematic; second, with altered secretion; third, follicular; fourth, with disorganization of tissue. In some of the best works on diseases of children, published subsequently to that of Billard, different forms of inflammation are described, according to the presence or absence of certain anatomical changes, as ulceration or softening. Practically little is gained by such a division of the general disease, and the lesions which are made the basis of the division are often merely the result of severe and protracted, simple or catarrhal, inflammation. I have records of the post-mortem appearances in eighty-two cases of intestinal inflammation in the infant. Eleven of these occurred in private or dispensary practice; about fifty in the Nursery and Child's Hospital, and the remainder in the Infant Asylum. Since preserving these records, I have witnessed a larger number of post-mortem examinations of infants who died of this disease chiefly in the institutions, and the lesions corresponded in general with those already observed. The question may properly be asked, Can inflammatory hyperæmia of the intestinal mucous membrane be distinguished from simple congestion if there is no ulceration and no appreciable thickening of the intestine? This is sometimes difficult, and it is possible that occasionally I have recorded as inflammatory what was simply a congestive lesion, but I do not think that I have incorporated a sufficient number of such cases to vitiate the statistics. In a large proportion of the autopsies there was manifest thickening of the intestinal mucous membrane or other unequivocal evidence of inflammation. The following is an analysis of the eighty-two cases:—

The upper part of the small intestine, embracing the duodenum and jejunum, was found inflamed in twelve cases. It was free from inflammation, and of a pale color, in fifty-one cases. The ileum was inflamed in forty-nine cases, and the cæcal portion, including the ileo-cæcal valve, was the part in which the inflammation was uniformly most intense, and to which it was often confined. In sixteen cases there was no ileitis, and in thirteen no enteritis whatever. Therefore, the ileum was inflamed in all but three of the cases of enteritis, in which the records give the exact location of the disease. In fourteen cases there was vascularity in streaks

or in patches, or simple arborescence in some part of the small intestines, the records not stating its exact location.

In most cases the inflamed mucous membrane was perceptibly thickened. Occasionally, especially if the vascularity was slight, the thickening was scarcely appreciable. In one case there was so much thickening of the ileum next to the ileo-cæcal valve that the mucous coat appeared as if closely studded with small warts. Ulcers of small size were found in the mucous membrane of the small intestines in five cases. These ulcers in one case were in the jejunum, in two in the ileum, and in two in both these divisions of the intestine. They were for the most part quite superficial, and circular or oval.

It is seen from the above records that the portion of the small intestine most frequently inflamed was the ileum. The inflammation usually affected the ileo-cæcal valve, and extended from it to a greater or less extent along the small intestine. In general, when inflammatory patches were found in different parts of the small intestine, those in the ileum nearest the ileo-cæcal valve presented the greatest vascularity and thickening. Billard noticed in his cases the frequency and intensity of the inflammation in the terminal portion of the ileum, and the consequent thickening of the ileo-cæcal valve, and conjectured that the vomiting so common and obstinate in enteritis might be due to obstruction at the ileo-cæcal orifice in consequence of this thickening. I have often seen the orifice reduced to a very small size from the hyperæmia and thickening of the valve, but have not seen any accumulation above it or other evidence of obstruction.

The inflamed mucous membrane was softened in greater or less degree according to the intensity of the inflammation. Sometimes the vessels of the submucous connective tissue were injected, and this tissue infiltrated. The softening of the mucous coat, and the firmness of its attachment to the parts underneath, varied considerably in different specimens. I was able, in cases in which there was softening, to detach readily the mucous coat with the nail or back of the scalpel, within so short a period after death that it was evident that the change of consistence could not have been cadaveric.

The infants in whom the duodenum and jejunum presented the inflammatory lesions were, with few exceptions, under the age of three months, and in many of these cases there was hyperæmia of the gastric mucous membrane, and in some also stomatitis.

In all the cases except one, namely, in eighty-one, there were lesions indicating inflammation of the mucous membrane of the colon. In thirty-nine, the catarrh extended over nearly or quite the whole extent of this portion of the intestine; in fourteen, it was confined to the descending portion entirely, or almost entirely; in twenty-eight cases, the records state that colitis was present, but its exact location was not mentioned. In eighteen of the examinations, the mucous membrane of the colon was

found ulcerated. According to the statistics, there is colitis in nearly every case of intestinal inflammation in infancy, and in a large proportion of cases also ileitis. The portion of the colon which is most frequently inflamed is that in and immediately above the sigmoid flexure. If the colitis affect other portions also, it is nevertheless in this part that we find the most marked inflammatory lesions.

The solitary glands, both of the large and small intestines and Peyer's patches, are involved in most cases of intestinal catarrh. Even in non-inflammatory diarrhœa they become tumefied, so as to be distinctly visible and somewhat elevated. In entero-colitis, as we have already seen, they present different appearances, according to the degree and duration of the inflammation. In recent cases, and in parts of the intestine where the inflammatory action has been mild, there is often no perceptible change of these glands except slight enlargement with vascularity. This enlargement is most apparent if the intestine is viewed by transmitted light, when not only the glands are seen to be swollen, but their central dark points are also quite distinct. If there is a higher grade of inflammation, or inflammation more protracted, the volume of the solitary follicles is so increased that they rise above the common level and present a papillary appearance. Peyer's patches are in a corresponding degree thickened.

The enlargement of these glands is due to hyperplasia, namely, an augumentation in the number of the elementary cells. The ulceration in the cases which I have examined appeared to be primarily and chiefly follicular. While some of the solitary glands in a specimen were found simply tumefied, others were slightly ulcerated, and others still nearly or quite destroyed. The ulcers were usually from one to three lines in diameter, circular or oval, with edges a little raised, and red. They resembled in appearance the ulcers in follicular stomatitis. In one or two instances I have seen small coagula of blood in the ulcers, and I have also seen ulcers which have evidently been larger, having partially healed. The principal seat of the ulcers was in the descending colon. They were either found in this portion of the intestine only, or, if occurring elsewhere, they were here most abundant.

Those in whom I have found ulcers have been ordinarily over the age of six months, which is the time when there is greatest development and activity of the glandular apparatus. In none of the cases observed by me were Peyer's patches ulcerated, though generally tumefied.

In cases in which the caput coli was inflamed, I have sometimes found the mucous membrane of the appendix vermiformis also injected and thickened. In one case only was there a pseudo-membrane upon the inflamed surface. This was in the descending colon, and it was thin like a film. The rectum presented no inflammatory or other lesions, or but slight lesions in comparison with those in the colon. Often, when there was almost general colitis, the rectum was found of a pale color, or but slightly

vascular. This may explain the infrequent occurrence of tenesmus in infantile entero-colitis. The amount of mucus secreted from the intestinal surface in this disease is considerably in excess of the normal quantity. It often forms a layer upon the mucous membrane of the intestines, and appears in the stools, mixed with epithelial cells and sometimes with blood or pus. If the quantity of mucus appearing in the stools is considerable, this form of intestinal catarrh has sometimes been designated mucous diarrhœa, or mucous disease; but there does not seem to me sufficient reason, either anatomical or clinical, for considering it a distinct malady.

The mesenteric glands are ordinarily enlarged, unless in very young infants. They are frequently found as large as a large pea, or even larger, and of a light color, from the anæmic state of the infant. In exceptional instances certain of them are found to have undergone cheesy degeneration. The enlargement of these glands, like that of the solitary follicles and Peyer's patches, occurs from hyperplasia. The condition of the stomach was recorded in sixty-nine cases. In forty-two it was healthy; in seventeen red, apparently inflamed; in seven of a pink color; in three it contained ulcers which were probably cadaveric. The usual healthy condition of the stomach is a noteworthy fact, taken in connection with the frequent vomiting, in intestinal catarrh. I have stated elsewhere that stomatitis is also a common complication in protracted and grave cases, accompanied by sponginess of the gums, which bleed if pressed or rubbed. The buccal surface in these cases is more vascular than natural, and, if the vital powers are much reduced, superficial ulceration is not infrequent, especially of the gums. In infants under the age of three or four months, œsophagitis is also a common accompaniment of entero-colitis.

Thrush, though a frequent complication under the age of three or four months, is rare in older infants. Thrush, in infants over the age of eight or ten months, occurring in connection with intestinal inflammation, is an unfavorable prognostic sign, indicating a gravity of the intestinal disease which commonly eventuates in death.

There exists an opinion in the profession that the liver is in fault in this disease, especially in that form of it which I have described as a summer epidemic of the cities. This opinion is, probably, less prevalent than formerly, but is still held by many, and it influences the choice of therapeutic agents.

I have notes of the appearance and state of the liver in thirty-two fatal cases of the epidemic entero-colitis of the summer season. Nothing could be seen in these examinations that indicated any disturbance in the function of this organ. The size of the liver was in some cases very different in those of about the same age, but probably there was no greater difference than usually obtains among glandular organs within the limits of health. The following table gives the weight of the liver in twenty cases in which the weight of this organ and the age of the patient are recorded:—

Age.		Age.	
4 weeks	5 ounces.	10 months	$6\frac{3}{4}$ ounces.
2 months	$3\frac{1}{2}$ "	13 "	6 "
2 "	$3\frac{1}{2}$ "	14 "	9 "
4 "	5 "	15 "	6 "
5 "	$6\frac{1}{2}$ "	15 "	$7\frac{1}{2}$ "
5 "	9 "	15 "	$9\frac{1}{2}$ "
7 "	$4\frac{1}{2}$ "	16 "	6 "
7 "	6 "	19 "	$4\frac{1}{2}$ "
7 "	$6\frac{1}{4}$ "	20 "	$9\frac{1}{4}$ "
9 "	8 "	23 "	15 "

I do not have access to tables giving the weight of the healthy liver at different ages, but in none of the above examinations did the size or the weight seem to me to be above the healthy standard, except in one, in which this organ was quite fatty. But in this case the degeneration and enlargement of the liver were doubtless due to tuberculosis.

In most of the cases the liver was examined microscopically, and the only fact worthy of note observed was the variable amount of fatty matter. Sometimes it was in excess, sometimes in moderate quantity or rather deficient, and sometimes in greater amount in one portion of the organ than in another.

The prevalent belief, then, that the liver is greatly affected in the summer epidemic of entero-colitis, receives no corroboration from the inspection of this organ. The only pathological state (if it be such) observed in it relates to the amount of oily matter, and this obviously requires no special treatment.

The cutaneous affections complicating entero-colitis have already been alluded to.

Frequently at post-mortem examinations of infants who have died of intestinal catarrh, intussusceptions are found in the small intestines. These probably in general occur at the moment of, or not long before, death, as they are small and readily reduced, but I have in a few instances found intussceptions which sustained the weight of two feet or more of intestine without being reduced, and which, from being in their interior more vascular than the contiguous membrane either above or below, probably occurred some hours, possibly days, before death, but, being sufficiently pervious to allow the food to pass, symptoms of obstruction were absent.

It has been said, in speaking of the symptoms, that a cough is common in protracted entero-colitis when the vital powers are greatly reduced, and the circulation is feeble. From the great emaciation and the character of the cough, the physician as well as friends is very apt to suspect the presence of tubercles. But tuberculosis is quite exceptional in these cases. I have, as stated above, records of eighty-two post-mortem examinations of infants who died of entero-colitis in the summer months, and tubercles were found in only one case. The cough was due to solidification of the

posterior and dependent portion of one or both lungs. The exact pathological character of this solidification of lung (hypostatic pneumonitis) is treated of in our remarks on disease of the respiratory organs.

In the cases of entero-colitis which were complicated with this state of the lungs, I have not usually found enough of the lung-tissue involved to make any perceptible difference in the sound on percussion. Its extent of solidification was sometimes not more than two or three lines, and frequently not more than a quarter to half an inch in an antero-posterior direction, although it embraced nearly or quite the entire posterior surface of the organ.

The state of the brain in the entero-colitis of infancy is interesting to the pathologist. When the disease is protracted, this organ wastes like the body and limbs. In the young infant, in whom the cranial bones are still ununited, the occipital and sometimes the frontal become depressed in proportion to the loss of brain-substance, so that the cranium is quite uneven. In older children with the cranial bones consolidated, serous effusion occurs according to the degree of waste, thus preserving the size of the encephalon. The effusion is chiefly external to the brain, extending on each side over the convolutions from the base to the vertex. The quantity of serum varies from one to two drachms to an ounce, or even more. The serous effusion is associated with passive congestion of the cerebral vessels and cranial sinuses, and this pathological state when sufficient to produce symptoms, is the common form of spurious hydrocephalus.

The following is a common example:—

In December, 1877, my attention was called to an infant, aged seven months, just admitted into the New York Foundling Asylum, with suspected brain disease. Its previous history had not been ascertained; its pupils reacted feebly by light, and its head constantly rotated from side to side. The diagnosis was easy from the symptoms, for its wasted state, and sunken eyes, without any marked pulmonary symptoms, indicated protracted intestinal catarrh, and the depressed anterior fontanelle, showed that the brain disease could not be an inflammation either meningeal or cerebral. It was obvious that the anatomical state of the brain, which we are now considering, was present. At the autopsy on the following day, the lesions of severe protracted intestinal catarrh were found. The large intestine especially, was thickened, and its mucous surface rough and uneven from proliferation of the mucous membrane, or sub-mucosa, which had evidently been going on for a considerable time. The portions of the surface which were roughened by this proliferation presented a dusky-red color. On opening the cranial cavity about one ounce of serum escaped, which had been effused between the superior surface of the brain and the meninges. The anterior portion of the brain, which was uppermost in the position in which the child had been in the crib, appeared normal, but the veins and capillaries in the posterior or depending portion were engorged with dark blood. The base of the brain did not present any inflammatory lesion. The cranial sinuses were also distended with dark blood and clots;

a long white clot was drawn out from the longitudinal sinus, being, from its color and firmness, in all probability, ante-mortem; the presence of which, whatever the condition otherwise, obviously rendered recovery impossible.

Diagnosis.—Persistent diarrhœa, with elevation of temperature, indicates intestinal catarrh. Abdominal tenderness, which is so important a diagnostic symptom in the adult, is generally absent in the infant, or, if present, is not easily ascertained. It is more difficult to determine, from the symptoms, what part of the intestinal tract is chiefly involved in the catarrh, though it may be assumed that it is the colon, and the lower part of the ilium if the patient is under the age of eighteen months. The presence of mucus, or of mucus tinged with blood in the stools, shows predominance of colitis.

Prognosis.—Though intestinal inflammation is one of the most fatal infantile maladies, still, by proper hygienic measures and a judicious selection and use of medicines, a large proportion of those affected may be saved. This inflammation and most of its complications are of such a nature that we may have reasonable hope that the infant will recover if suitable measures are employed sufficiently early. Many do recover from a state of emaciation and feebleness which, occurring in any other pathological state, would be almost necessarily fatal. The most unfavorable symptoms in this disease, except those due to extreme prostration or collapse, arise from the state of the brain. Rolling the head, squinting, feeble action of the pupils, spasmodic or irregular movements of the limbs, indicate the near approach of death. There are many facts which should be taken into consideration in making a prognosis. The age of the infant, the time in the year, the surroundings, especially in reference to the impurity of the atmosphere, are to be considered, as well as the present state of the patient.

Intestinal inflammation of infancy might, in many instances, be prevented by judicious measures. Especially is it preventable in those cases in which the exciting cause is dietetic. The reader is referred to the chapters on weaning and artificial feeding, for facts in reference to this matter. Unfortunately, however, often the physician is not consulted in regard to the alimentation of the infant, or the time and manner of weaning, or other important matters of regimen, until diarrhœa, inflammatory or non-inflammatory, is established; his purpose is then not to prevent, but to cure.

Treatment. *Regimenal Measures.*—The infant with intestinal catarrh is thirsty, and is, therefore, apt to take more nutriment, in the liquid form than it requires. If nursing it craves the breast, or if weaned craves the bottle at short intervals, but no more nutriment should be allowed than is required for the sustenance of the patient, since an amount of food which cannot be fully digested, undergoes fermentative changes and be-

comes an irritant to the intestines. The infant should, therefore, take its food in proper quantity and at proper intervals, and if it is thirsty, it should take a little gum water or light barley water in the intervals. But exhaustion should be guarded against, and while the diet should be bland and unirritating, it should be nutritious.

As one of the chief causes of intestinal catarrh, when not produced by exposure to cold, is the use of indigestible and therefore irritating food, it is obviously of the utmost importance that the food should be of suitable nature, properly prepared, and given in proper quantity. This remark is especially applicable to the catarrh of the summer months, the cause of which is largely dietetic. To infants under the age of one year, and particularly under six months, no food is so suitable as the breast-milk, and one affected with the "summer complaint," and remaining in the city, will not in general do well unless it obtain the milk either of its mother or a wet-nurse. Many are the instances every summer, in New York city, in which the diarrhœa continues in spite of all other measures, hygienic and medicinal, till a wet-nurse is employed, when in consequence of the changed diet there is rapid and complete restoration to health from a state of emaciation and weakness.

In certain cases the breast-milk, either of the mother or wet-nurse, disagrees with the infant, and its use aggravates the intestinal disease. In the country, or in the cool months in the city, weaning may be proper under such circumstances. Certainly weaning or the employment of another wet-nurse is required. In the city in the summer months, for reasons elsewhere fully stated, weaning is a very injudicious if not fatal measure, and, if the entero-colitis is aggravated by the character of the mother's milk, a wet-nurse should be engaged. If the breast-milk is suspected as the cause or one cause of the infant's sickness, it should be examined by the microscope, before a change in diet or in nursing is recommended. It has been ascertained by the microscope, that the elements of colostrum which have a purgative effect may return at any period of lactation.

If the mother's milk disagree, and a wet-nurse for any reason is not employed, it is then necessary to recommend a diet which will be the best possible substitute for the natural aliment. For young infants the upper third of fresh cow's milk, which has been allowed to stand two hours, should be employed. For an infant of two months the milk should be given with one-fourth its bulk of water added, but for one over the age of three or four months it need not be diluted.

It is often advisable, especially in hot weather when the lactic acid fermentation begins early, to add a little lime-water or bicarbonate of potash to the milk. As a rule, I think infants with intestinal catarrh, artificially fed, do better if a certain proportion of farinaceous food is added to the milk, though it may be omitted certain times in the feeding. Of the fari-

naceous articles found in the shops, I prefer Liebig's, especially Horlick's preparation of it, for infants under the age of five months, since in this food the starch is converted into glucose and dextrine. For infants over the age of five months, barley flour boiled half an hour, wheat flour boiled dry in a bag for twelve hours, Ridge's food, etc., are useful dietetic articles. The juice expressed by a lemon-squeezer from beef steak, rare-done, and given at intervals in small quantity, is also useful in most cases of intestinal catarrh, and particularly so when the child begins to emaciate and the strength fails. For facts relating to artificial feeding the reader is referred to the appropriate chapter.

But one chief cause of the great summer epidemic of intestinal catarrh in the cities, we have seen to be atmospheric. This requires attention on the part of the practitioner, to a different matter in the hygienic management of these cases, namely, the state of the air which the infant breathes. In cool months the atmosphere is more pure than in the summer months, as it contains less of those noxious gases which arise from decaying animal and vegetable substances. In those months, then, in which the weather is such that there is no decomposition of organic matter, the atmospheric cause of entero-colitis is less operative, and less is gained for the patient by change of locality. But in the summer season one of the most important conditions of successful treatment of this and the other diarrhœal maladies of infancy is the removal of patients from an impure to a pure atmosphere. Physicians of experience all agree in the choice of salubrious localities, containing a sparse population. Many are the instances every summer in this city of infants removed to the country with intestinal inflammation, with features haggard and shrunken, with limbs shrivelled, and skin lying in folds, too weak to raise or at least hold their heads from the pillow, vomiting nearly all the nutriment taken, with stools frequent and thin, resulting in great measure from molecular disintegration of the tissues, presenting indeed an appearance seldom seen in any other disease except in the last stages of phthisis, and returning in late autumn, with the cheerfulness, vigor, and rotundity of health. The localities usually preferred by the physicians of this city are the elevated portions of New Jersey and Eastern Pennsylvania, the Highlands of the Hudson, the central and the northern parts of New York State, and Northern New England. Taken to a salubrious locality, the infant will soon begin to improve after it has recovered from the fatigue of travelling, unless the case is exceptionally obstinate.

Sometimes parents, not noticing the immediate improvement which they had been led to expect, return to the city without giving the country fair trial, and the life of the infant is almost necessarily sacrificed. Returned to the foul air of the city while the weather is still warm, it sinks rapidly from an aggravation of the malady. Dr. James Jackson recommends, if the infant do not improve where it is taken, that it should be conveyed to

another locality. This is good advice, provided that the selection be made of a place elevated, and having a sparse population. The infant, although it has recovered, should not be brought back while the weather is still warm. One attack of the disease does not diminish but increases the liability to a second seizure.

If the situation of the family is such that it is not practicable to take the infant to the country, and such cases are frequent among the poor, it should be kept much of the time in the open air; it is a common practice in this city to take such patients in the daytime to the seashore, or upon ferry-boats. Dr. E. H. Parker says: "Many of my patients are sent to the ferries to cross them, so that the cool, fresh, sea-breeze may fan them, and it acts sometimes like magic, to raise their drooping heads." I have not observed such marked benefit in these cases from the sea-breeze as from the air of elevated rural localities, which can generally be found in the vicinity of cities, and are easily accessible.

Medicinal Treatment.—Sometimes it is proper to commence treatment by the employment of a gentle purgative, particularly when the disease commences abruptly from a state of previous good health. It is then frequently caused by exposure to cold, or more rarely by some indigestible and highly irritating substance in the intestines. In such patients there is often a full habit. The pulse is strong and quick, the heat of surface great, the face perhaps flushed, the stools sometimes slimy and bloody, sometimes green or brown. It is proper and often serviceable, when there is this commencement of the affection, to give a single dose of castor oil or syrup of rhubarb. Any indigestible substance, if present, is removed from the intestine, and opiates or other remedies designed to control the disease may then be more successfully employed. Such cases occur in the winter not less than in the summer, and in all localities, rural as well as in the city. But the summer epidemics of intestinal inflammation in the cities do not in general require such preliminary treatment. Diarrhœa, moderate, perhaps, has already continued for a time when the physician is called, and no irritating substance remains except the acid, which is abundantly generated in the intestine in this disease, and which we have the means of removing without purgation. Preliminary treatment having been employed or not, according to the nature of the attack and condition of the patient, remedies calculated to arrest the inflammation should then be prescribed.

The same general plan of medicinal treatment holds good for the intestinal catarrh of infants, which has been found efficacious for that of adults. But the causes of this catarrh are, as we have seen, in some respects different in infancy from those operative in other periods of life, so as to require some variation in the treatment. The acid fermentation occurring in the stomach, which is very common, especially in the catarrh of the summer season, requires the use of antacids. If by the appearance of the stools, or the substance ejected from the stomach, or by the usual test with

litmus paper, the presence of acid in an irritating quantity be ascertained or suspected, lime water or a little bicarbonate of soda should be added to the food. The creta preparata of the pharmacopœia, or, which is more convenient, the mistura cretæ, administered every two hours, is an useful antacid for this condition. By the alkali alone, aided by the judicious use of stimulants, the disease is sometimes arrested; but, unless circumstances are favorable, and the case is mild, other medicines are required. The physician should see that the chalk is finely triturated.

Opium is used by most practitioners in the treatment of this malady. Either as a main remedy or adjuvant it is employed, and properly, in nearly all severe cases. For a young infant paregoric is an eligible preparation of opium. For the age of one month, the dose is three to five drops; for the age of six months, ten to twelve drops, repeated in three hours or a longer time, according to the state of the patient. After the age of six months the stronger preparations of opium are more frequently used. At the age of one year the liq. opii compositus or tinctura opii deodorat. may be given in doses of one drop. Dover's powder is also a useful medicine in this disease, given in doses of three-fourths of a grain to an infant one year old.

Opium is, however, in general best given in mixtures which will be mentioned hereafter. It quiets the action of the bowels, and diminishes the number of evacuations. It is contraindicated or should be used with caution if cerebral symptoms are present. Sometimes in the commencement of the disease, if there is much febrile reaction, the patient may be drowsy and in danger of convulsions. Then opiates should be given cautiously. Also in the advanced stages of this disease, when, perhaps, there is more or less serous effusion in the cranial cavity, opium should be cautiously prescribed, as it might tend to produce that fatal stupor, in which unfavorable cases are apt to terminate.

Astringents have long been used as an adjuvant to the opiate, but the medicine, which, employed in combination with opium, is the most efficient in controlling infantile entero-colitis, is the subnitrate of bismuth. While it aids strongly in checking the diarrhœa, it is an efficient antiemetic and antiseptic. It should be prescribed in doses of ten or twelve grains for an infant of twelve months, and larger doses produce no ill effect, for its action seems to be almost entirely local and soothing upon the intestinal surface. It undergoes a chemical change in the stomach, becoming black, being probably converted into the bismuth sulphide, and it produces dark stools. An intelligent physician has informed me that he has sometimes observed a peculiar faint odor, somewhat like that of garlic in the breath of those who are taking the bismuth in frequent large doses, which seems to indicate that there is some absorption of it.[1] In those cases in

[1] The same offensiveness of the breath has since been noticed in two cases in my practice.

which the symptoms are chiefly due to the colitis, and the stools contain blood with a large proportion of mucus, it has been customary to prescribe laudanum or other form of opium with castor oil. I now prefer, however, the bismuth and opium in the treatment of cases which are more decidedly dysenteric, as well as for cases of the usual form of intestinal catarrh.

The following formulæ are employed with the best results in the institutions of New York, with which I have an official connection, the dose being for an infant of one year:—

℞. Tinc. opii deodorat., gtt. xvj;
Bismuth. subnitrat., ʒij;
Syr. simplic., ℥ss;
Mistur. cretæ, ʒiss. Misce.
Shake bottle. Give one teaspoonful every two to four hours.

℞. Tinc. opii deodorat., gtt. xvj;
Bismuth. subnitrat., ʒij;
Syr. simplic., ℥ss;
Syr. cinnamomi, ℥iss.
Shake bottle. Give one teaspoonful from two to four hours.

℞. Bismuth. subnitrat., ʒij;
Pulv. cret. comp. c. opio, ʒss. Misce.
Divid. in chart. No. x. Dose, one powder every three hours.

℞. Bismuth. subnitrat., ʒij;
Pulv. ipecac. comp., gr. ix. Misce.
Divid. in chart. No. xii. Dose, one powder every three hours.

An infant of six months can take half the dose, and one of three or four months one-fourth or one-third the dose of either of the above mixtures.

Enemata.—These are of great service in many cases of intestinal inflammation. At any stage of the disease, when the stomach is irritable and medicines are not retained, they may be advantageously employed. Laudanum especially is often given in this way to the infant with great benefit. It may be prescribed mixed with a little starch-water, and the best instrument for administering it is a small glass or gutter-percha syringe, the nurse retaining the enema for a time by means of a compress. Beck, in his *Infant Therapeutics*, advises to give by injection twice as much of the opiate as would be administered by the mouth. A somewhat larger proportion may, however, be safely employed.

The following formula for a clyster has given more satisfaction in my practice than any other which I have employed:—

℞. Argent. nitrat., gr. j:
Bismuth. subnitrat., ℥ss;
Mucil. acaciæ,
Aquæ, āā ℥ij. Misce.

One-quarter to one-half of this should be used at a time, with the addition of as much laudanum as is thought proper, and it should be retained by a compress, held by the nurse.

In most of those cases of intestinal catarrh which occur under the depressing effect of warm weather, alcoholic stimulants are required almost from the commencement of the disease, and their use is beneficial in chronic or protracted cases, whatever the cause or season. Bourbon whiskey or brandy is the best of these stimulants, and it should be given in small doses, repeated at intervals of two hours. I have usually ordered three or four drops to an infant one month old, and an additional drop or two drops for each month. The stimulant is not only useful in sustaining the vital powers, but it also aids in relieving the irritability of stomach.

In certain cases vomiting is a prominent symptom. It is common and often obstinate in cases occurring during the summer epidemic, and it increases greatly the prostration. Sometimes it is probably due to excess of acid in the stomach, sometimes it is the result of the general irritability and increased movement of the gastro-intestinal canal, and sometimes it probably has a cerebral origin. The following are formulæ which will be found useful for this symptom :—

℞. Bismuth. subnitrat., ℥ij ;
Spts. ammon. aromat., ℥ss ;
Syr. simplic.,
Aquæ, āā ℥j. Misce.

Shake bottle. Dose, one teaspoonful hourly, or every second hour if required.

℞. Acid. carbolic., gtt. ij ;
Aq. calcis, ℥ij. Misce.

Dose, one teaspoonful with a teaspoonful of milk (breast-milk if the baby nurses), to be repeated according to the nausea.

Lime-water alone often removes the nausea when there is an excess of acids in the stomach, but it is rendered more effectual in certain cases by the addition of carbolic acid, which tends to check any fermentative process.

Another remedy is the neutral mixture, prepared by the following formula, the bottle being tightly corked immediately on mixing the ingredients, so as to retain the carbonic acid :—

℞. Potass. bicarbonate, gr. xxv ;
Acid. citric., gr. xvij ;
Aq. amygdal. amaræ, ℥j ;
Aquæ, ℥ij. Misce.

Dose, one teaspoonful to a child from eight to ten months, according to the nausea.

Dr. Sweezey, one of the attending physicians in the class of children's diseases at the Outdoor Department at Bellevue, and who has called my attention to the good effects of minute doses of ipecacuanha to relieve nausea in this disease, employed the following formula :—

℞. Tinct. ipecacuanhæ, gtt. iv ;
Aquæ, ℥iv. Misce.

Dose, one teaspoonful, repeated according to the nausea.

I have employed all these prescriptions, and in certain cases with a satisfactory result, but my preference is for the bismuth in large doses, as it seems to afford relief in the largest proportion of cases. Nevertheless there are instances, especially during the summer epidemics, when this symptom is very obstinate, and all these remedies may fail. In these cases perfect quiet of the child, the administration of but little nutriment at a time, mustard over the epigastrium, and the use of an occasional small piece of ice may relieve the nausea.

When the catarrh is chronic, and the vital powers begin to fail, as indicated by pallor, more or less emaciation, and loss of strength, the following is the best tonic mixture with which I am acquainted. It aids in restraining the diarrhœa, while it increases the appetite and strength. It should not be prescribed until the inflammation has assumed a subacute or chronic character.

R. Tinct. colombæ, ʒiij ;
Liq. ferri nitratis, gtt. xxvij ;
Syr. simplic., ʒiij. Misce.
Dose, one teaspoonful every four hours to an infant of one year.

In the Outdoor Department at Bellevue we commonly give this tonic alternately with the bismuth powders.

External Treatment.—Some writers recommend depletion by leeching in intestinal inflammation, advice likely to do harm, unless the particular cases are described in which it may possibly be of service. It can be useful only in those cases in which the infant is robust and of full habit, and the disease commences suddenly with decided febrile reaction. Such cases are oftenest seen with us in the winter season, and even these are ordinarily best treated without loss of blood. Sinapisms and poultices usually are sufficient as local measures. In these cases, also, the warm mustard foot-bath should be employed, and repeated if there is restlessness or cerebral symptoms.

In all forms of intestinal inflammation in infancy and in all its stages, mild counter-irritation over the abdomen is often useful, but vesication, by increasing the restlessness of the infant and reducing its strength, without materially modifying the severity or duration of the disease, does more harm than good. It is not to be thought of as a remedial measure. I have known a troublesome sore continuing till death, and probably hastening this result, to occur from this treatment. Poultices or fomentations over the abdomen are sometimes beneficial, especially those of a mildly irritating nature. A poultice of powdered cloves, cinnamon, and ginger, or of linseed meal to which a little mustard is added, may be employed, or a linseed poultice spread thin, under which a single layer of muslin is placed, saturated with camphorated oil or tincture of camphor, and over both oil silk. In the entero-colitis of infants, occurring in the cool

months, and due to exposure to cold, this treatment is especially useful. In the epidemic entero-colitis of the summer months, which may be aggravated by heat, treatment by poultices may be injudicious, but in such cases it is proper to produce moderate redness over the abdomen by temporary applications.

CHAPTER IX.

ENTERITIS AND COLITIS IN CHILDHOOD.

Intestinal inflammation in childhood differs materially from the form or type which it commonly presents in infancy. Its causes, symptoms and extent differ in important particulars in the two periods. In childhood there is not ordinarily such extensive inflammation of the mucous membrane of the intestines as we have seen is present in the majority of cases in infancy, and it may, therefore, be properly treated as two diseases, according to the seat of the morbid process, namely, enteritis and colitis. Both these affections in the child resemble so closely the form which they exhibit in adult life, that no extended description is needed in this connection.

Causes.—A main cause is sudden reduction of temperature by exposure to cold, or to currents of air, which checks perspiration, and causes determination of blood from the surface to the viscera. These inflammations are also caused sometimes by irritating substances in the intestines. I have known fecal accumulations as well as worms to produce severe dysentery in the child, accompanied by the characteristic tenesmus and muco-sanguineous stools, and ceasing as soon as the offending substances were expelled. The use of unripe or stale vegetables, if there is a strong predisposition to mucous inflammation, may be a sufficient cause, and some of the most dangerous cases are due to the accumulation in the intestines of seeds and the parenchyma of fruits. But the most common cause is that mentioned, namely, sudden exposure to cold when the body is heated, a danger to which children are especially liable, on account of the easy disturbance of the circulatory system in them, and their heedless exposure of themselves, unless incessantly watched.

Enteritis and colitis are also frequently secondary diseases. They occur in children as complications or sequelæ of the eruptive fevers, especially measles.

Symptoms.—The alvine discharges in enteritis and colitis in childhood are such as occur in these diseases at a more advanced age. In enteritis they are thin and of the natural color, or occasionally green; in colitis

they are more consistent than in enteritis, and are largely muco-sanguineous. Sometimes in enteritis, if the inflammation is not intense, the diarrhœa is slow in appearing, or it may be slight, so as not to attract special attention. The disease may then resemble remittent fever, for which it is at times mistaken. The upper part of the small intestines is less frequently affected than the lower. If there is duodenitis, the flow of bile is occasionally impeded from tumefaction at the mouth of the common bile-duct, and the icteric hue appears. In both enteritis and colitis there is abdominal tenderness, with more or less constant pain if the disease is severe, and in colitis, tormina and tenesmus. The pulse is accelerated, the heat of surface augumented, the face flushed, and, except in mild cases, indicative of suffering. In many children at the commencement of the inflammation the nervous system is profoundly affected, as indicated by headache, stupor, twitching of the limbs, and sometimes by convulsions. The chief danger at the commencement of the disease is, indeed, from this source. Sometimes there is irritability of the stomach, and the food is rejected, though much less frequently than in the intestinal inflammation of infancy. Anorexia and thirst are common symptoms. If the inflammation continue, there is soon perceptible emaciation, with loss of strength. The eyes become hollow, the face pale, and the surface cool. Death may occur at an early period, the vital powers succumbing from the intensity of the inflammation. In other cases, the acute disease ends in a subacute or chronic inflammation; the patient becomes gradually more reduced, till he dies in a state of extreme emaciation, such as we often observe in the entero-colitis of infancy, or from this state he may recover by degrees, though perhaps with an irritable state of the bowels, which continues for months. In a majority of cases, however, enteritis and colitis in childhood, if not neglected, soon begin to yield, and they terminate favorably in one or two weeks.

Diagnosis.—It is not difficult to determine the existence of the inflammation. This is indicated by the fever, abdominal tenderness, and the relaxed state of the bowels. Whether the disease is enteritis or colitis is determined by the character of the stools, the seat of the tenderness, and the presence or absence of tenesmus.

Prognosis.—It has been stated above that enteritis and colitis in children commonly terminate favorably. The result depends not only on the extent and severity of the inflammation, but the constitution and previous health. The inflammation is more serious when secondary than when primary. Extensive and great tenderness of the abdomen, features pale, anxious, and indicative of suffering, pulse frequent and feeble, should excite the most serious apprehensions. Frequent vomiting also denotes a grave form of the disease. Stupor, and especially convulsive movements, show that the nervous centres are affected, and should make us guarded in the prognosis. Improvement in the disease, on which to base a favorable

prognosis, is apparent in the diminution of the tenderness, improvement in the pulse and character of the stools, a more cheerful countenance, and less disrelish of food.

Treatment.—This should be similar to that employed for the adult. In enteritis at the commencement of the disease, if there is reason to suspect the presence of any irritating substance in the intestines, and ordinarily in colitis, it is advisable to commence treatment by the use of some simple evacuant, like castor oil. After this our reliance, so far as internal treatment is concerned, must be mainly on opiate and antiphlogistic medicines. One of the best remedies of this class is the Dover's powder, which may be given to a child five years old in doses of three grains every three hours. A corresponding dose of any of the other opiates may be given, but with less sudorific effect. In colitis the occasional administration of a laxative should not be neglected, if the stools are entirely or mainly muco-sanguineous. It should be employed so as to prevent accumulation of fecal matters in the colon, which would serve as an irritant and increase the inflammation. The dose should be small, merely sufficient to produce a fecal evacuation, and repeated as required, daily or less frequently. The laxative commonly preferred is magnesia, rhubarb, or castor oil. The physician may prescribe an opiate mixture containing sufficient of the laxative to have the effect desired, though ordinarily it is better to prescribe the two separately, so that the laxative can be given or withheld, according to circumstances, while the opiate is continued more regularly. Except that there is some irritating substance which requires removal, the effect of laxatives is injurious, instead of beneficial. Most of the formulæ given above in our remarks relating to the treatment of infantile intestinal catarrh, are likewise useful for the enteritis and colitis of childhood, the quantity of the opiate, which is the important ingredient, being increased according to the increase in the age. The following formulæ may be employed for a child of five years :—

℞. Pulv. opii, gr. v ;
Bismuth. subnitrat., ʒij. Misce.
Divid. in pulveres No. xx. Give one powder every two to four hours.

℞. Pulv. ipecac. comp., ʒj ;
Bismuth. subnitrat., ʒij. Misce.
Divid. in pulveres No. xxiv. Give one powder as above.

℞. Tinc. opii deodorat., gtt. xiviij ;
Bismuth. subnitrat., ʒij ;
Aq. menth. piperit.,
Syr. zingiberis, āā ℥j. Misce.
Shake bottle. Give one teaspoonful from two to four hours.

The local treatment which is found most useful consists in the use of

emollient applications covered with oil-silk, and made sufficiently irritating by mustard or otherwise to cause constant redness.

If there are symptoms threatening convulsions, a mustard foot-bath repeated occasionally will usually tranquillize the nervous system and avert the danger.

The diet should be bland and unirritating. In the first stages of the inflammation, rice or barley-water, or arrowroot boiled in water, and similar drinks should constitute the main diet. When the active inflammation has abated, and at any period of the disease if there is a tendency to prostration, more nourishing food should be given. Milk and animal broths may then be allowed. In cases which are protracted, or attended with symptoms of exhaustion, alcoholic stimulants are required.

CHAPTER X.

CHOLERA INFANTUM.

Cholera infantum, or, as it is sometimes called, choleriform diarrhœa, is a disease of the summer months; and with exceptional cases, of the cities. It receives the name which designates it from the violence of its symptoms, which closely resemble those in Asiatic cholera. It is, however, quite distinct in its nature, occurring independently of the epidemics of that disease.

I have elsewhere stated that, as regards at least this city, the term cholera infantum has been so extended as to embrace a large part of the diarrhœal maladies affecting infants in the summer months. Some physicians apply it even to mild but protracted cases of ordinary non-inflammatory or inflammatory diarrhœa occurring in the season mentioned. I employ it, and it should, in my opinion, only be employed, to designate that form of infantile diarrhœa in which there are frequent watery stools, accompanied by vomiting, great elevation of temperature, and rapid and great emaciation.

The number of deaths from cholera infantum reported in our bills of mortality is so large, while the number from the same disease embraced in the death statistics of European cities is so small comparatively, that some have been led to believe that this malady is much more prevalent and fatal in this country than in Europe, whereas, were these terms employed in all places to designate precisely the same disease, probably no great difference would be found in the prevalence of cholera infantum on the two sides of the Atlantic.

Causes.—It has been stated that cholera infantum prevails mainly in the cities and in the summer months. Cases occur from the month of May

to October. Its maximum frequency and severity correspond with the degree of heat, and it is therefore most prevalent in the months of July and August. One of the chief causes of this disease is, doubtless, residence in an atmosphere loaded with noxious vapors, especially gases arising from animal and vegetable decomposition, or an atmosphere rendered impure by overcrowding and by personal and domiciliary uncleanliness. It is, therefore, much more common in tenement houses and parts of the city occupied by the poor than in cleaner and less crowded streets and apartments.

Summer heat and the anti-hygienic conditions to which it gives rise in the cities, sometimes appear to be sufficient in themselves to develop cholera infantum; at least it occurs without other obvious cause. In other, and probably the majority of cases, another cause co-operates, namely, the use of improper food. Atmospheric heat and its depressing influences are then predisposing causes, while the use of indigestible or irritating food is the exciting cause. Infants upon whom both causes are operative are most liable to cholera infantum in its severe form. Hence bottle-fed infants of the city are especially liable to it, and infants whose food is carelessly and improperly prepared. Often in the hot months, acid and indigestible fruits, as currants, heedlessly given to an infant, occasion the attack.

Cholera infantum occurs commonly under the age of two years. It is so frequent during the period of first dentition, that some writers consider dentition a cause. At this period, however, as has been stated elsewhere, there is great functional activity, and rapid development of the intestinal follicles, and the peculiar liability to cholera infantum at this age should be attributed to this cause rather than to dentition.

Symptoms.—Cholera infantum sometimes commences abruptly, the previous health having been good. In other cases it is preceded by a premonitory stage, that of diarrhœa. The stools are thinner than natural, and somewhat more frequent, but not such as to excite alarm. Suddenly the evacuations become more frequent and watery, and the parents are surprised and frightened by the rapid sinking and real danger of the infant. Occasionally this antecedent diarrhœa has continued several weeks, attended with emaciation and associated with intestinal inflammation.

This disease is characterized by the discharge of thin stools, designated by some watery, by other serous. The first evacuations, unless there has been previous diarrhœa, contain considerable fecal matter. They are so thin as to soak into the diaper like the urine, and in some cases they scarcely produce more of a stain than does this secretion. The odor is peculiar, not fecal, but musty and offensive; occasionally the stools are almost odorless. Commencing simultaneously with the watery evacuations, or soon after, is another symptom, namely, irritability of the stomach, which increases greatly the prostration and danger. Whatever is swallowed by the infant is rejected immediately, or after a few minutes, or

there may be retching without vomiting. The appetite is lost, and the thirst is intense. Cold water, especially, is taken with avidity, and if the infant nurses, it eagerly seizes the breast, in order to relieve the thirst. The tongue is moist at first, and clean or covered with a light fur. The pulse is accelerated, while the respiration is either natural or somewhat increased in frequency; the surface is warm, but its temperature is speedily reduced. There is no disease of infancy in which the temperature of the blood is higher. In ordinary cases the thermometer introduced into the rectum rises above 105°, and I have seen it indicate 107½°. There is no abdominal tenderness, and no evidence of pain. The infant is often restless at first, but its restlessness is due to thirst, or that unpleasant sensation which the sick experience when the vital powers are rapidly reduced. The urine is scanty in proportion to the gravity of the attack.

The loss of strength and the emaciation are more rapid than in any other diarrhœal malady, except Asiatic cholera, and the most severe form of cholera morbus. The parents scarcely recognize in the changed and melancholy aspect of the infant any resemblance to the features which it exhibited a day or two before. The eyes are sunken, the eyelids and lips are permanently open from the feeble contractile power of the muscles which close them, while the loss of the fluids from the tissues and the emaciation are such that the bony angles become more prominent, and the skin in places lies in folds.

As the disease approaches a fatal termination, which often occurs in two or three days, the infant remains quiet, not disturbed even by the flies which alight upon its face. The limbs and cheeks become cool; the eyes bleared, pupils contracted, and the urine scanty or suppressed. As death draws near the respiration becomes accelarated from the pulmonary congestion consequent on the feeble contractile power of the heart, the pulse becomes more and more feeble, the surface has a clammy coldness, and stupor results, which becomes more and more profound, and from which it is impossible to arouse the infant.

In the most favorable cases cholera infantum is checked before the occurrence of these fatal symptoms. And often even in cases which are ultimately fatal, there is not such a speedy termination of the malady. The choleriform diarrhœa abates, and the case becomes one of ordinary entero-colitis as described in the foregoing pages.

Anatomical Characters.—Rilliet and Barthez, who of foreign writers treat of this disease at greatest length, describe it under the name of gastro-intestinal choleriform catarrh. "The perusal," they remark, "of the anatomico-pathological description, and especially the study of the facts, show that the gastro-intestinal tube in subjects who succumb to this disease may be in four different states: (*a*), either the stomach is softened without any lesion of the digestive tube; (*b*), or the stomach is softened at the same time that the mucous membrane of the intestine, and especially its follicu-

lar apparatus, is diseased; (*c*), or the stomach is healthy whilst the follicular apparatus, or the mucous membrane, is diseased; (*d*), or, finally, the gastro-intestinal tube is not the seat of any lesion appreciable to our senses in the present state of our knowledge, or it presents lesions so insignificant that they are not sufficient to explain the gravity of the symptoms.

"So far the disease resembles all the catarrhs, but what is special is the abundance of the serous secretion, and the disturbance of the great sympathetic nerve.

"The serous secretion, which appears to be produced by a perspiration (analogous to that of the respiratory passages and of the skin) rather than by a follicular secretion, shows, perhaps, that the elimination of substances is effected by other organs than the follicles; perhaps, also, we ought to see a proof that the materials to eliminate are not the same as in simple catarrh. Upon all these points we are constrained to remain in doubt. We content ourselves with pointing out the fact."

American writers divide cholera infantum into three stages, the first characterized by turgescence of the intestinal follicles, with more or less softening of the mucous membrane. In the second stage the mucous membrane of the intestines is vascular in patches and streaks, and somewhat thickened and softened, while the solitary glands and patches of Peyer present an inflammatory hyperæmia, and occasionally certain of them are ulcerated. In the third stage the brain is involved. The cranial sinuses, veins, and capillaries of the brain are congested, and there is transudation of serum upon the surface of the brain or in the ventricles. The following observations show the character of these lesions:—

On the 1st of August, 1861, I made an autopsy of an infant sixteen months old, who died of cholera infantum, with a sickness of less than one day. The examination was made thirty hours after death. Nothing unusual was observed in the brain, except, perhaps, a little more than the ordinary injection of vessels at the vertex; no disease of stomach and intestines except enlargement of the patches of Peyer as well as the solitary glands; mucous membrane pale. In this and the following cases there was apparently slight softening of the intestinal mucous membrane; but whether it was pathological or cadaveric is uncertain, as the weather was very warm. The liver seemed healthy. Examined by the microscope, it was found to contain about the normal amount of oil-globules.

The second case was that of an infant seven months old, wet-nursed, who died July 26, 1862, after a sickness also of about one day. He was previously emaciated, but without any definite ailment. The post-mortem examination was made on the 28th. The brain was somewhat softer than natural, but was otherwise healthy. There was no abnormal vascularity of the membranes of the brain, and no serous effusion within the cranium. The mucous membrane of the intestines was of normal appearance through-

out, unless somewhat thickened and softened; the solitary glands of the colon were enlarged. The patches of Peyer were not distinct.

At the New York Protestant Episcopal Orphan Asylum, an infant twenty months old, previously healthy, was seized with cholera infantum on the 25th of June, 1864. The alvine evacuations, as is usual in this disease were frequent and watery, and attended by obstinate vomiting. Death occurred in slight spasms, in thirty-six hours. The exciting cause was apparently the use of a few currants, which were eaten in a cake the day before, some of which fruit was contained in the first evacuations. The brain was not examined. The only pathological changes which were observed in the stomach and intestines were slightly vascular patches in the small intestines, and an unusual prominence of the solitary glands in the colon. These glands resemble small beads imbedded in the mucous membrane. The lungs in the above cases were healthy, excepting hypostatic congestion.

Since the dates of these autopsies, I have made others in cases which terminated fatally after a brief duration, and have uniformly found similar lesions, namely, the gastro-intestinal surface either without vascularity or scantily vascular in streaks or patches, sometimes presenting a whitish or soggy appearance, and somewhat softened, while the solitary glands were enlarged so as to be prominent upon the surface. In cases which continue longer, evident inflammatory lesions soon appear, which are identical with those already described in the article which relates to intestinal inflammation.

Nature.—It was formerly my opinion that cholera infantum is essentially non-inflammatory, but that it soon became inflammatory if not checked. Careful observations of its symptoms and lesions have since convinced me that it is the most violent inflammation to which infants are liable in our climate. There is no other infantile malady in which there is uniformly so high a temperature, and under which patients sink more rapidly. The alvine discharges to which the rapid prostration is largely due, probably consists in part of intestinal secretions, and in part of serum which has transuded from the capillaries of the intestines. It is well known to pathologists, that in inflammation of mucous surfaces of short duration, the redness is apt to disappear in the cadaver.

The opinion has been expressed by certain observers that cholera infantum is identical with thermic fever or sunstroke. There is, indeed, a resemblance as regards certain important symptoms. In cholera infantum the temperature is from 105° to 108°; in sunstroke it is also very high, often rising above 108°. Great heat of head, contracted pupils, thin fecal evacuations, embarrassed respiration, scanty urine, and cerebral symptoms are common towards the close of cholera infantum, and they are the prominent symptoms in sunstroke. Nevertheless, I cannot accept the theory which regards these maladies as identical, and which remove

cholera infantum from the list of intestinal diseases. In cholera infantum the gastro-intestinal symptoms always take the precedence, and are, except in advanced cases, always more prominent than other symptoms. It does not commence as by a stroke like *coup de soleil*, but it comes on more gradually though rapidly, and it often supervenes upon a diarrhœa or some error of diet. In the commencement of cholera infantum the infant is not apt to be drowsy, and it is often wide awake and restless from the thirst. Contrast this with the alarming stupor of sunstroke. Sunstroke only occurs during the hours of excessive heat, but cholera infantum may occur at any hour, or in any day during the hot weather, provided that there is sufficient dietetic cause. Again, intestinal inflammation is not common in sunstrake, while it is the common, or as I believe the essential, lesion of cholera infantum. These facts show, in my opinion, that the two maladies are essentially and entirely distinct. Nevertheless, cases of apparent sunstroke sometimes occur in the infant, and if the bowels are at the same time relaxed the disease is apt to be regarded as cholera infantum, and if fatal is usually reported as such to the health authorities. Such cases I have occasionally observed, or they have been reported to me, although they are not common.

With the exception of the organs of digestion, no uniform lesion is observed in any of the viscera, unless such as is due to change in the quantity and fluidity of the blood, and its circulation. Writers describe an anæmic appearance of the thoracic and abdominal viscera, and occasional passive congestion of the cerebral vessels. The cerebral symptoms often present towards the close of life in unfavorable cases of cholera infantum may arise from that state of the brain known as spurious hydrocephalus, which is not attended by any uniform or certain lesion of this organ. As the urinary secretion is scanty or suppressed, cerebral symptoms may be in certain cases be due to uræmia.

Diagnosis.—This disease is diagnosticated by the symptoms, and especially by the frequency and character of the stools. The stools have already been described as frequent, often passed with considerable force, deficient in fecal matter, and thin, so as to soak into the diaper almost like urine. The vomiting, thirst, rapid sinking, and emaciation serve to distinguish cholera infantum from other diarrhœal maladies.

When Asiatic cholera is prevalent, the differential diagnosis of the two diseases is difficult if not impossible.

Prognosis.—This is one of those diseases in regard to which physicians often injure their reputation by not giving sufficient notice of the danger, or even by expressing a favorable opinion, when the case soon after ends fatally. A favorable prognosis should seldom be expressed without qualification. If the urgent symptoms are relieved, still the disease may continue as an ordinary intestinal inflammation, which, in hot weather, is formidable and often fatal. If the stools become more consistent and less

frequent, without the occurrence of cerebral symptoms, while the limbs are warm and pulse good, we may confidently express the opinion that there is no present danger.

The duration of true cholera infantum is short. It either ends fatally, or it begins soon to abate and ceases, or it continues as an entero-colitis. Death may occur, in twenty-four or forty-eight hours, in a state of collapse, from the frequency of the stools, or not till after three or four days. In general, if the case do not end within three or four days by recovery or death, it becomes one of severe ordinary entero-colitis.

Treatment.—Cholera infantum requires beyond most other diseases, the employment of proper remedial measures, from the earliest possible moment, since the infant rapidly sinks, unless the evacuations from the bowels are arrested, or are rendered less frequent and watery. Regarding the disease as a violent intestinal inflammation, we have no difficulty in determining the therapeutic indications. Those already recommended in our article relating to intestinal inflammation, are indicated, and to the full extent which the infant will bear, without causing too much stupor. An infant between the ages of eight and twelve months, should take one teaspoonful of the following mixture every two or three hours, till the vomiting and diarrhœa are controlled :—

℞. Tinct. opii, gtt. xvj ;
Spts. ammon. aromat., ℥ss–j ;
Bismuth. subnitrat., ʒij ;
Syr. simplic., ℥ss.
Mistur. cretæ, ℥iss. Misce.

An infant of six months can take one-half the dose, and one of three or four months, one-third or one-fourth the dose. Instead of this, one of the equivalent mixtures which are recommended for the treatment of intestinal inflammation, may be given. If cerebral symptoms appear, as rolling the head, drowsiness, etc., I usually write the prescription without the opiate, and it may then be given more frequently if the case require it, while the opiate prescribed alone is given more guardedly and at longer intervals.

There is danger in this disease of the sudden supervention of stupor, amounting even to coma and ending fatally. In these cases the stools are generally suddenly checked, and the opiate might aid in producing this result. In a few instances which I can recall to mind, where death occurred in this way, the friends believed that the melancholy result was hastened by the medicine. If the evacautions are partially checked and there are signs of stupor, the opiate should either be omitted or given less frequently. Explicit and positive directions to this effect should be given. Eligible preparations of opium for this disease are paregoric, tincture of opium, pulv. cretæ comp. c. opio, and, if there is no irritability of stomach, Dover's powder.

Certain writers recommend the employment of a purgative as preliminary treatment, in order to remove any irritating substance from the intestines. But delay in the use of remedies to check the evacuations involves too much risk. When the urgent symptoms are somewhat controlled, a moderate dose of castor oil may be prescribed if there is reason to suspect that there is any irritating substance in the intestines.

By this mode of treatment the stools are generally in a few hours rendered less frequent and more consistent.

There are physicians who believe that calomel in small and repeated doses has a beneficial effect in choleriform diarrhœa, but those who use it employ it in combination with opium, and it is probable that the good effect observed is mainly due to the latter remedy. From the anatomical characters of cholera infantum there is apparently no indication for a medicine that affects the function of the liver, and there is no evidence that calomel exerts any good effect on the follicular apparatus of the intestines, which, so far as we can localize the disease, seems to be most in fault of any part of the digestive apparatus. On theoretical gounds, therefore, I should oppose the employment of this agent, and my observations of its effects have been such that I entirely discard its use while we have other safe and efficient remedies to meet every indication.

Ordinarily, as the diarrhœa is relieved, the vomiting ceases. The remedies employed for the former are also curative of the latter; still the vomiting, if frequent and obstinate, sometimes does require special treatment, and there are no better anti-emetic mixtures than those recommended in our remarks on the treatment of intestinal inflammation. In robust infants, at the commencement of the attack, small pieces of ice taken in the mouth aid in diminishing the irritability of stomach. Mustard should also be applied to the epigastrium.

In most cases alcoholic stimulants are required. The best of these is Bourbon whiskey or brandy, which should be used from an early period of the disease. Aside from its sustaining the vital powers, it aids also in relieving the irritability of stomach.

The diet in cholera infantum should be simple but nutritious. That recommended for intestinal inflammation is proper for infants with this malady.

CHAPTER XI.

INTESTINAL WORMS.

The belief has been prevalent in the profession in former times, and *is* now among the people, that worms in the intestines constitute a frequent disease, especially in children. As pathology and the means of diagnosticating diseases are better understood, this idea has been gradually abandoned by physicians and the intelligent portion of the community. Still these parasites must be considered an occasional cause of serious derangements, and, in rare instances, a cause even of death. They indeed often exist in small number, without producing any appreciable deviation in the individual from the healthy state; but the most common and best known species, when they have once effected a lodgment in the intestines of man, ordinarily grow and multiply so as to produce symptoms, and require medicines for their expulsion.

So far as is now ascertained by observations in different countries, about fifty animal parasites make their abode in man. It is not improbable that the number will yet be found greater by observations in distant uncivilized countries. Of these fifty, twenty-one reside in the alimentary canal (Heller), several of them being microscopic. Of those occupying the intestines only, the following species are specially interesting to the practising physician, on account of their relation—for the most part causative—to certain pathological states, to wit: the ascaris lumbricoides, or round-worm; the oxyuris vermicularis, or thread-worm; the bothriocephalus latus, and three species of tænia, or the tape-worms, and the trichocephalus dispar, or whip-worm.

Ascaris Lumbricoides.—The round-worm has a dingy reddish or yellowish-red color and a cylindrical form, tapering towards both extremities from the point of its greatest diameter, which is a little posterior to the middle. The dead worm is paler than the living. The anterior extremity is tipped with three lips, between which and the body is a circular groove. Between these three lips, anteriorly is the aperture of the mouth, from which the œsophagus extends to the distance of one-fourth to one-third of an inch. The intestine, which has a light brownish color, extends from the œsophagus to near the posterior extremity of the animal, where it terminates in the anus. The females are in numerical excess of the males, and their size is also greater. The shape of the worm is like that of the common earth-worm, from which it derives the name lumbricus, but it is

somewhat more pointed and its color a paler red. The tail of the male worm is curved like a hook, while that of the female is straight.

The total number of eggs contained in a fully developed female has been estimated at sixty millions. The eggs when immature are conical, and are attached to a longitudinal band; when mature they are oval, with dark granular contents and a strong double shell, and their diameter is about $\frac{1}{500}$ of an inch. They are expelled in countless numbers with the feces, and at the time of expulsion are surrounded by an albuminous coating stained with bile. Their vitality is retained under apparently very unfavorable circumstances, even for years. They hatch even after they have been repeatedly frozen or desiccated.

The ascaris lumbricoides inhabits the small intestines, where it is rapidly developed from the embryonic state. The remark made by Heller, that when found in the colon it is always dead, cannot be true, for many live worms are expelled in the stools.

The round-worm, more than all other intestinal worms, is inclined to wander away from its usual abiding place, namely, from the jejunum and ileum, producing symptoms of more or less gravity, referable to the part over which it crawls. It occasionally enters the stomach, from which it is vomited, or it ascends the œsophagus into the fauces, from which it is soon removed by the efforts of the individual. Cases are on record, one of which Andral witnessed, in which the worm entered the larynx, producing suffocation and speedy death. M. Tonnellé also witnessed such a case. A child, nine years old, was suddenly seized with great difficulty of respiration and pain in the upper part of the chest. A careful examination of the thorax gave a negative result. Death occurred in from twelve to fifteen hours, and at the post-mortem examination a lumbricus was found filling the cavity of the larynx. M. Blandin, also, witnessed a case, when interne of the Hôpital des Enfants. An infant was suffocated by one of these worms, which had penetrated as far as the right bronchus. Very rarely they crawl from the fauces into the nasal passages. This worm is so strong and active that there is no recess or reflexion of the mucous membrane of the digestive apparatus which it could possibly penetrate, in which it has not been found. It has been discovered in the appendix vermiformis, in the pancreatic duct, in the common bile-duct, and even in the gall-bladder. The number of these worms found in the intestines is very various. There may be only one, or the number may be almost incredibly large.

Thus, Barrier relates the case of an infant thirty months old, who died in Hôpital Necker. It was believed to be tubercular. Numerous tumors, which could be felt in the abdomen, were supposed to be tubercular masses. On making the post-mortem examination, the mesenteric glands were found healthy, but the intestines throughout their entire extent were filled with lumbrici. The masses which, during life, were believed to be

tubercular glands, were found to consist of worms. The cæcum, especially, was greatly distended by them. The intertwining or collection in balls of these worms constitutes, indeed, one of the chief dangers, as it renders them so much the more difficult of expulsion.

The round-worm possesses no organs of penetration, still, if the intestine is weakened by disease, especially by ulceration, it may, by pressure with its head, force an opening through which it escapes into the cavity of the abdomen, causing peritonitis and death. This worm is commonly found, whether single or in masses, surrounded with mucus, which serves as a partial protection to the intestines.

The portion of the mucous membrane in contact with lumbrici is often found inflamed, either from movements of the worm, or from pressure of a mass of worms, or even of a single worm in a confined position, as the appendix vermiformis. This inflammation, continuing and increasing, may end in ulceration, and thus a weakened spot be produced, which may be ruptured by simple pressure of the mouth of the worm. In this way are to be explained those apparent cases of perforation, which have led some observers to believe that lumbrici had actually the power of penetrating the healthy coats of the intestines. The perforation is obviously most apt to occur in those who have been enfeebled, and whose tissues have been rendered less firm and resisting by antecedent disease, as by typhoid fever.

M. Guersant describes a case in which the appendix vermiformis contained an ulcerated opening, through which two round-worms had partly passed into the abdominal cavity, producing fatal perityphlitis. The effect of their impaction in this narrow cul-de-sac was much like that of a bean or seed lodged in the same situation.

The ascaris lumbricoides has occasionally been found in the most remarkable locations, namely, in abscesses lying without the intestines. They have been known to effect a lodgment in the liver, and produce an abscess there, no doubt, by crawling up and distending a bile-duct. Their lodgment in other viscera, which have no pervious connections with the intestinal tract, is no doubt accomplished through fistulous openings produced by inflammation which they had no part in causing, as, for example, in the bladder and kidneys, of which there are well-authenticated cases. Worm cysts in the abdominal walls have been found to occur in most instances in the usual site of hernias, namely, at the umbilicus in children, and in the inguinal region in adults. It is presumed, therefore, that the worms had entered hernial protrusions, from which they had passed by ulceration into the abdominal walls, and had there become encapsulated.

The *oxyuris vermicularis*, or thread-worm, so called from its resemblance to pieces of ordinary white sewing thread, is also frequent in childhood, and is not infrequent in the adult. The length of the male oxyuris is from one-sixth to one-fifth of an inch; that of the female from one-third

to one-half of an inch. The posterior extremity of the male is blunt, and is curved, or rolled up towards the abdomen; that of the female is slender and pointed like an awl.

The head of this worm is relatively broad, from an unusual thickness or fulness of the cuticle, and the mouth, surrounded by "three nodular lips," is situated in the centre of the extremity. The œsophagus extends backward from the mouth, gradually growing larger, like the segment of a long and narrow cone, and ending in a globular enlargement, which has been designated the pharynx. From the pharynx the intestine runs in nearly a straight line through the worm.

The eggs are numerous, so completely filling the interior of the female as to conceal the organs from view. They are flattened on one side, but are rounded or convex in other parts of their circumference. One end is more pointed than the other, as in the eggs of birds. Certain of the eggs in the mature female are seen to be undergoing segmentation, preparatory hatching, while others more advanced contain tadpole-shaped embryos, and others still contain worm-shaped embryos, either lying within the shells or protruding from them. The hatching and growth of this worm, which have been observed under the microscope, are very rapid under favorable circumstances. "I once," says Heller, "saw the metamorphosis from the tadpole-shaped embryo to the worm-shaped embryo completed in about one hour," but the usual time is longer. Leuckart saw oxyurides, one-fourth of an inch in length, fourteen days after the eggs had been swallowed.

Oxyurides may be developed so rapidly from eggs swallowed in the ingesta, that they attain nearly or quite their full growth while still in the small intestines, so that, although their chosen residence is in the large intestines, some of them are not infrequently found in the ileum, and even in the jejunum, of full size and active. The part of the intestinal tract which the oxyurides prefer, and in which the largest colony of them reside, is the cæcum and appendix vermiformis, and not the rectum, as stated in most of the books, and in this situation, where they have been little disturbed, their habits and the relative proportion of the sexes can be best observed. But they are ordinarily found both in the cæcum and rectum in the same individual, and, indeed, upon all parts of the intervening surface of the colon.

The number of oxyurides in the individual varies greatly. They are occasionally so numerous upon the intestinal surface that they resemble fur, and when they are so abundant they are commonly found above the ileo-cæcal valve as well as below it. The males are smaller and apparently more fragile and perishable than the female. Therefore in the rectum and other exposed situations, there is a numerical excess of the females; but in reflexions of the intestines, where they are securely lodged, as in the appendix vermiformis, no marked difference has been observed

in the relative number of the two sexes. Since the males are more delicate, transparent, and smaller than the females, they are more apt to be overlooked in a hasty post-mortem examination.

The term *tape-worm* is applied to several species of the tænia, and to at least two species of the bothriocephalus, but all except four, namely, the tænia solium, tænia saginata or medio-canellata, tænia elliptica or cucumerina, and the bothriocephalus latus, are rare in Europe and North America, and are therefore of little interest to the practising physician.

The tape-worm is an hermaphrodite, each segment containing the two sexual organs. The head, or scolex, is small, about the size of a pin's head, and segment after segment is produced by a budding process from the head. The segments are attached to each other at their extremities, and each segment as it becomes further and further removed from the head, by the formation of new intervening segments at the upper end of the chain, becomes also larger and more matured. The oldest segments having attained their full growth, are detached, and have an independent existence. A separation of the chain of segments at any point does not compromise the life of the parasite. If only the head remain uninjured the segmentation continues from it, and in time the former number of segments and former length of the chain are restored. This worm resides in the small intestines, the larger species sometimes extending from the upper part of the jejunum to near the ileo-cæcal valve.

The *tænia solium* is developed from an embryo, known as the cysticercus cellulosæ, contained in the muscles of the hog. It has also been found in some other animals, as the dog, deer, and polar bear. It is a vesicle, about the size of a pea or small bean, having a delicate cell wall, and is nearly spherical, except as its shape is changed by compression between the muscular fibres. At one point of the cell wall is a depression, attached to the inner surface of which, and lying within the cyst, is a whitish, pear-shaped, solid body, which is the head of the cysticercus, and is identical in appearance and character with the head of the tænia solium turned inside out. Many experiments have shown the close relationship of the cysticercus and tænia solium, that they are two forms of existence of the same parasite. Segments of the tænia solium have been repeatedly fed to pigs, and the cysticercus produced in their muscles, though in what way the ovum or embryo passes from the stomach to the muscles is not known. On the other hand, swine flesh containing cysticerci has been fed to criminals who were soon to be executed, and after their death the tænia was found in their intestines. It is evident that this parasite occurs only in those who eat swine flesh, as sausages, either raw or but slightly cooked.

The head of this species of tænia, which is about the size of a small pin's head, has at the top a conical protuberance, upon which is a corona of hooklets, arranged in two circles, the hooklets of the outer circle being smaller than those of the inner. The projecting points, however, of the

two rows fall together, forming one circle. The hooklets are inserted into depressions in the head, and many of them have fallen out in most specimens which we have an opportunity of examining. The depressions in which the hooklets are lodged are often dark from pigmentation. Back of the circle of hooks are four sucking disks, which the worm is able to protrude and move freely. When protruded they appear as small tubercles with slender pedicles. The neck, which is slender and about one inch in length, shows no markings from commencing segmentation, and it is succeeded by very small and delicate segments, which gradually increase in size as the distance from the head increases.

The mature segments (proglottides) vary in size accordingly as they are in a state of contraction or relaxation. When relaxed, their length is about half an inch and breadth one-quarter of an inch. The genital organs are situated on the margin of each segment, a little posterior to the middle, and there is an alternation in their location between the right and left margins in the chain of segments. The uterus lies in the centre of the segment, forming a longitudinal straight line. From seven to twelve branches are given off from each side of the uterus, and these divide and subdivide like the branches of a tree. The male genital organs lie in the same aperture or pore in the margin of the segment, with which the uterus and ovaries connect.

The eggs of the tænia solium are globular, with a diameter of about $\frac{1}{750}$th of an inch, and with thick shells, which are striated like Mosaic work by lines which cross each other. It is estimated that not less than 50,000,000 eggs are contained in all the segments of a matured tænia.

This parasite is very liable to abnormal development. In some instances two or more segments are fused together, and often they are stunted in their growth, or they contain holes, fissures, and flaws, either from their original development, or produced by rupture of the distended uterus. Again, rarely two tænia are blended, so that along the flat side of one chain another is united by the margin, so that a section of the double parasite resembles the Roman letter T or Y. The nutrition of the segments is maintained through a vessel running the whole length of the worm, near each margin, and having communicating branches.

The *tænia saginata*, designated also *medico-canellata*, is much larger, stronger, and thicker, both as regards the head and segments, than the tænia solium. When fully matured it measures eighteen feet. The diameter of the head is nearly one line ($\frac{9}{100}$ inch). It is furnished with four strong sucking disks, but it lacks the circlet of hooks which characterizes the tænia solium. Instead of the hooks the head is furnished with a small frontal sucking disk. The heads of some specimens of this worm are free from pigment, but other specimens present various shades of pigmentation—from a slight staining to a jet black color. The neck is short, and very near the head are markings which indicate commencing segmen-

tation. The matured segments vary in measurement when relaxed—from a length of eight lines and breadth of two lines, to a length of nine lines and breadth of three lines. As in the tænia solium the genital pores are situated on the margins of the segments, varying irregularly from side to side, and the uterus has lateral branches, which divide dichotomously. There is but little difference in the sexual apparatus of the tænia solium and tænia saginata, but the eggs of the latter are somewhat larger than those of the former, and are oval.

The development of the tænia saginata is sometimes irregular, producing monstrosities, as in the tænia solium. The embryos of this parasite occur chiefly in the muscles of ruminating animals, as the ox, sheep, goat, etc., and therefore its presence in man is attributable to the use of the flesh of these animals, either slightly cooked or raw. The cysticercus of this species appears to be less tenacious of life than that of the tænia solium, and when it perishes it becomes changed into a greenish-yellow pulp, surrounded by the capsule, and imbedded in the muscular or other tissue where it had lodged.

It is easy to distinguish this worm from the tænia solium if the head is found, by its larger size, the larger size of its sucking disks, and the absence of the circle of hooks. The segments are distinguished by their greater size, and the greater number, and the dichotomous division of the branches of the uterus. This species occurs over a much greater area of the earth's surface than the tænia solium.

The *tænia elliptica* or *cucumerina* is a more delicate worm than the preceding species, measuring, when fully grown, from seven to ten or eleven inches in length. Upon its head is a rostellum or beak, which the worm is able to thrust forward, and on which are about sixty hooks, irregularly arranged. The anterior portion of the parasite is very delicate, like a thread, and its segments are small, but as in the other species they become larger, as their distance from the head increases. The matured segments which have a reddish-white color are readily detached, and when separated they move about actively. This tænia is also an hermaphrodite, and a genital pore containing a double set of genital organs is located on each margin of the segment. The tænia elliptica inhabits the small intestines of the dog and cat, and many children in different localities have been affected with it.

Heller states that the segments of another and rare species of tænia, which were expelled from a child of nineteen months, are preserved in the Museum of Pathological Anatomy in Boston. Nearly in the middle of the posterior half of each segment, is a yellow spot, namely, the receptaculum, full of ova, and, therefore, the name flavo-punctata has been applied to this worm. Little is known in regard to the tænia nana and tænia Madagascariensis, since they occur in distant countries.

The *bothriocephalus latus* is the largest of the tape-worms, attaining

the length of 15 to 24 feet. It is one of the most important of the intestinal parasites. The head has an almond-shape, or the shape of an elongated, and somewhat flattened globe, its length being about one line, and its diameter from one-third to one-half a line. Running longitudinally along each flattened side of the head is a groove or fissure, containing the apparatus of suction. Those segments, which are still in the process of growth, have a breadth three or four times greater than their length, while the matured segments are nearly square. The genital pore occurs in the centre of one side of the segment, and in the chain of segments all the pores are found on the same side. A brownish, rosette-shaped spot is observed at the site of each ripe pore produced by the convolutions of the uterus, and the numerous eggs which this organ contains.

The egg, which is oval, has a thin shell, a light-brown color, and at one end of it is a lid or operculum, which is separated from the rest of the egg by a well-defined line. At the hatching an embryo, provided with six hooks, escapes from the lid. When it has separated from the egg it is provided with an albuminous covering, from which cilia radiate in all directions, by the movement of which it is propelled. After a few days this covering is lost, and the embryo now moves about by amœboid extension and contraction. It is believed that in this embryonic state it enters an aquatic animal, a mollusk or fish, where it undergoes further development, and from which it is received into the stomach in the food. The bothriocephalus occurs not only in man, but also in some of the domestic animals, which eat fish, as the dog. This parasite is believed to be rare outside of Europe, and in Europe it is chiefly met in countries bordering on inland lakes and seas.

The *trichocephalus dispar* is comparatively unimportant to the physician, since it is uncertain whether it materially impairs the health or produces symptoms. It inhabits the cæcum, but in rare instances it has been found in the ileum and appendix vermiformis. The number of these parasites is usually small, but as many as seventy to one hundred have been observed in the intestine of the adult.

The trichocephalus dispar occurs also in the monkey, and a very similar, if not identical worm, has been found in the pig. It is not frequent in children, and it has not been observed in very young children. It occurs in man in every part of the globe, and in some countries as Egypt, Nubia, and Syria, it is said to be very common. This worm, which is also sometimes designated the whip-worm from its shape, attains the length of one and a half to two inches, the female being longer than the male. Its anterior two-thirds are thin, delicate, and flexible, like a small thread. The posterior one-third which contains the generative organs, and intestinal canal is considerably thicker, and it ends abruptly. On the under surface, extending nearly the whole length of the body, is a longitudinal band, the width of which is about one-third the circumference of the body.

In the female, the posterior or thick portion of the worm is slightly bent or curved like the stock of a hunting whip, while that of the male is rolled in the spiral form. The digestive tube consists of an œsophagus, which extends through the anterior thread-like part, and the stomach and rectum which lie in the posterior thick division. The genitals of the female lie in the commencement of the thick portion, and the uterus, when distended with eggs, occupies nearly the whole of this section. In the male, the pore, which contains the genitals, lies in the posterior extremity of the thick part where it forms a cloaca with the termination of the intestinal canal. The eggs, which are numerous, are oval, brownish, and with a glistening protuberance at each extremity, giving them the shape of a lemon. They have great vitality, hatching after repeated desiccation and freezing. Their development from the egg is slow. It is believed that the trichocephalus is produced directly from the egg, which has lodged in the intestine, and, therefore, does not have or require an intermediate stage of preparation in another animal. This parasite resides in the cæcum, but when many are present, some are found in the ascending colon, and occasionally a few are observed in the small intestine.

The tænia is rare in early life, but cases now and then occur. I have met very few cases in this city under the age of five years. Rosen and Bremser report cases between the ages of six and eleven years, and Hufeland one at the age of six months. Wawruch collected 206 observations of tænia, in 22 of which the age was less than fifteen years; the youngest was a girl of three years. A most remarkable case of tænia is reported in the *Gazette Médicale* of Paris in 1837. M. Muller was called to treat a foster child five days old for slight constipation. The bowels were evacuated by the use of rhubarb, manna, and a few grains of salt, and in the excrement a foot and a half of tænia were discovered. This worm had evidently existed during the fœtal life of the infant.

A similar case was treated by Prof. Skene, in the Long Island Hospital, in September, 1871, and reported by Dr. Armor, in the *New York Medical Journal*. The infant was born September 3d, of a hearty Irish servant girl. On the 7th it refused to nurse, and was observed to have a mild form of tetanus. On the 8th small doses of calomel having been given, followed by castor oil, two segments of a tænia solium were passed from the bowels, and on subsequent days ten more segments, after which the tetanus ceased. The remedies employed after September 8th were the oil of male fern and turpentine. The mother, who had presented no symptoms of tænia, was ordered an emulsion of pumpkin-seeds, which "she faithfully took for twenty-four hours, at the end of which she passed over seventy segments of tænia." This case is interesting as throwing light on a possible mode of the production of tænia, quite different from the ordinary and recognized mode, and also as showing the causative relation of intestinal worms to tetanus infantum.

Causes.—It is obvious that intestinal worms are developed from eggs or embryo, which are introduced into the stomach in the ingesta. The eggs of the ascaris lumbricoides have been found by Mosler in drinking water (*Virchow's Arch.*, 1860), but it is probable that in most instances they are contained in fruits and vegetables which are eaten raw. The eggs of the oxyuris vermicularis are received from some one who is himself affected with the disease. Both Zenker and Heller state that they have frequently discovered ripe eggs of this worm around the nails of persons who were troubled with oxyurides, a fact readily explained from the itching which they cause. If these eggs are upon the fingers of the mother or nurse, it is easy to understand how they are acquired by the child. We can understand also why this worm is so common in degraded and filthy families. In reference to the etiology of the tape-worm nothing need be added to what has been stated above, and little is known in reference to the manner in which the eggs of the tricocephalus are received.

Certain conditions of the intestinal surface favor the occurrence of worms. Thus children in advanced typhoid fever are not unfrequently affected with the ascaris lumbricoides.

Symptoms of the Ascaris Lumbricoides.—These are in part constitutional and in part local, due to the mechanical effect of the entozoa on the coats of the intestines. Writers, especially Rilliet and Barthez, have described the symptoms supposed to indicate lumbrici with minuteness. Those of a constitutional character are the following: Features at one time flushed, at another pallid, and in some children of a leaden hue; lower eyelids swollen, and sometimes surrounded by a blue semicircle; thirst, nausea, or even vomiting; appetite diminished or augmented, or variable; breath foul; papillæ of the tongue red and projecting; pulse accelerated and irregular. Rilliet and Barthez state that they observed this irregularity in a boy three years old, at the time he was passing a large number of lumbrici. The irregularity afterwards disappeared. Acceleration of the pulse is one of the most common symptoms of these worms. The popular idea of "worm fever" has indeed a foundation in fact. This fever is often remittent and mild, but occasionally it is continuous and of a high grade.

The symptoms pertaining to the nervous system are important. In mild cases they may be absent, as when there are few lumbrici, and the child is robust, and over the age of five years, but in severe cases more or fewer of these symptoms are commonly present. They are dilatation of the pupils, especially inequality of dilatation, to which Munro attached diagnostic value; strabismus, twitching of the muscles, clonic convulsions, somnolence, headache, neuralgic pains, delirium. Rarely chorea, deafness, and paralysis, it is believed, may result. (M. Bouchut, *Gaz. des Hôpitaux*, 1867.) In the *Amer. Journ. of Med. Sci.* for July, 1869, Dr. Leedom, of Montgomery County, Pa., relates the case of a boy of seven

years, who had night-blindness due to a large number of lumbrici in the intestines. By the employment of pinkroot and calomel these were expelled, and the blindness ceased. Hyperæsthesia of the abdominal surface was present in a case which I attended, and which subsided as soon as the lumbrici were expelled. Grinding the teeth in sleep, and picking the nostrils, are symptoms to which families attach great value. Observations, however, show that, though sometimes due to worms, they more frequently have another cause.

The local symptoms or disorders, in other words, those having a mechanical origin, are colicky pains, experienced chiefly in the umbilical region; stools sometimes natural; in other cases diarrhœa with fecal or muco-sanguineous stools; flatulence. M. Davaine, at a recent period, made the important discovery that the feces of patients affected with worms contain the ova of the particular species present, in large numbers. These ova, which have been described above, can be seen through a lens magnifying 150 diameters.

In exceptional cases, there are local symptoms due to the presence of worms in unusual situations, such as a crawling sensation in the œsophagus; a sense of constriction in this tube or the pharynx; nausea and vomiting; a cough, especially if the worm has crawled to the upper part of the œsophagus; rarely the most urgent dyspnœa, and probable suffocation, if a lumbricus has entered the larynx. Earache, and perhaps convulsions if the worm has entered the Eustachian tube (Case Davaine, p. 144). The most dangerous symptoms indeed arise from the fondness which this worm exhibits of crawling through narrow openings.

The enteritis and colitis, to which these worms sometimes give rise, is ordinarily mild, but in rare instances ulceration occurs, which may be attended by profuse and even fatal hemorrhage. Occasionally very painful and dangerous constipation results from an accumulation of worms, in a ball or mass too large to be expelled, unless with much delay and suffering, preventing the passage of fecal matter, and producing severe abdominal pains. The symptoms in these cases resemble closely those of intussusception. A marked example of constipation produced in this way occurred in a family with whom I am acquainted, and who then resided in the interior of this State. A little girl of three or four years was suddenly affected with obstinate constipation. The physicians prescribed active purgatives, calomel among others, and finally croton oil, and various injections, without relief. There was great pain with distension of the abdomen, and death seemed inevitable, when, after the lapse of several days, a free evacuation occurred, and in the stool was a mass of worms firmly intertwined.

Children often have lumbrici without any appreciable impairment of the general health, but their presence may intensify the symptoms of intercurrent diseases, and greatly increase the danger. Thus I recollect

two children of three and three and a half years, with pneumonitis, who, at the same time, had lumbrici, one passing in the course of a few days thirty and the other twelve of these entozoa. Both presented well-marked physical signs of pneumonitis, and, though they recovered, the febrile movement and nervous symptoms were apparently aggravated by the intestinal affection. One had convulsions in the commencement of the inflammation, followed by profound stupor and amaurosis, lasting two or three days.

Often the symptoms due to lumbrici coexist with those of a protracted and distinct intestinal disease. Thus, as we have seen, the intestinal secretions of typhoid fever and of chronic diarrhœal maladies afford a nidus for the growth of worms, and accordingly, at an advanced stage of these diseases, lumbrici are common.

These symptoms produced by the *oxyuris vermicularis* are somewhat different. These worms do not usually cause the fever, disturbed digestion, the colicky pains, or the dangerous nervous symptoms which arise from the presence of lumbrici. Nor do they, like lumbrici, endanger life by crawling into unusual situations. In one recent case, I could detect no other cause of chorea than the presence of oxyurides, and eclampsia has been attributed to them, but such a result is exceptional, if, indeed, the cause is rightly assigned.

Although the cæcum is the chosen abode of this worm, and here more than elsewhere it exists in its normal state, it is not certain that it produces any appreciable symptoms in this part of the intestinal tract.

The symptoms which render this the most annoying of all the intestinal parasites are produced by those oxyurides, chiefly the females, which descend into the rectum, where by their active movements they produce intense itching. A small number of worms cause little inconvenience, but when many are present in the folds of the rectum, their crawling produces such intense pruritus that the patient can with difficulty remain quiet. Usually this symptom is most marked in the early evening, when the child is warm in bed. It sometimes causes onanism in the girl as well as boy. This symptom may be nearly or quite absent during the day, but return so regularly at night as to resemble and be mistaken for a periodical nervous affection. So eminent a physician as Cruveilhier confesses that he has made this mistake of diagnosis. In the female child the oxyuris occasionally passes from the rectum to the vulva, producing leucorrhœa.

In many instances tape-worms exist in children as well as adults, who thrive and present no symptoms, but in other instances there is more or less disturbance of the digestive function, with an uncomfortable sensation in the abdomen. This sensation is more noticed after fasting, or after the use of certain kinds of food, and it is diminished by a full meal. Great hunger and a feeling of faintness are also common according to authorities, but I have not particularly remarked this in children. Irregular action of

the bowels, vomiting, and various nervous symptoms, as itching of the nostrils and anus, headache, tinnitus aurium, cardialgia, numbness, deafness, blindness, etc., have with more or less correctness been attributed to the tape-worm. Certainly such symptoms occasionally arise from this cause, for they cease with the expulsion of the worm (see case of Chorea, *Medico-Chir. Rev.*, January, 1868). Since the cysticercus cellulosæ is the embryonic form of the tænia solium, it is quite possible that individuals possessing the latter may be infected from its ova with the former, so that symptoms which have been attributed to the intestinal parasite, have sometimes been due to the encysted embryo. We are unacquainted with the symptoms of the trichocephalus if any occur, and this worm is very rare in children.

Diagnosis.—Bremser long since made the remark, and it has been repeated by most writers on diseases of children, that there is no sign or symptom which affords positive proof of the presence of intestinal worms, except the expulsion of one or more. Late microscopic investigations have revealed, however, a pathognomonic sign, namely the presence of ova in the feces, which indicate not only the nature of the disease, but the species of the worm.

The symptoms and disorders produced by lumbrici may all occur from other causes. Still, if several of them are present, and a careful examination discloses no other cause, the presence of worms should be suspected, provided the child is over the age of two years. The microscope may then be used for diagnosis. A little tentative treatment, entirely safe to the child, will also determine whether the suspicion is correct. One or two doses of medicine, administered under such circumstances, like the surgeon's exploring needle, may reveal the nature of the disease, and indicate the means of cure.

In case of the oxyuris vermicularis, the itching directs attention to the anus as the place of the disease, and here the offending entozoa may often be discovered by the eye.

Prognosis.—Intestinal worms produce a fatal result in only a small proportion of cases. Oxyurides never prove fatal, unless in rare instances, through convulsions. The manner in which death may be produced by lumbrici has already been pointed out.

In general, when the nature of the disease is ascertained, the worms are readily expelled by treatment, and the patient restored to health. If then there is no complicating disease, the prognosis is good.

Treatment.—Much injury has been done to children by the use of anthelmintics occasionally employed by physicians, but oftener by parents before the physician is called. Medicines of this kind are usually irritants, and, in many of those diseases which simulate the verminous affection, but are distinct from it, there is already an irritated if not an inflamed state of the intestinal mucous surface.

Vermifuges administered under such circumstances obviously do harm, and in all acute diseases in which they are not required, even if their action is harmless, their employment is to be regretted, since it consumes time which is very precious. It is thus that many lives are lost by the use of anthelmintic nostrums, which are extensively advertised and which command a ready sale, inasmuch as the belief in the presence of worms as a frequent cause of disease pervades all classes.

A safe rule, followed by many physicians, and it would be much better if it were general, is not to give anthelmintics unless the child has passed one or more worms, or their ova are found in the feces, and not then if the symptoms seem to be referable to a coexisting disease. In doubtful cases in which the symptoms resemble those of worms, a purgative dose of calomel or calomel and rhubarb may be employed. It will generally bring away one or more lumbrici or a mass of ascaris vermicularis, if either species of entozoa is present. This purgative may be safely employed if there is no previous diarrhœa or debility. If after one two doses and a free purgation no worms are passed, anthelmintic remedies should not be given, for it is almost certain that no worms exist.

A large number of medicines have, or have had, a reputation as anthelmintics. Santonin, the active principle of the European wormseed, is one of the best, and is much employed in this country and in Europe. It is nearly tasteless; it may be given in powder, spread on bread with the butter. It is kept in shops in one or two-grain lozenges, with and without calomel. It has the advantage of easy administration, and is destructive to both the round- and thread-worm. M. Bouchut considers it preferable to all other remedies in the treatment of the round-worm. "To children two years of age he administers it in doses of ten centigrammes (2.30 grains), and in patients above this age the quantity is increased by five centigrammes (1.15 grains) for every additional year." He gives in addition occasional doses of calomel or castor oil. In this country santonin is usually administered in one to three-grain doses, two or three times daily, with an occasional purgative. The purgative is required to aid not only in the expulsion of the worm, but also of the ova. In overdoses santonin causes vomiting, diarrhœa, and altered vision, so that objects appear yellow, but in medicinal doses it produces no unpleasant consequences. Other medicines are preferable if there are symptoms of enteritis. For many years the anthelmintic most employed in this country was the pinkroot, the root of the *Spigelia marilandica*, an indigenous plant. It was not only prescribed by physicians, but employed by families as a domestic remedy. It is apt to cause, if the dose is large, cerebral symptoms, as vertigo, dimness of sight, spasm of the facial muscles, stupor, and even convulsions. These effects less frequently occur if the pinkroot is given with a purgative, and it has been customary to administer it in combination with senna

in an infusion. A half ounce of spigelia with an equal quantity of senna is macerated for two hours in a pint of boiling water, and then strained. For a child two or three years old the dose is half an ounce to one ounce. So popular has this vermifuge been in this country, that probably a majority of the native-born adults in the States recollect the nauseating doses of pinkroot administered by anxious parents. Pharmacy now provides us with the same medicine in a more convenient and acceptable form, that of the fluid extracts :—

℞. Fluid ext. spigel., f℥j ;
Fluid ext. sennæ, f℥ss. Misce.
One teaspoonful to a child from three to five years.

The officinal fluid extract of spigelia and senna may be given in the same dose. Professor Procter recommended the addition of santonin to this extract :—

℞. Fluid ext. spigel. et sennæ, f℥j ;
Santonin, gr. viij. Misce.

This is probably the best anthelmintic that can be employed for the destruction of the round-worm in uncomplicated cases, and it is also very useful in treating the ascaris vermicularis. Chenopodium is also a good anthelmintic. It is efficient, and at the same time one of the safest in case the mucous membrane is inflamed. If there is abdominal tenderness, with stools too frequent, and thin, or mucous, and tinged with blood, I should prefer the chenopodium to most of the other vermifuges. To a child of three years five drops of the oil may be given three times daily. It may be continued for a longer period than would be safe for most of the other vermifuges. Twice a week, during its use, a mild purgative should be given, as castor oil, rhubarb, or magnesia, unless the bowels are open. It may be given dropped on sugar, or in a mucilaginous mixture.

Dr. J. F. Meigs says: I myself rarely give any other remedy than *wormseed oil* in slight and especially in doubtful cases, unless this has already been tried and failed. From my own experience, I believe that this remedy is all-sufficient in a large majority of the cases that occur in this city, as these are almost always of a mild character, and as it not only produces the expulsion of the parasites when they exist, but also acts beneficially upon the forms of digestive irritation which simulate so closely the symptoms produced by worms. I am persuaded, indeed, that of all the cases that have come under my notice, in which it seemed probable that worms might be present, none were expelled in nearly half, and yet the signs of disturbed health have passed away under the use of the remedy." . . . . "The following is a very good formula for the administration of this remedy :—

"℞. Ol. chenopodii, gtt. lx vel ʒj ;
P. g. acaciæ, ʒij ;
Syrup. simplic., ℥j ;
Aq. cinnamom., ℥ij. Misce.

"Give a desertspoonful three times a day for three days, and repeat after several days."

In cases of protracted intestinal disease attended by an increased and vitiated secretion from the mucous surface, a state which often gives rise to worms, turpentine is one of the best anthelmintics. In fact, in some of these cases there is no good substitute for it. For example, a boy of about ten years, attended by myself, October, 1864, had reached or nearly reached the fourth week of typhoid fever, when he passed from his bowels a large quantity of blood. He was previously emaciated and weak, and there had been, as is usual in such cases, considerable diarrhœa. The hemorrhage was attended with great prostration, from which, however, he partially rallied by the use of stimulants. On the following day an equally severe hemorrhage occurred, attended with coldness of the face and extremities and great feebleness of pulse, so that death appeared imminent. Turpentine was now administered every six hours, a few lumbrici were passed, and the case thenceforth progressed favorably. The mechanical effect of the lumbrici on the ulcerated surface of intestine had probably given rise to the hemorrhage. Turpentine may be given in doses of from five to ten minims three times daily to a child five years old. Sweetened milk or sugar in powder is a good vehicle for it, or it may be given in a mucilaginous mixture.

℞. Spts. terebinth. rect., ʒij ;
Ol. limonis, gtt. v ;
Mucil. gum acac.,
Syr. simplic., āā ʒvj ;
Aq. anisi, ℥j. Misce.
Dose, one teaspoonful every six hours.

The following formula for the employment of this agent is recommended by Dr. Condie :—

℞. Mucil. gum acac., ℥ij ;
Sacch. alb., ʒx ;
Spir. æther. nitr., ʒiij ;
Spir. terebinth. rect., ʒiij ;
Magnes. calcinat., ℈j ;
Aquæ menthæ, ℥j. Misce.

It is useless to enumerate the many anthelmintic mixtures which have been extolled from time to time. Those mentioned above are the least nauseous, and will rarely disappoint the practitioner. One other antidote for the round-worm should be mentioned, as it has been much used and is efficient, namely, cowhage. This consist of the bristles which cover the pods of the *Mucuna pruriens*, a tropical plant. The pods are dipped in

plain syrup of the ordinary consistence, and the bristles are scraped off with the syrup. When enough of the medicine is added to render the syrup of the consistence of thick honey, it is ready for use. The dose is a teaspoonful every morning for three days, after which a cathartic should be administered. I have never prescribed cowhage, although it is not unfrequently ordered by physicians, and a popular nostrum consists chiefly of it.

One affected with tape-worm is obviously cured only when the head of the parasite is expelled; but, in the majority of cases which I have observed, the head has not been found in the evacuations, even when the treatment had effected a complete cure, as shown by the subsequent history. The chain of expelled segments commonly terminated very near the head. This I believe is the common experience if we trust the friends of the patient with the examination of the stools. The physician himself should search for the worm's head, the evacuations being preserved, the nurse being directed to add a little carbolic or salicylic acid, and a sufficient quantity of water to nearly fill the vessel. The liquid should not be roughly stirred with a stick, as physicians are in the habit of doing, since this breaks the worm into small portions, and renders the inspection more difficult, but it should be shaken frequently so as to detach the segments and head if, it be present, from the fecal matter. After it has stood at least five to ten minutes, the worm, which has greater specific gravity than water, sinks to the bottom, and the upper part should be poured off. This process must be repeated till the water is nearly colorless, after which search should be made for the fragments, and the head, if present, will be found.

Since entire expulsion of the tape-worm is effected with difficulty, preparatory treatment for about forty-eight hours should be employed before the vermifuge is administered. During this time the patient should take a mild purgative once or twice, and such food, in moderate quantity, should be allowed as leaves little residuum, as beef-tea, milk, etc., with some stimulant, if the patient feels exhausted. There are three articles of food which experience has shown to be especially useful in this preparatory treatment, perhaps from a sickening effect which they produce upon the worm, namely, salt herrings, onions, and garlic. These may therefore be taken as food in the twelve or eighteen hours preceding the employment of the vermifuge, which it is ordinarily most convenient to administer in the morning.

The various tænicides recommended in the books are probably all more or less efficient, but the one which has given most satisfaction in the Outdoor Department at Bellevue, where probably a larger number of these cases is treated than in any other place in this country, is the oil of male fern, but it is found necessary to employ a larger dose than is recommended in some of the books. For a child of six years the dose employed is one to two drachms in any convenient vehicle, as the syrupus aurantii florum.

This should be followed in about four hours by a dose of castor oil, which completes the treatment. Heller, a very high German authority, recommends koosso or its active principle koossin, in the use of which I have had no personal experience. The pumpkin-seed has also been employed at Bellevue and in other parts of this city, but it seems to be less efficient than the oil of the fern. If the chain of segments break near the head, and the head is not seen, it will be necessary to wait two or three months in order to determine whether the cure is complete.

Since the symptoms produced by the *oxyuris vermicularis* are referable chiefly to the rectum, and are caused by the active movements of the worm, the prompt and thorough use of enemata, which causes their expulsion, is evidently required. Enemata are more effectual if used cool than if warm, and since this worm inhabits the cæcum as well as rectum, large enemata given through a long tube or a large catheter are more effectual, causing the expulsion of a larger number of worms than are expelled by small enemata employed in the usual manner. Various substances have been used for this purpose, as lime-water, table salt in water, turpentine in milk, decoction of aloe, decoction of garlic, etc. Heller says: "Simple water would do well for this purpose, for in a short time it causes the worm to swell up and burst; but that is not altogether without an injurious effect on the intestinal mucous membrane. Hence, Vix recommends a solution of castile soap in distilled water, or rain water, of the strength of one to two and a half grains to the ounce. This has no unpleasant action on the intestinal mucous membrane, while at the same time it quickly destroys both the worm and their eggs. . . . . Vix has tested all the medicines usually used in enemata, and has found the above solution of castile soap to be the most effectual." The use of the enema in the evening, although a small quantity of liquid is used so as to wash out the rectum, insures relief from the itching and sleeplessness during the night.

But it is undeniable that enemata alone do not effect a complete and permanent cure in a large proportion of cases, and hence those affected with this worm remain sufferers for years, having only a temporary respite, unless medicines are administered by the mouth. Those medicines which produce free watery evacuations appear to be the most effectual in dislodging and expelling oxyurides whose attachment to the intestinal surface is not strong; therefore Heller recommends the saline purgatives "joined with copious draughts of water."

CHAPTER XII.

GASTRO-INTESTINAL HEMORRHAGE.

Hemorrhage from the capillaries is more frequent in infancy than at any other period of life, whether in consequence of the irregularity of the circulation and frequent congestions in the infant, or the greater delicacy and feebleness of the minute vessels at this age. Hemorrhage, generally capillary, from the gastro-intestinal mucous surface, occurs sufficiently often in the child, and especially in the infant, to render it a disease of some importance. It is more frequently the younger the individual.

This hemorrhage occurs in three distinct pathological states: first, in the newborn infant from causes not fully ascertained; secondly, from a pathological state of the blood or the vessels in which it circulates, and which is often connected with purpura hæmorrhagica; thirdly, from a local cause.

First Variety.—In 49 cases, which I have collected from different writers, the hemorrhage occurred in 38 under the age of six days, in 5 from six to ten days, and in 6 from ten to twenty days. Some authors cite cases which occurred at the age of several weeks, but hemorrhage into the intestines at so late a period cannot be due to any cause operating at birth, and it is proper to consider such as examples of one of the other varieties.

Passive congestion of the gastro-intestinal mucous membrane is not infrequent in the newborn. Billard speaks of twenty-five cases without hemorrhage which he has examined. This anatomical state of the mucous membrane of the intestines, whether occurring as part of a general plethora or being simply a local affection with no hyperæmia of other parts, evidently requires only a certain increase and hemorrhage inevitably results.

The cause of the abnormal congestion of the gastro-intestinal mucous membrane, so common in the newborn, has been referred by writers to the previous health of the parents, to circumstances attending the birth, especially to too speedy a ligature of the cord, to irritant matters in the intestines, to external violence, and to the two opposite extremes, namely, a plethoric and a feeble state. In my opinion, the chief cause, in many cases, is the tardy or incomplete establishment of the respiratory and circulatory functions, which gives rise to congestion in the cavities of the heart and in the lungs, and, consequently, in the capillaries of the systemic system. Evidently, this congestion is most intense in the full-blooded. Billard says of fifteen cases of intestinal hemorrhage which he

examined, most of them were remarkable for the plethoric condition of their bodies and the general congestion of their integuments. Some, on the contrary, were pale and feeble, as is common after abundant hemorrhage.

In two infants who died soon after birth, and whose bodies I subsequently examined, there was apparently a plethoric state, which rendered a fatal result more certain, if it did not, indeed, produce it. In *one* of these, in addition to intense general congestion, meningeal apoplexy had occurred, although the birth of the child had been easy.

It is not difficult to understand in what way too speedy a ligature of the cord may be a cause of capillary congestion and hemorrhage. At the moment of birth, the uterus is contracted, the placenta compressed, and, if the cord is now tied, more blood remains in the vessels of the infant than if tied a little later. A little later, in consequence of the temporary cessation of uterine contractions, and the re-establishment of circulation in the infant, blood flows through the cord towards the placenta. The cord thus acts as a safety valve to the circulation. Any accoucheur who will take pains to witness the effect on the cord of the return of circulation, will observe what I have stated. Too speedy a ligature of the cord would not, however, be sufficient in the majority of cases to produce that amount of plethora which would give rise to intestinal hemorrhage without other co-operating causes.

Tardy or incomplete establishment of respiration and circulation, which gives rise to intestinal congestion and hemorrhage, may be due to disease of the heart or lungs, as atelectasis or cyanosis, to feebleness of the infant, or to slow and difficult birth. In a large proportion of cases, however, the birth is easy. Thus, three of five patients with intestinal hemorrhage, who were treated by M. Gendrin, were born of an easy labor, and the same was true of four infants observed by M. Kiwisch.

Although gastro-intestinal hemorrhage in the newborn apparently results in certain instances from the conditions mentioned above, which produce congestion of the gastro-intestinal mucous surface, there are other cases in which the cause must be different. Dr. Silverman, of Breslau, has recently published the statistics of 42 cases (*Jahr. für Kinderk.*, Sept. 1877), 23 of which were fatal. In 25 of these the blood escaped both from the mouth and anus, in 10 from the anus alone, and in 7 from the mouth alone. The hemorrhage, in a majority of the cases began in the second day after birth, but in 11 it began on the first day, and in all prior to the eighth. It is suggested that the hemorrhage, in certain instances at least, occurs from an ulcer in the gastro-intestinal surface, which is produced by an embolus in the umbilical vein, or its branches, or by suspension or incomplete establishment of the respiratory function in consequence of accidents of birth, atelectasis, etc. Ebstein, according to Silvermann, has demonstrated experimentally that the suspension of respiration in

animals produces congestion, extravasation of blood, ulceration in the stomach. From the fœtal anatomy, it is evident that an embolus occurring in the umbilical vein near the liver, and extending into the branches of the vein would be likely to cause congestion of the intestines by obstructing the portal circulation.

Dr. Lederer states (*Zeitung für Kinderk.*, Nov. 1877) that he has treated eight newborn infants for this disease, five of which died from the severe gastric and intestinal hemorrhage, accompanied also by umbilical hemorrhage. The age of the youngest was six hours. That of the oldest eleven days. They were all well-developed; of normal conformation, and were nourished with breast-milk. In the three who were cured, the hemorrhage was arrested in twenty-four hours, but there was for a long time a tendency to intestinal catarrh. Dr. Lederer admits the obscurity of the cause, but does not think that it was an embolism in all the cases.

The *second* variety of gastro-intestinal hemorrhage often occurs as a sequel of other and debilitating diseases. I have known it to occur as a sequel of measles, smallpox, scarlet fever, and in one case of typhoid fever. One of these patients, when apparently the period of danger was passed, began to lose blood from nearly all the mucous surfaces, from the nostrils and gums, as well as intestines, and the case, which but for the hemorrhage would doubtless have had a favorable issue, terminated fatally in less than a week.

Patients with this variety of gastro-intestinal hemorrhage sometimes present the maculæ of purpura, and commonly their aspect is pallid and cachectic. The following was a fatal case of hemorrhage occurring from the ileum, in a mild form of purpura hæmorrhagica:—

Case.—An infant, eight months old, of healthy parentage, nursing, with no previous sickness, and fleshy, vomited a small quantity of blood on the 25th of March, 1865; soon after it passed a stool consisting of almost pure blood. On the following day five or six patches of purpura hæmorrhagica were observed on the arms and legs. These maculæ continued till death. There was no more hæmatemesis, but the stools, which were from two to four daily, consisted largely of blood. Death occurred from exhaustion on March 31st.

Sectio Cadaver.—Head not examined; thoracic organs healthy, but pale; liver fatty; stomach, upper part of small intestines, and entire colon of normal appearance, unless presenting a somewhat lighter color than the healthy intestine from deficiency of blood; mucous membrane in the ileum to the extent of several inches, intensely injected without thickening. The blood had obviously escaped from this portion of the intestine, and a moderate amount of this fluid was found in the tube below the point of vascularity. This case is interesting not only on account of the development of purpura hæmorrhagica, but the subsequent intestinal hemorrhage in a nursing child, apparently of healthy parentage, and without previous sickness.

In our remarks on internal convulsions, the case is related of a scrofulous infant who, to all appearance in her ordinary health, suddenly be-

came affected with intestinal hemorrhage in connection with external and internal convulsions. A point of interest in this case was the relation of the hemorrhage to the neurosis. In one of the three cases of intestinal hemorrhage described by West, there were also convulsions. In rare instances there is an hereditary hemorrhagic diathesis to which the hemorrhage is attributable. In the *New York Journal of Medicine and Surgery*, July, 1840, Prof. Swett relates the history of a hemorrhagic family. Seventeen out of eighteen children of this family had died of hemorrhages, and the survivor had had intestinal hemorrhage with epistaxis.

In the *third* variety, among the local causes producing hemorrhage may be mentioned ulceration as in typhoid fever, or in severe intestinal inflammation, the mechanical effect of solid substances, lumbrici, invagination, obstruction to the portal circulation, polypus of the rectum. Occasionally at the post-mortem examination of young infants I have found blood with mucus in the duodenum and jejunum, these portions of the intestines being at the same time intensely congested. In one case of protracted entero colitis occurring in the summer season, I found many small circular ulcers in the colon, nearly all containing points of extravasated blood. Such are the principal local causes of hemorrhage from the bowels. Ordinary colitis may also be considered a cause, although the amount of blood evacuated in this disease is commonly small.

Of the three forms of intestinal hemorrhage described above, that arising from local causes is most frequent, while that occurring from a purpuric or hæmorrhagic diathesis is least frequent. In rare cases fatal intestinal hemorrhage may occur in the newborn, and the blood be retained in the intestine, or if passed it may so closely resemble the meconium that its true nature is not discovered. Mr. Bednar relates the following case (*Krankheiten der Neugebornen*): "On the eleventh day after birth the boy's skin (then of a pale yellow color) diminished in warmth, the impulse of the heart became dull and prolonged, the respiratory murmur scarcely perceptible. The child lay almost motionless and slumbering. The day following the surface could scarcely be kept warm, and the little patient had to be aroused to suck. On the twentieth day after birth it died. The brain was found to be anæmic, the lungs plethoric, whilst blood was effused into the duodenum and stomach."

Intestinal is more frequent than gastric hemorrhage, and the flow, except when produced by a local cause, is usually from the small intestines. The blood, unless it comes from a point near the anus, as the rectum or descending colon, is commonly dark, and sometimes partially decomposed, emitting an offensive odor. Admixture of the blood with the intestinal secretions prevents coagulations of the fibrin.

Gastro-intestinal hemorrhage in itself produces few symptoms aside from the prostration which attends all hemorrhages. The disease with which it is associated may give rise to many and severe symptoms.

Prognosis.—The result in the first and second varieties is much more unfavorable than in the third. Many newborn infants affected with gastro-intestinal hemorrhage die, but some recover. Billard attended fifteen fatal cases. It is probable, however, that death in the first variety is often due more to some coexisting lesion, than to the intestinal hemorrhage. Meningeal apoplexy, and the incomplete establishment of the circulatory and respiratory functions, may both operate as direct causes of death in this variety.

In the second variety, also, a very guarded prognosis should be given; so great a change in the circulatory system as to cause rupture of the capillaries, or transudation of blood in the ordinary course of the circulation, is a serious state. When this hemorrhage occurs as a sequel of the eruptive fevers, or in purpura hæmorrhagica, the patient is more apt to die than recover.

In the third form of intestinal hemorrhage, the result depends on the nature of the cause, whether it is susceptible of removal. The majority of cases in this variety recover.

Treatment.—Billard recommends, as a means of preventing capillary congestion and hemorrhage in the newborn, to allow a little blood to escape from the umbilical cord before its ligation, if the establishment of respiration and circulation is difficult or incomplete. This relieves the hyperæmia of the internal organs and facilitates the flow of blood. After the commencement of internal hemorrhage and the appearance of bloody stools, the same may be done if plethora is indicated by the florid and robust appearance of the infant, and the cord is not too much shrivelled.

The treatment, both therapeutic and regimenal, of intestinal hemorrhage should vary according to the age and state of the infant, the profuseness of the hemorrhage, and the nature of the cause. Perfect quietude, in the recumbent position, is requisite in all severe cases. Derivation to the extremities should be procured in the young infant, by heated dry flannel or flannel wrung out of hot water; in the older infant, by the same, with the addition of mustard. The nursing infant should remain at the breast, being allowed, perhaps, in addition to the breast-milk, a little cool barley or gum-water. Spoon-fed infants should be given food of the blandest quality, in the liquid form and cool. This is the proper diet, whatever the age, in the commencement of the hemorrhage. If there is evidence of exhaustion, cool beef-tea, or essence, and alcoholic stimulants, are necessary. It has been advised, in certain forms of intestinal hemorrhage, to apply leeches over the abdomen or around the anus. This treatment would, in my opinion, rarely be useful, but, on the contrary, in most cases, injurious. Hemorrhage from a mucous surface, when once established, will generally quickly relieve the local hyperæmia, and leeching, unless very cautiously employed, would promote the prostration, in which the real danger in this

disease consists. On the other hand, moderate counter-irritation over the abdomen may be attended with real benefit as a derivative.

The therapeutic treatment consists mainly in the use of astringents. Of the mineral astringents, acetate of lead and nitrate of silver have been used, but the liquor ferri subsulphatis is preferable to all other astringents in hemorrhage from the stomach and upper part of the small intestine, but it is believed to be decomposed in its passage through the intestine, so that it has less astringent or styptic effect in the lower bowel than gallic acid. It may be given to a child five years of age, in doses of three or four drops, in sweetened water or in mucilage.

Astringent enemata are sometimes useful. M. Rilliet treated a case which recovered with enemata, each containing twelve grains of extract of rhatany, a strong decoction of the same astringent being applied externally to the abdomen. M. Bouchut recommends "cold water externally to the abdomen, internally by the mouth, or by enemata frequently repeated. These enemata should be composed of two or three large spoonfuls only. They may be rendered more active with three grains of tannin, or with seven grains of the extract of rhatany, or seven grains of catechu, or, lastly, with one grain of nitrate of silver. In this latter case, a small glass syringe and distilled water must be used, to avoid the premature decomposition of the medicine."

In the hemorrhage occurring in purpura, or after exhausting constitutional diseases, tonics should be given in addition to astringents. In chronic inflammatory disease of the intestinal mucous membrane, attended by a vitiated secretion of the follicles, the hemorrhage may be best treated by turpentine. I have elsewhere related two cases of recovery by the use of this agent, in one of which (typhoid fever) lumbrici were expelled. Ergot, from the contracting influence which it exerts on the arterioles, is also useful in many cases. It is especially useful in purpura hæmorrhagica.

If the hemorrhage is due to a local cause, as lumbrici or a rectal polypus, the treatment obviously should consist in the removal of this cause.

CHAPTER XIII.

INTUSSUSCEPTION.

Intussusception, or the passage of one portion of intestine into another, has long been known as an occasional accident. Hippocrates, though debarred from the study of morbid anatomy, appears to have had a pretty clear idea of this lesion, and he suggested a mode of treatment which has been employed till the present time.

Intussusception without Symptoms.

This is not properly a disease. It consists in a displacement without any other anatomical change. There is, therefore, no obstruction, inflammation, or even congestion present, and no symptoms. This form of invagination might ordinarily be reduced by the normal peristaltic and vermicular movements of the intestine.

Invagination of a portion of the small intestine into the part immediately below it is often observed at the post-mortem examination of young infants, who had presented no symptoms due to the displacement. The invaginated mass is usually from half an inch to two inches in length, and, as a rule, this accident is multiple. There may be ten or more distinct intussusceptions, at distances of a few inches from each other. The simple displacement is believed to occur ordinarily at or a short time prior to the moment of dissolution. It has been supposed to be most frequent in those who have died of cerebral or spasmodic diseases, but its occurrence is not unusual in other pathological states. I have often found it at the post-mortem examination of infants who have had subacute or chronic entero-colitis. Hevin states that he has seen it at the Salpétrière over three hundred times. Billard has seen it especially in infants who have been subject to constipation. Any irritant, mechanical or other, which disturbs the regular movements of the intestines, doubtless may produce it. It has been caused in the rabbit by irritating the anus.

It is not improbable that simple intussusception occasionally occurs temporarily in children whose health remains good, when the regular movements of their intestines are disturbed by irritating ingesta or other causes. This form of displacement never takes place in the large intestine. Its usual seat is the lower part of the jejunum, and upper part of the ileum. As it possesses little interest as regards pathology, and none whatever as regards symptomatology and therapeutics, it may be ignored in our description of intussusception.

Intussusception with Symptoms.

Intussusception, or invagination, is one of the most painful and dangerous of human maladies, but fortunately is not very frequent. I have the records of fifty-two cases occurring in children, from which records the facts contained in this section are chiefly derived. The patients were under the age of twelve years.

Previous Health.—In thirty-four of the fifty-two cases, the state of the health previously to the invagination was recorded. From the following table it is seen that half, or seventeen, were previously well, the remaining half suffering from some disease or derangement.

Age.	Previous Health.	
	Good.	Disease or Derangement.
One year or under	15	8
Over one year	2	9
	17	17

MM. Rilliet and Barthez, whose views in reference to intussusception are derived from the examination of the records of twenty-five cases, state that the previous health is ordinarily good, and the disease is, therefore, primitive. Their remark, according to the above statistics, is seen to be correct as regards patients under the age of one year, but incorrect for those over that age.

Most of the seventeen who had previous ill-health had diarrhœa, dysentery, or constipation, or diarrhœa alternating with constipation. Of those otherwise affected, one had thread-worms, two obscure abdominal pains, one nausea and vomiting, and one whose age was four months had had symptoms of invagination, when ten weeks old, which soon passed off. It is seen that the pre-existing affections were ordinarily such as would be likely to accelerate the movements of the intestines and at the same time render them irregular.

Causes.—The above statistics, therefore, show that intussusception is often preceded by disease or functional derangement of the intestines. The two opposite conditions, namely, constipation and the diarrhœal maladies, so often precede the displacement that they must be regarded as common causes. Another probable cause is intestinal worms, which, by their mechanical action stimulate the intestines. They were present in three of the fifty-two patients, though two of the three seemed well till the occurrence of the intussusception, but the other patient had complained of irritation at the anus, and ascarides had been found on examination.

The use of irritating and indigestible food is an occasional cause. Thus, some who have had intussusception have been in the habit of taking fruits, candies, and pastries freely. Such ingesta may be an immediate cause by their irritating effect, or a remote cause giving rise to diarrhœa, which, in turn, produces intussusception.

Sex is a predisposing cause, since male patients are largely in excess. Of the twenty-five cases collated by Rilliet and Barthez, all but three were boys. In our own collection, the sex of thirty-four of the patients was recorded, and of these twenty-three were boys.

In rare instances external violence is the apparent exciting cause. One patient received a severe contusion of the abdomen two years before death, and from this time continued to complain at intervals of pain in the bowels. One writer also mentions the case of a child nine years old who received a blow from a comrade at school, and from this time had alternately diarrhœa and constipation till the invagination commenced. Rilliet

and Barthez also relate the case of two children who were taken suddenly with invagination when their parents were tossing them in their arms.

Age.—Of the fifty-two cases embraced in our statistics, the ages were as follows :—

3	were	3	months	old.	1	was 10	months old.
12	"	4	"	"	1	" 11	" "
3	"	5	"	"	1	" 12	" "
5	"	6	"	"	2	were from 1 to	2 years old.
1	was	7	"	"	8	" " 2 "	5 " "
1	"	8	"	"	8	" " 5 "	12 " "
3	were	9	"	"	3	not given.	

There were, therefore, no cases under the age of three months, 23 cases between the ages of three and six months, or nearly one-half of the entire number, 8 from the age of six months to one year, and only 18 between the ages of one year and twelve. These statistics correspond, in the main, with those of Rilliet and Barthez, in whose collection of 25 cases there was no one under the age of four months. Leichtenstern says: "Half of all invaginations, according to my statistics of four hundred and seventy-three cases occur during the first ten years. The first year after the third month is remarkable for a special frequency—one-fourth of all intussusceptions." (*Ziemssen's Encyclop.*)

The great liability to intussusception in infancy is due partly to the anatomical character of the intestine in this period of life, and partly, doubtless, to the fact that there are more frequent irregularities in the intestinal movements than in older children. In the infant the walls of the intestines are thin, the mucous and muscular coats and the connective tissue being much less developed than in those that are older; the mesentery and meso-colon have also greater depth as compared with the same in other periods of life, except the meso-colon at the points where it passes over the kidneys, in which places it is very short, or even in some cases nearly absent. Moreover, the space occupied by the large intestine, in which part of the digestive tube intussusception commonly occurs, is much shorter relatively to the length of the intestine than in those that are older. In about thirty measurements, which I have made of the length of the large intestine and the space occupied by it, the latter was found, in the average, about one-third that of the former, which, of course, necessitates doubling of the intestine on itself. These peculiarities of structure in the infant obviously favor the occurrence of intussusception.

Seat and Pathological Anatomy.—While intussusception occurring without symptoms is usually multiple, that form which occurs with symptoms is ordinarily single. Two exceptional cases will be presently related. In one recorded case there was invagination with symptoms, and coexisting with it another in the small intestines apparently without symptoms, and quickly reduced by handling.

While intussusception without symptoms occurs in the small intestine, the seat of intussusception with symptoms is, with occasional exceptions, the colon. The colon constitutes the entire invaginated mass, or else, and more frequently, it forms the exterior, while the incarcerated portion consists wholly or in part of the ileum.

Intussusception in the Small Intestines.

Bouchut says: "M. Rilliet states, in a recent treatise, that in infancy the intestinal invagination is always accomplished at the expense of the large intestine, and that there is never invagination of the small intestine. This is incorrect. I have observed the small intestine invaginated in the adjacent inferior part. Taylor has reported a case of this kind in a child twenty months old, who died after an attack of acute peritonitis. M. Marage has seen another case in a child thirteen months old, who recovered after having voided the invaginated portion furnished with two of those diverticula so frequent in the small intestine of the fœtus."

But, from all that appears, the case reported by M. Marage may have been, and probably was, an example of the common form of intussusception, namely, of the ileum into the colon. In Mr. Taylor's case the invagination was really of the ileum into the colon, although a small portion of the ileum next to the valve had not been inverted, so that it constituted a little of the exterior of the mass.

Nevertheless, Bouchut is correct in stating that irreducible and fatal intussusception may occur in the small intestines. Probably the displacement is at first of the simple variety, but, continuing and increasing in extent, its return becomes impossible. The positive statement of so great an authority as M. Rilliet, that intussusception with symptoms does not occur in the small intestines, justifies the publication of the following cases, which establish the fact that there are instances, though not frequent, in which the displacement does have this location:—

Case I.—Male. This patient's health had been uniformly good, and nothing unusual was observed in his condition till the age of four and a half months, when he became restless as if in almost constant pain, with occasional exacerbations. Castor oil was prescribed, which operated freely, and then the following mixture:—

℞. Magnes. calcinat., ℈j;
Tinct. opii camphorat., ʒij;
Tinct. asafœt., ʒss;
Aq. anisi, ʒj. Misce.
Dose, ten to twenty drops, repeated according to the pain.

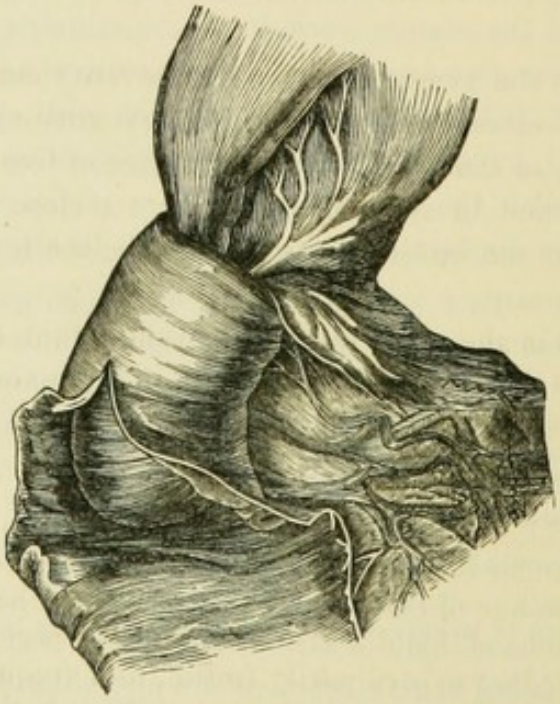
These remedies failed to give relief, as did also chloroform given in doses of two drops. After two or three days, another set of symptoms arose, those characteristic of pneumonitis, namely, hurried respiration, accelerated pulse, short, suppressed cough, and expiratory moan. He was treated with the oiled silk jacket, and mild counter-irritation, and took an

expectorant mixture containing carbonate of ammonia. In a few days the pulmonary disease was evidently subsiding, but the pain in the abdomen, with occasional exacerbations, continued. His countenance was pallid, and bore an expression of suffering. There was no distension or tenderness of abdomen, and no abdominal tumor. He took little nutriment, and seldom vomited. In the last part of his sickness the dejections were scanty, and the last three days his stools consisted mainly of mucus and a little blood. The pain seemed to be growing less, when he was seized with convulsions, and died the same day, precisely two weeks from the commencement of his sickness.

Sectio Cadaver.—Head not examined; body slightly emaciated; mucous membrane of trachea and bronchial tubes vascular; posterior portion of the lower lobe of each lung solid, of greater specific gravity than water, and allowing only partial inflation; it was in the second stage of pneumonitis. Stomach, duodenum, jejunum, healthy. In the upper part of the ileum was an intussusception two-thirds of an inch long, presenting no trace of inflammation, either within or around it, and its vascularity, when it was examined externally, did not seem notably increased. Above the intussusception the intestine was empty; below it, and chiefly in the small intestine, was a dark-colored substance evidently blood, and giving in a few hours the offensive odor of decaying animal matter. There was a passage through the intussusception, at least two or three lines in diameter, as shown by a probe. The intussusception sustained the weight of sixteen inches of the intestine, and it would apparently have sustained considerably more. The remaining organs were healthy.

Case II.—F. S., a female infant, four months old, was treated at the New York Infant Asylum in June and July, 1865, for entero-colitis, the

Fig. 25.



usual epidemic of the summer season. The following records show the state of the bowels immediately before her death :—

June 29th. Has five or six stools daily. 30th. Two stools in twenty-

four hours. July 1st. Had two stools since the last record; no vomiting. 3d. Four stools in last twenty-four hours. 4th. The diarrhœa continues as before; the stools about four daily. On the 6th of July she died.

Her pulse during the time in which these records were taken generally numbered about 128 per minute. She was much emaciated, and the day before death she frequently struck her head with the hand. The medicines employed were mainly alkalies and astringents.

Sectio Cadaver.—Parietal bones united; some serous effusion over the convolutions of the brain, under the arachnoid; occipital bone depressed; commencing at a point about two feet below the stomach were four intussusceptions two or three inches from each other. The invaginated masses were from one to one and a half inch in length, and three of them were found to be very vascular in their interior. Above, between, and immediately below the intussusceptions the intestine was healthy. One of the invaginations was tested by weight, and was found to sustain one and a half foot of intestine, and would have sustained more. Water poured above these intussusceptions escaped through them very slowly; no fibrinous exudation; descending colon vascular and thickened, and solitary glands enlarged.

The irreducible character of the intussusceptions in the above cases was shown by the fact that they sustained weights which doubtless produced greater traction than that exerted by the intestine in its normal action. That the displacement existed prior to the moment of death was shown by the symptoms in one of the cases and by the anatomical changes in both. In one the capillaries of the incarcerated mass were ruptured during the last days of life, so as to produce sanguineous stools; while in the other there was intense congestion of the invaginated mucous membrane, while that portion of this membrane which was adjacent but not engaged was healthy.

In both patients the symptoms were less severe than in ordinary cases, and they came on more gradually, for the invaginated intestine was not completely closed, so that it allowed the passage of fecal matter in one till the close of life, and in the other till near its close. At both of the autopsies water poured into the intestines above the invaginations passed slowly through them.

Intussusception in the small intestines in the infant, commencing as the simple form, may become irreducible, and yet remaining pervious may continue for weeks without giving rise to severe or dangerous symptoms. The following case was an example of this:—

Case.—Male child, died at the age of nineteen months, the last eleven of which he was under observation. The mother states that he had never been well since the age of one month, and that there had been little variation in the symptoms of his disease. During the period in which he was under observation, he was ordinarily fretful, and frequently seemed to be in considerable pain. His stomach through this whole time was so irritable, that he rarely took more than three or four spoonfuls of nutriment without vomiting. There was usually more or less diarrhœa, but no tenderness or distension of abdomen. He became slowly but gradually more emaciated,

and finally died in a state of extreme emaciation and exhaustion. He had no convulsions, and was conscious to the last.

Sectio Cadaver.—Brain not examined; lungs healthy, except a circumscribed portion, which was inflamed at the summit of the right lung; liver small and almost destitute of oily matter, as shown by the microscope. In the jejunum, about two feet below the stomach, was an intussusception two inches long, the intestine forming which seemed to have undergone no structural change. Above the intussusception the intestine was of small calibre, and entirely empty and pale; below the intussusception the intestine was somewhat larger than above, but it seemed quite healthy. The invagination was sufficiently pervious to allow water to pass through it, and it readily sustained the weight of two feet of intestine. From eight to ten inches below this intussusception there was another, which was immediately drawn out the moment the intestine was disturbed. The other abdominal viscera were healthy.

There is uncertainty as to the duration of intussusception in the above case, but the symptoms indicated that it existed a considerable time prior to death. There was no strangulation, nor indeed any appreciable anatomical alteration in the coats of the intestine, but the fact that the invaginated mass sustained two feet of intestine, and required considerable traction for its reduction, shows that it was not a case of simple displacement occurring at the moment of death and without symptoms, but was an example of the variety with symptoms.

Intussusception in Large Intestines.

In most cases of intussusception occurring in infancy and childhood, the ileum is invaginated in the colon, or the first part of the colon is invaginated in the part succeeding it. Intussusception not unfrequently begins in the prolapse of the ileum through the ileo-cæcal valve, in the same way that prolapse of the rectum occurs through the sphincter ani. If death take place early, only a small portion of the ileum may have passed the valve. If the case is protracted, the tenesmus brings down more and more of the ileum, with its accompanying mesentery. The constriction of the valve, which acts as a ligature, soon prevents the further descent of the ileum; and, the tenesmus continuing, the next step in the displacement is the inversion of the caput coli, which is drawn into the colon by the descending mass, and, unless the case terminate by sloughing or death, the ascending and transverse portions of the colon are successively invaginated. The records show that intussusception occurs as above stated in a large proportion of cases. In one case, among those which I have collated the intussusception began a few inches above the valve, so that the ileum constituted a small portion of the exterior of the mass. Occasionally the cæcum is the part primarily inverted and invaginated, and, descending along the colon, it draws after it the ileum, which sustains its natural relation to the ileo-cæcal valve. When this occurs the cæcum

is found at the lower end of the mass, and two orifices are observed, one leading through the valve, and the other into the appendix vermiformis. These two forms of invagination—that in which the ileum, passing through the ileo-cæcal valve, successively inverts and draws after it the caput coli and the divisions of the colon; and that in which the caput coli is primarily invaginated, and descending along the large intestines, inverts the latter, and draws after it the ileum—constitute the vast majority of cases of this disease in the first years of life.

I have notes of 45 fatal cases occurring under the age of twelve years, in which the portion of intestine first displaced is recorded. In four of these the displacement was entirely in the small intestine, involving in no way the colon; in 38 cases it commenced either by prolapse of the ileum through the ileo-cæcal valve, or by inversion of the cæcum into the ascending colon, there being perhaps not much difference in the relative frequency of these two modes; in one case the invagination was confined to a segment of the transverse colon, in another to a segment of the descending colon, and in the remaining case to the lower part of the descending colon and the upper part of the rectum. In three instances the invaginated mass itself became invaginated, producing an intussusception of great thickness and necessarily fatal.

As we have seen in regard to intussusception in the small intestines, so that occurring in the large intestine may be attended by so little constriction of the incarcerated portion that it remains pervious, though with diminished calibre. In such a case life may be protracted for weeks or even months, without reduction of the displacement or any material change in it, the passage of fecal matter being sufficiently free for the maintenance of life. Death finally occurs in a state of exhaustion. Thus in one instance a child, four months old, lived six weeks after the symptoms of invagination commenced, and seventeen days "with a portion of the bowel protruding from the anus." It was found at the post-mortem examination that part of the ileum had descended through the entire colon, and had remained pervious. In a case related by Dr. Worthington in the *Amer. Jour. of Med. Sci.* for January, 1849, there were symptoms of intussusception for seven months before death, and during the last six weeks of life, the invaginated intestine protruded frequently from the anus, and was replaced by the mother. In this case "the cæcum was inverted, and descended through the colon to the lower portion of the rectum, carrying with it the ileum and the entire colon, except the last ten or twelve inches." In another case the symptoms indicated a continuance of the disease for three, if not eight, months. But such cases are exceptional. Ordinarily as the intestine becomes invaginated, its mesentery or mesocolon is also invaginated, and its veins compressed. The pathological state of the incarcerated mass soon becomes that of intense congestion. In infants, usually in a few hours, so great is the distension of the capil-

laries that they give way, blood escapes into the intestine, and passes from the bowels in scanty motions. On examining the invaginated intestine after death, if gangrene has not occurred, it is found of a uniform intense red color, sometimes resembling to the naked eye a long and firm clot of blood. In those who die early there are no traces of inflammation, but in more protracted cases the attrition between the serous surfaces excites local peritonitis. But in none of the fifty-two cases which I have collated in which post-mortem examinations were made, did the inflammation extend more than a few lines beyond the invagination. Usually the intestine forming the exterior of the invaginated mass is much drawn together or puckered. In one case treated by myself, the entire large intestine which formed the exterior of the mass was compressed within a space of six inches or less, since about twelve inches of the ileum, doubled on itself, lay within the entire colon and protruded from the anus, the only part of the large intestine which was inverted being the caput coli. In one case six or seven inches of the ileum, which formed a portion of the exterior of the mass, were compressed within the space of one inch.

The abdomen, at first of natural fulness and soft, usually becomes more and more distended till the close of life; but in cases of much vomiting the distension is moderate. This fulness is due to gas and fecal accumulation above the invagination. The portion of intestine below the displacement is ordinarily empty, except that in the infant it commonly contains mucus, mixed with more or less blood, which has escaped from the capillaries of the strangulated mass.

There are few anatomical changes in this disease, which do not arise directly from the intussusception, and are, therefore, located either within the mass or in its immediate vicinity. In those who recover by the process of sloughing, the cicatricial contraction may give rise to symptoms and lesions of greater or less gravity. Thus the late Sir James Y. Simpson examined a child aged 9 years, who recovered with loss of ten inches of intestine, and at the meeting of the Medical Society, before which the specimen was presented, remarked that there was unusual distension of the cutaneous veins of the patient, due probably to such compression of the ascending vena cava by the cicatrix, that the venous circulation was obstructed. (*Trans. Medico-Chir. Soc.*, Edin.) In the *London Lancet* for 1854, Mr. Charles King relates the case of a child aged 6 years, who, on the eleventh day of the disease, voided the cæcum and a part of the colon. Two days subsequently pulsation ceased in the left leg, and all that part below the patella became gangrenous. The patient gradually recovered with loss of the leg. The cause of this unfortunate sequela was doubtless compression from the cicatricial contraction of the artery which supplied the leg, and probably the formation of a thrombus. In the *Lond. Med. and Phys. Jour.* for December 18th, 1823, Dr. F. Bush relates a case in which he was enabled to observe the extent and appearance of the cica-

trix. The patient, aged twelve years, discharged from the bowels fifteen to eighteen inches of the ileum on the eighth day of the intussusception, after which convalescence was rapid. Fourteen weeks later the child died from typhus fever, and at the autopsy "traces of the diseased bowels were visible by a contraction and puckering where the slough had taken place, and the parts united." But fortunately in most instances when the intestine sloughs and the child survives, no serious or permanent injury results from the cicatrization. The cicatrix stretches little by little, and accommodates itself to the surrounding parts.

Symptoms.—The symptoms vary according to the age of the patient and the degree of strangulation. Pain in the abdomen, usually paroxysmal, is among the first, and is one of the most conspicuous symptoms. It is often severe, resembling the pain of hernia, and abating only with the failing strength of the child. After the first few days, if inflammation arises, the pain is continuous, though more severe in paroxysm. At first pressure upon the abdomen is tolerated, but afterwards there is tenderness. This is due to the inflammation, which occurs in and around the invaginated mass, and it is, therefore, confined to the part of the abdomen in which the tumor lies. At this point also the abdomen is more full than elsewhere, and not unfrequently the physician can feel the invaginated mass and detect its exact location, and approximately its extent. Sometimes, at an early period as well as late, cerebral symptoms occur, as in a case related by Dr. Coggswell in the London *Lancet* for July, 1853, which terminated in convulsions and death on the second day. Convulsions are, however, comparatively rare, and the mind is generally clear till the last moment. In infants the countenance, in the intervals of pain, in the first stages of the complaint, is often placid and not indicative of any serious disease, but in older patients constant and severe local symptoms, referable to the intussusception, commence early. At an advanced period, whatever the age, the countenance becomes anxious and haggard, the eyes hollow or sunken, the body loses its plumpness, and, if the case is protracted, becomes emaciated.

Vomiting is rarely absent; in thirty-nine out of forty-seven cases it is stated to have been present; in seven cases there is no record of this symptom, while it is recorded absent in only one case; but in this case, the records of which are very meagre, death occurred on the second day. The vomiting becomes stercoraceous in a few days, and it ordinarily continues with greater or less frequency till the period of collapse. It relieves partially the distension.

The appetite is impaired and often entirely lost. Infants at the breast commonly nurse, however, for several days, probably from thirst rather than hunger.

There is commonly one natural evacuation from the bowels after the

intussusception commences, and then obstinate constipation succeeds. This evacuation consists of the excrementitious matter below the invagination. In children under the age of one year, scanty motions of blood mixed with mucus begin to occur in a few hours. In twenty-seven children under this age I find that twenty-four had such evacuations, occurring in most of them several times in the course of the day; in two of the twenty-seven there is no record of this symptom, but in the remaining case it is stated to have been absent. Scanty evacuations of blood unmixed with fecal matter have been considered pathognomonic of intussusception in the infant, and we see the ground for such belief; but in exceptional instances the invaginated mass is partly pervious, and although the dejections may contain blood they are also excrementitious. In our collection of cases are three examples of this in infants under the age of one year. One has already been referred to. In this case there was the rare anomaly of so large an opening through the ileo-cæcal valve, as to allow not only prolapse and descent of the ileum through the entire colon, so as to protrude six inches from the anus, but also fecal passages through it daily.

In children above the age of one year, the capillaries of the invaginated intestine are not so frequently ruptured as under this age, and sanguineous evacuations are therefore less common. I have records of nineteen cases between the ages of one year and twelve, in only six of which it is stated that there were bloody motions, and in these the blood was not passed frequently, nor even in some cases daily, as in infants, nor in so pure a state, unless in two cases, the records of which are not explicit on this point. Two of these six patients passed moderate bloody evacuations after protracted periods of constipation, one had fecal discharges with the blood through the entire sickness, and in one blood was passed at first, but finally the stools were entirely fecal.

In those above the age of one year, there was for the most part obstinate constipation, no dejections, whether bloody or fecal, occurring for several days, but there were a few exceptions. In three cases the bowels were relaxed. The ileum, in these three, had descended through the entire colon, or the larger part of the colon, and being pervious, the feces escaped from the anus without detention in the large intestine, or with detention only in its lower portions, and were therefore liquid.

Tenesmus is another symptom. It is not always present, but in a large proportion of cases, even when the invagination is in the upper part of the large intestine, it is a frequent and distressing symptom. It often does not commence till there is a considerable amount of displacement, and it ceases when the strength is much reduced.

The temperature of the surface is normal in the commencement of intussusception; but finally, as febrile reaction comes on symptomatic of

the inflammation, it rises and continues above the healthy standard till the intestine sloughs, or till the stage of collapse occurs which ushers in death. The pulse, especially in the infant, is tranquil at first, but, whatever the age, it soon becomes accelerated from the paroxysms of pain, and subsequently from the inflammation which occurs in the invaginated mass. There is no disturbance of respiration, except that it is somewhat hurried from the fever, and from the pain felt in advanced cases on full inspiration.

It will be seen that the symptoms vary in certain particulars, under the age of one year, from those occurring over that age, but differences in the symptoms depend more on the degree of invagination and constriction, than on the age and exact location of the disease.

Diagnosis.—The diagnosis of intussusception is not, in general, difficult, except at its commencement. When the inversion has reached that degree at which obstruction occurs, the symptoms are, in most cases, such that the disease can be readily diagnosticated. In the cases whose records I have collated a correct diagnosis was, with few exceptions, made, and at an early period. In the infant, the disease for which intussusception is most frequently mistaken is dysentery, on account of the tenesmus and the muco-sanguineous stools. In certain of the reported cases this mistake was not rectified until it was ascertained that purgatives produced no fecal evacuations.

The symptoms which are commonly present, and which indicate the nature of the disease, are obstinate constipation, vomiting, paroxysmal pain referred to the seat of the disease, and tenesmus. In the infant, also, scanty evacuations from the bowels of mucus and blood, or of pure blood, is, as we have seen, an important diagnostic sign. It should be borne in mind, however, that in exceptional cases the displaced bowel may remain pervious, and the usual symptoms which possess diagnostic value therefore be absent. There may be no vomiting or tenesmus, and there may even be diarrhœa in place of constipation, as in the cases related above. As an aid to diagnosis, it should be stated that whatever the age of the child affected with intussusception, clysters are often administered with difficulty, and are quickly and forcibly returned, on account of the resistance opposed by the invaginated mass. We have stated above that the seat and even extent of displacement can be ascertained in a large proportion of cases by digital examination of the abdominal walls. The tumor can be felt hard, elongated, and tender on pressure, so that the diagnosis is clear. If the invagination be in the lower part of the large intestine, it can sometimes be discovered by an examination per rectum.

Duration.—In the following table, the duration of the intussusception in forty-nine cases is given, as nearly as it can be ascertained from the records :—

2 died the 1st day.	1 died the 8th day.
6 " " 2d "	1 " " 10th "
14 " " 3d "	1 " " 14th "
2 " " 4th "	1 lived nearly a week.
5 " " 5th "	1 " 6 weeks.
2 " " 6th "	3, time of death not given.
2 " " 7th "	7 recovered.
1 lived over a week.	

In two of the three cases in which the duration is not stated, the patients lived much longer than the usual period. One of these two, a girl of six years, having eaten raw carrots, was seized with pain in the abdomen, which lasted eight months, when she died. During the last three months she passed mucus and blood. In this case the cæcum had descended to the anus, drawing with it the ileum, which remained pervious. The symptoms indicated the continuance of the invagination for three months if not eight. The other patient was a boy, aged 3 years and 4 months, who complained of pain in the abdomen for many months, and occasionally vomited. During the last six weeks of his life, all the phenomena of invagination were present. In this case also, the inverted caput coli had descended along the entire length of the colon, and it lay at the autopsy in the rectum.

In West's *Treatise on Diseases of Children* (fifth edition, 1866, page 504), it is stated that death in this complaint always occurs within a week. The above statistics, however, show that there are exceptions to this statement, although a large majority do die within the first seven days. In thirty-three of the cases embraced in my statistics death occurred within the first week, and in no fatal case in which strangulation was complete was life prolonged beyond the eighth day. In these cases of complete strangulation the average duration was 3.7 days, and the largest number of deaths occurred on the third day. Death on the first day is rare, but it occurred in two instances. When so early it is often, if not generally, in convulsions and coma.

Prognosis.—Intussusception is in its nature so grave an accident that the physician called to a case should always explain its gravity to the friends. But, while death is a common result, there are three different modes of termination in which life is preserved. First, the reduction of the incarcerated intestine, with immediate relief. There can be no doubt that it is possible for intussusception, when recent, to be reduced by the unaided action of the bowels, in the same way as the common, simple intussusception in the jejunum and ileum, or as hernia is reduced, through the vermicular action of the intestines. For sometimes, as in Dr. Coggswell's case (Lond. *Lancet*, July, 1853), the patients at some previous time have experienced the same symptoms as those which accompanied the attack, and which subsiding, they remained for a time in perfect health. This termination is probably rare, if the symptoms are sufficiently marked to necessitate treatment. Again, the intussusception may be cured by early

and well-applied treatment. The physician may succeed in reducing the displaced intestine, even if the intussusception is in the upper part of the colon.

A second mode of favorable termination is alluded to by certain foreign writers. The intussusception continues for a considerable period with the characteristic symptoms, and then, as Bouchut expresses it, "the vomitings gradually cease, the intestinal hemorrhage disappears, the strength returns, and the health becomes restored without the expulsion of fragments of the intestine." What changes the displaced intestine undergoes in these protracted cases, which gradually recover without sloughing, have not been clearly ascertained, although they have been the subject of conjecture. According to Rilliet, a large proportion of favorable cases terminate in this manner. It does not appear, however, from the statistics which I have collected, that this is the common mode of recovery. The clinical history of intussusception establishes the fact that in a large majority of protracted cases there is either death or the third mode of favorable termination, namely, by sloughing.

But we cannot reasonably expect recovery in young children through sloughing and the expulsion of the intestine; since few have the requisite strength for so tedious and exhaustive a process. The youngest child that recovered in this way, so far as I have been able to ascertain, was an infant thirteen months old, whose case was reported by M. Marage. With the exception of this case, the youngest was a boy, aged five years. The older the child, the greater, of course, the power of endurance, and the better the prospect of recovery. Of the fifty two cases whose records I have collated, seven recovered by the sloughing and expulsion of the mass. These children were of the ages of five, six, six, nine, eleven, twelve, and twelve years. The separation of the invaginated mass occurred in six of of these between the sixth and twelfth days, with an average of nine and a half days, the time not being given in one case. If, then, the patient can be carried through the first week without too much exhaustion, we may each day look for the discharge of the slough, the reopening of the bowels, and ultimate recovery.

But in those cases in which the intussusception remains open, so as to allow the passage of fecal matter, recovery is improbable unless the displacement is diagnosticated early and properly treated. If the intussusception continues, it becomes greater and greater from the absence of strangulation. Without inflammation and with little or no congestion of the displaced portion, and without the severe symptoms which occur in ordinary cases, the patient wastes away, having irregular evacuations and more or less abdominal pain, and finally dies in a state of emaciation and weakness. In the early stage of this form of displacement it is not improbable that injections or inflation, employed with sufficient force, will give relief, but, if the early period passes without such treatment, cure is

impossible by the ordinary methods. It is in such instances especially, to wit, those in which the displacement occurs without strangulation or inflammation, and in which fecal matter passes through the displaced mass more or less freely, that laparotomy is justifiable, and is likely to give relief, when injections and inflation have been employed in vain. Jonathan Hutchinson's successful performance of this operation in a child of two years, who had this kind of displacement, is known to most readers. (See London *Lancet*, November 22, 1873.)

The prognosis is most favorable when the displacement occurs in the lower part of the large intestine, for its reduction is then comparatively easy. An interesting case of this kind was observed and treated by Drs. O'Dwyer, Reid, and myself, in the New York Foundling Asylum, in 1875. The child was a female, aged two years, and had had previous good health. The invaginated mass protruded like a prolapse, about four inches outside of the anus. It was cold, considerable hemorrhage had occurred from it, and the infant seemed in collapse. When the mass was returned so far as it could be carried within the pelvis, by the index finger, the lower end of it could still be felt like an os uteri. It protruded four or five times within twenty-four hours, but, by replacement so far as possible with the fingers, and the use of simple water injections, it was finally permanently reduced, and, with the use of stimulants, she soon fully recovered.

Modes of Death.—This is different in different cases. It sometimes occurs from collapse. At a meeting of the New York Pathological Society, held December 10, 1873, I presented a specimen, showing intussusception occurring about one foot above the ileo-cæcal valve, in an infant aged thirteen months. On the day before its death, its previous health having been good, it seemed ill, and vomited once or twice, but did not appear to be in pain. It had two evacuations from the bowels, of the usual appearance, in the latter part of the day. On the following morning it was unexpectedly in collapse, and died within about twenty-four hours from the commencement of the sickness. At the post-mortem examination the head was not opened, and all the organs of the trunk were found normal except the intussusception. The mass involved in the displacement measured two and a half inches in length, and was slightly crescentic. The mucous membrane above and below it had the normal appearance, as did that of the external or incarcerating portion of the mass, while that of the incarcerated part was deeply injected. Water poured into the intestine above the invagination was wholly arrested by it. (*New York Med. Rec.*, April 1,1874.) But in the majority of instances death occurs from asthenia, which comes on gradually, but increases rapidly in consequence of the pain, vomiting, and imperfect nutrition. Children dying in this way may have convulsive movements more or less marked, but the prevailing characteristic as death approaches is extreme exhaustion. In exceptional instances the life of the sufferer is cut short

by convulsions before the stage of exhaustion is reached. Thus a child aged three years, whose case was reported by Dr. Isaac Thomas, in the *Amer. Med. Recorder*, in 1823, and another, aged two years, whose case was reported by Dr. Coggswell, in the London *Lancet*, July, 1853, died in convulsions on the second day.

TREATMENT.—It is unfortunate, in cases of intussusception, that the time in which treatment can be of most service is apt to pass by before the true condition of the intestine is detected. Invagination being comparatively rare, the patient is generally on the first day treated for colic or dysentery or some other common affection of the bowels; and it is often not till the second day, when the intestine has become incarcerated, that the physician accurately diagnosticates the disease. The purgative medicines often given in the commencement injure the patient. In fact, both reason and experience teach us the impropriety of purgatives in this complaint. Cathartic remedies act as a *vis à tergo*, and may cause still further descent of the inverted intestine. Yet such powerful agents of this class as quicksilver have been employed. It was administered in two doses of one ounce each in one of the cases embraced in my statistics, but none of the mineral passed the bowels. At the post-mortem examination a considerable part of it was found in small globules, coated with a black layer consisting of the sulphuret or black oxide of mercury, in the intestine above the intussusception. It need not be added that the case was speedily fatal.

The proper treatment of intussusception consists in attempts to reduce the displacement by pressure from below. This pressure may be applied either by liquid injections into the rectum or by inflation of the lower intestine by air or gas.

Injections should be made with lukewarm water, for cold or hot water may cause contraction of the muscular fibres of the intestine, and increase the constriction. The child should be placed in bed, or in the nurse's lap, with the nates elevated 45°. With the common India-rubber, or better the fountain-syringe, and the aid of an assistant, the liquid should be gently thrown into the rectum until the abdomen is somewhat distended. By carrying the fingers, firmly but gently applied upon the abdominal walls, along the direction of the colon, the liquid is made to press against the lower end of the intussusception. The same gentleness and perseverance is required in kneading and pressing the abdominal walls as in the treatment of hernia, by taxis. If the invagination is in the descending colon, probably only a small quantity of the liquid can be injected, and it may be forcibly returned, but by repeating the injections, a sufficient quantity can ordinarily be introduced to obtain the full effect of the mode of treatment. There is also sometimes an increased irritability of the rectum, even when the intussusception is at the other extremity of the large intestine, so that tenesmus and expulsive efforts follow the introduction of the instrument.

The assistant can aid in overcoming this by pressing the soft parts of the nates around the instrument.

If the injection fail to reduce the displacement, it may be repeated after allowing the patient to rest for awhile. In the *New York Medical Journal* for May, 1875, is the history of an interesting case, which was treated by Drs. Church and Warren, of this city, and is reported by the latter. The infant was seven months old and had the usual symptoms, such as frequent paroxysmal pain in abdomen, vomiting, tenesmus, scanty muco-sanguineous stools. On the third day injections were twice employed without result, but on the fourth day an injection of ten or twelve ounces reduced the displacement, and the infant recovered. In a second case treated by Dr. Warren the age was nine months, and a tumor appeared a little above the umbilicus a few hours after the commencement of the symptoms. The following is Dr. Warren's account of this interesting case which will give a clear idea of the proper mode of treatment.

"The patient was looking very pale and prostrated, the pulse was quick and feeble, and the skin cold. I at once determined to use fluid injections, and, with the little patient placed in a semi-prone position in his mother's lap, with an ordinary Davidson's syringe I commenced injecting tepid soap and water, but after perhaps a gill had been thrown into the rectum it was almost immediately rejected, very highly colored with blood, and mixed with it a very small quantity of mucus and fecal matter; the latter, by the way, not hardened, but of the consistency of soft putty. In a second attempt the fluid was retained longer, but was after a little while discharged, with more blood and mucus, but with much less tenesmus and pain.

"When, soon after, I made my third attempt, the child's chest was rested upon the side of its mother's lap, with the lower extremities elevated by an assistant, so that the position was at an angle of about 45°, anus upward. This time I injected the fluid very slowly, in order to avoid, if possible, the irritation caused generally by the frequent emptying and refilling of the syringe (which, by the way, is a very serious hindrance to the successful use of this syringe, and which renders it much inferior to the fountain or hydrostatic). In this manner I succeeded in injecting, as I estimated at the time, perhaps ten or twelve ounces, and during the operation the child gradually became more quiet, and had, when I ceased, fallen asleep. Then, with the direction that occasional doses of tinct. opii camph. should be administered during the night, to control, if possible, the peristaltic action of the intestines, I left him.

"On the following morning, to my surprise, I found the child sleeping quietly and naturally, and I was informed that at about 5 A. M. (six hours after my visit) he had a movement of the bowels, which was saved for my inspection, and consisted simply of the enema, slightly colored with fecal matter. From that time he seemed to be entirely free from pain, and six

or seven hours later had a natural passage, after which recovery progressed rapidly, and in a few days he was discharged well."

The following case is interesting as showing success from the use of injections after the lapse of two days, in a severe case, which had resisted treatment on the first day. The good result was apparently in great part due to the manipulation which was made so as to press the water against the course which intussusceptions are known to take.

On September 10, 1876, I visited, with Dr. Gillette, a nursing infant, aged nine months, whose history was as follows: It was habitually constipated, but it continued in its usual health till September 8, on which day it was carried by its nurse to one of the city parks. After its return it began to be fretful; it vomited, and seemed to be in pain. It continued to vomit frequently, especially after nursing, or taking drinks, and in the ensuing night passed two scanty stools of mucus and blood without fecal matter. In the morning of September 9, Dr. G. was summoned, who found the pulse 180, and temperature 102°, and the matter vomited greenish like bile. In the evening the temperature was $102\frac{3}{4}°$. Dr. G. diagnosticated intussusception, and employed injections of water, but they were returned without bringing fecal matter, and without apparent result. He also administered opiates by the mouth.

September 10, temperature $102\frac{3}{4}°$; features pallid, and beginning to have a pinched or sunken appearance, and they indicate much suffering; no nutriment is apparently retained on account of the frequent vomiting, and the bowels are obstinately constipated. As the symptoms indicated rapid sinking and collapse, consultation was called at 4 P. M. It was impossible to determine certainly, through the abdominal walls, on account of the distension, whether there was any tumor, but it was my opinion, and the opinion of one of the other physicians, that a tumor, hard and inelastic, could be felt nearly in the median line, between the umbilicus and the symphysis pubis. At about 5 P. M. the shoulders of the little patient were lowered, and the nates elevated, so that the trunk formed an angle of perhaps forty-five degrees with the horizontal, and a large quantity of tepid water was gently passed into the intestine through Davidson's syringe, with the vaginal nozzle attached. It was impossible to estimate the quantity retained, since a considerable part of it escaped, although the anus was firmly pressed around the instrument.

When the abdomen was distended as fully as seemed justifiable, the nates being still elevated, and the liquid retained, so far as possible, by firm pressure upon the anus, the abdomen was firmly and deeply kneaded by the hand, the movements being made chiefly from the right lumbar towards the right inguinal, and from the right inguinal towards the hypogastric region. The kneading was continued perhaps eight to ten minutes, and the water, which contained no perceptible amount of fecal matter, blood, or mucus, was allowed to escape.

After this operation the child became quiet, slept, and the vomiting ceased. At our next visit at 7 P. M., although the severe symptoms had in great part abated, and the countenance had lost that pinched and suffering aspect which was so prominent before, it was deemed best, in consultation, to repeat the injection, and this time through a rectal tube, which was introduced further than the nozzle employed at the preceding visit. The body was placed in the same position as before, and the abdomen kneaded in the same manner. The water, when allowed to return, brought no fecal matter, but the last that flowed contained two shreds, the largest about one inch in length by two lines in width, resembling matted and nucleated epithelial cells. It was believed that they were composed of such cells, with perhaps some of the mucous membrane to which they were attached, and that they were detached from the invaginated portion. An opiate mixture was now prescribed, to be given sufficiently often to relieve any restlessness, and keep the patient quiet, and a flaxseed poultice was applied over the abdomen. On the following day the temperature was 103½°, pulse 158, and the abdomen somewhat distended; but the vomiting had ceased, and there had been two fecal evacuations since our last visit. The intussusception had been relieved, the inflammatory symptoms soon abated, and the infant's health was fully restored.

Injections in order to be effectual, and give promise of success, must be aided by gravitation. Unless the nates are so elevated as to obtain the benefit of this hydraulic principle, I am convinced that inflation is more likely to reduce the displacement, and if, after sufficient trial of injections, relief is not obtained inflation should be employed. Inflation produces an equable and effective distension of the external or incarcerating portion of intestine, and cases of cure by inflation have been reported after injections had failed. Treatment by inflation, which indeed ought to occur to any intelligent physician, appreciating the anatomical condition of the parts, as the correct mode, was prominently brought to the notice of the profession in modern times by Mr. Samuel Mitchell, in a communication to the London *Lancet* for March 17, 1838.

"I take the liberty," he writes, "of suggesting to the profession, through the medium of your valuable periodical, the trial of inflating the bowels by means of a glyster-pipe attached to a common pair of bellows; it has fallen to my lot to witness several of these most distressing cases in children; the nature of the obstruction was foretold during life, and unfortunately verified by post-mortem examination. The last case of the kind which came under my care, about two years since, presented all the usual symptoms: intolerable restlessness, the most obstinate sickness, the singularly distressed state of countenance, and shrunken features. The usual remedies were had recourse to, viz., warm baths, glysters, anodyne frictions over the abdomen, etc., but without avail. As a forlorn hope I made trial of inflation by the above means, with the most happy result. The

sickness immediately ceased; the child within an hour passed a natural stool, and in the morning was almost without ailment."

This mode of treatment is termed novel in the *Lancet*, but it is really as old as the time of Hippocrates, who speaks of throwing air into the bowels, by which flatulence is imitated (flatus immitatur). (*Hippocrates' Works*, translated from the Greek by Grimm, 4 bd., page 198.) Haller also recommended the same treatment: "Flatus etiam immissus celerrime susceptionem dispellet." (*Physiologia Corporis Humani*, tom. vii, p. 95.) In the *Edinburgh Medical Journal*, October, 1864, Dr. David Greig relates five cases of successful treatment of intussusception by inflation. The first, an infant six months old, previously in good health, suddenly became very fretful, apparently having severe paroxysmal pain in the abdomen. She had vomiting, and finally tenesmus, with bloody evacuations. Warm water enemata could not be employed on account, the writer thinks, of the spasmodic action of the intestines, and an abdominal tumor could be distinctly felt near the umbilicus. Castor oil and a purgative powder, and enemata of water having been employed in vain, and the case becoming really critical on the second day, inflation was resorted to. The writer says: "The nozzle of a small pair of bellows was introduced into the anus, and air injected to a considerable extent. Contrary to our expectation, the air passed readily into the bowel, and seemed to give the child great relief. After the injection it lay very quiet, as if asleep, and evidently quite free from pain. In about twenty minutes from the time the air injection was administered, a slight rumbling noise was heard in the child's abdomen, followed by a crack so loud and distinct as to alarm the attendants in the room, who thought something had burst in the child's bowels. The child, however, continued as if asleep, and free from pain, and in about half an hour a large feculent stool, slightly mixed with blood and mucus, was passed without pain. During the night the child rested pretty well, had no return of vomiting, took the breast as usual, and in two days was quite well."

Another child, nine months old, treated by Dr. Greig, presenting nearly the same symptoms and the abdominal tumor, also obtained relief by inflation, after castor oil and enemata had failed to produce any benefit.

An apparatus for the production and injection of carbonic acid gas has been invented by Schultz and Warker, of this city, and is manufactured by them. It consists essentially of two glass chambers, one over the other. In the lower one a bicarbonate is placed, and in the upper an acid in a liquid state. By the gradual admixture of the two, carbonic acid is set free. An elastic tube conveys the gas from the lower chamber. The apparatus has been used by physicians of the city for the reduction of intussusception and other purposes, and is a useful invention.

The same firm, and several others in this city, prepare for the shops large bottles of highly charged carbonic acid water, from which when

inverted a powerful current of carbonic acid gas can be obtained. Two or three of these bottles, with a portion of the tube from Davidson's syringe, which can be readily attached to the stem from which the gas escapes, constitute all that is required for an ordinary case.

The following cases, which I treated with Dr. Büchler, of this city, in 1871, show what may be achieved by inflation, and also the unfavorable result which must inevitably occur in certain cases. A German infant, five months old, nursing, began to be fretful, crying often on March 7th, and before night passed a scanty motion of blood. The symptoms continuing, I was asked to examine the infant on the 10th, and learned the following facts: It had vomited daily, had had daily scanty but infrequent stools, consisting chiefly of blood, accompanied at first by tenesmus, but not within the last day; it continued to nurse, but was becoming thinner and weaker, and was evidently in pain. The symptoms indicating the nature of the disease, the abdomen, which was not distended, was examined for the tumor, which was found in the right side in the site of the ascending colon, apparently about one and a half to two inches in length; pulse 124 in sleep; no cough. An ineffectual attempt was made to reduce the intussusception by a very rude and imperfectly constructed apparatus (the bellows), when from the lateness of the hour farther treatment was postponed till early the following morning. 11th. Tumor still detected in the right lumbar region; pulse 120 asleep, 150 awake. By means of Schultz and Warker's apparatus, the intestines were inflated so as to produce very decided prominence of the abdomen, and the abdomen gently kneaded. After some minutes the gas was allowed to escape, when the tumor had disappeared. In a few hours, a natural evacuation occurred from the bowels, and the infant has remained well since.

The second case ended unfavorably, although the symptoms were apparently no more grave than in the case just related, and had continued a shorter time. This infant was also of German parentage. The tumor, firm and elongated, could be distinctly felt in the left lumbar region. In this case the inverted bottles of carbonic acid water were employed, and when, after considerable delay and kneading of the abdomen, the gas was allowed to escape from the intestine, the tumor had disappeared. A few hours afterwards convulsions occurred, ending fatally. At the autopsy the invaginated mass, which was too firmly strangulated to admit of reduction by inflation, was found in the epigastric region, having been carried up from its former position by the inflation of the intestine below. It consisted of the terminal part of the ileum, which had passed through the ileo-cœcal orifice, and become incarcerated in the ascending colon, and, as is not unusual in these cases, the action of the intestines had changed the location of the tumor in the abdomen from the right to the left side.

Whether air or carbonic acid is employed, it is necessary to produce distension of the intestine to its fullest extent below the seat of the com-

plaint, without endangering rupture, and of course the sooner it is used the better the chance of success. In a few days the displaced intestine has, in a large proportion of cases, become so firmly incarcerated, and has descended so far, that attempts to replace it, either by injections or inflation, are unsuccessful; still, even at a late period, a persevering attempt should be made if it has not previously been tried. If injections and inflation fail to effect the desired result, the employment of quicksilver, by the rectum with the thighs elevated, has been suggested to me as worthy of trial by a physician of large practice in this city, who has had considerable experience with intussusceptions. This may be a useful suggestion, especially if the invagination is in the descending colon.

If the modes of treatment which I have recommended above, fail to give relief when perseveringly and sufficiently employed in a case of acute intussusception, the patient's state is one of extreme peril, and the prognosis is unfavorable. Yet recovery is possible in one of two ways, namely, by incision through the abdominal walls (laparotomy), and reduction of the displacement by the fingers within the abdominal cavity; and secondly, by sloughing of the invaginated mass, and union by adhesive inflammation of the ends of the intestine which have preserved their vitality. Atrophy of the imprisoned part so seldom occurs in a case which has resisted injections and inflation, that it need not be considered in this connection, as a mode of recovery.

Laparotomy has been successfully performed in a child aged two years, as I have stated above, by Dr. Jonathan Hutchinson, of London. The case was one of those exceptional ones in which great displacement had occurred without strangulation. It had continued as indicated by the symptoms about one month, and a portion of the intestine terminating in the ileo-cæcal valve had extended several inches from the anus. "The patient was anæsthetized by chloroform, and the abdomen was opened in the middle line below the umbilicus. The intussusception was then easily found, and as easily reduced. The after-treatment consisted only in the administration of a few mild opiates, and the child made a rapid recovery." (See London *Lancet*, November 22, 1873.) In a case of this kind, there can be no doubt of the propriety and necessity of laparotomy as a last resort, for there being no strangulation, sloughing could not occur, and death sooner or later, from exhaustion, must be the inevitable result. Cases of this sort have usually been left to perish, after the ordinary modes of relief have failed. Thus as far back as 1784, M. Robin published in the *Mém. de l'Acad. de Chirurg.*, the case of a child aged $3\frac{1}{2}$ years, who died after the lapse of three months, with a cæcum protruding from the anus. And in the *Amer. Journ. of Med. Sci.* for 1849, Dr. Worthington published a similar case, in which a child aged three years and four months lived even a longer time. In these days of anæsthetics, and with the brilliant success of Hutchinson, a physician would in my opinion be

reprehensible if he allowed a child aged two years or over, with this form of the displacement, to perish without strongly advising laparotomy.

But the question arises, whether in those more frequent cases of intussusception in young children, in which, after the displacement has continued a few hours, there is such firm constriction of the invaginated mass, that the patient suffers much pain and constitutional disturbance, and probably passes bloody stools, and injections and inflation have failed to reduce the displacement, laparotomy is justifiable. This operation, in the case of infants, has heretofore been regarded as so dangerous, and so likely in itself to prove fatal, that the profession have generally considered it unjustifiable, believing that, although death was nearly certain without it, the performance of it did not increase the chances of a favorable result. Dr. J. B. Sands, of New York, has recently shown that laparotomy is justifiable, as a last resort, for the relief of this form of intussusception, even in the youngest infants; and in the following case, recorded in the *New York Medical Journal*, June, 1877, saved the patient, who doubtless would otherwise have perished.

On March 11, 1877, an infant of six months suddenly presented the characteristic symptoms of intussusception, such as tenesmus, abdominal pain, vomiting, and bloody stools. A few hours later, when Dr. Sands was called, the pulse was rapid and feeble, with symptoms of collapse. An elongated tumor could be felt in the abdomen, extending from the left iliac region to the left hypochondrium, inelastic, tender on pressure, and dull on percussion. The lower end of the invaginated mass could be readily touched by the finger introduced into the rectum. The usual methods to effect reduction were at once employed with partial success, for the tumor disappeared from the site where it had been discovered, and was reduced to a small and firm mass, on a level with the umbilicus, but it resisted any further attempts to effect its reduction.

Dr. Sands, then having etherized the patient, made an incision in the median line of the abdomen, extending downward about two inches from a point a little below the umbilicus. Through this opening, proceeding cautiously, and using as little violence as possible, he was able after some delay to reduce the displacement. The invaginated mass, which was only one and a half inches in length, consisted of the terminal portion of the ileum and the cæcum, which had entered the ascending colon. The wound was closed by five silver sutures, which embraced the peritoneum, and the patient made a good recovery. The operation was performed eighteen hours after the commencement of symptoms.

Dr. Sands has collected the statistics of twenty cases of laparotomy for intussusception occurring at different ages, in which the result was stated. Of these, seven recovered, or one in three; but he judiciously remarks, considering the gravity of the operation, that it is doubtful whether future statistics will show so favorable a result of laparotomy for this displacement

as to justify the frequent use of the knife. For facts and statistics relating to this subject the reader is referred to an elaborate paper by Dr. Ashhurst, published in the *American Journal of the Medical Sciences* for July, 1874.

It is obvious that the earlier the displacement is recognized, the greater the probability of the reduction by the judicious use of injections and inflation, and it is seen from cases related above that this treatment may be successful as late as the second or third day, after previous attempts to reduce the intussusception by the same means have failed, and when there is that degree of strangulation that bloody stools occur. But as my own experience has shown me, there is also inevitably a large proportion of cases in which the use of injections and inflation, however judiciously and perseveringly made, totally fail, and it seems to me, in the light of present experience, that when pressure from below by water, air, or gas, which is the only efficient mode of treatment short of the knife, has been tried sufficiently long and often without result, that it is the duty of the physician to seek surgical advice in reference to laparotomy, as he would in a case of hernia, especially since, under Lister's antiseptic method, the danger from severe operations, appears to be considerably diminished. It may be added that laparotomy performed on the first or second day will be much more likely to save life in ordinary cases than if performed later, since the strangulated intestine is soon badly damaged, and a local peritonitis is apt to be developed any time after the first forty-eight hours.

When an intussusception has reached that stage in which active interference is no longer proper, the physician can only prescribe opiates, with sustaining measures and an emollient poultice over the abdomen, and must await the result. The diet should consist of beef juice and other concentrated nutriment, which leaves little residuum. Vomiting, which is so common, is best controlled by bismuth and opiates; convulsions require the bromide of potassium, and an enema of three to five grains of chloral hydrat, dissolved in a little water.

SECTION IV.

DISEASES OF THE CIRCULATORY SYSTEM.

CHAPTER I.

CYANOSIS.

Certain of the diseases which pertain to the circulatory system have been treated of in other parts of this book (umbilical hemorrhage, gastro-intestinal hemorrhage, etc.). It remains to consider that general condition of the blood which is designated morbus cæruleus or cyanosis.

In 1863, I read before the New York Academy of Medicine a statistical paper on cyanosis, which was published in the Transactions of that Society. This paper contains an analysis of 191 cases, collated from the various European and American medical journals, and to these cases I am indebted for most of the following facts pertaining to this disease.

The term cyanosis or blue disease is differently employed by writers. Some apply it to cases of transient lividity occurring in the course of acute diseases, as well as to those cases which depend on permanent structural changes, or on malformations. I apply this term, as do most pathologists, only to the latter cases.

Some are inclined to discard the consideration of cyanosis as a disease, regarding it rather as a symptom. Their view is, in my opinion, correct in reference to the cyanotic state which occurs in certain acute diseases, but not in reference to cyanosis, as I have defined the term and employ it. The propriety of considering cyanosis a disease is more apparent if we are not misled by the term which designates it. Lividity is not its most important or its essential characteristic. It is simply a sign, although conspicuous, and, indeed, the only one by which the disease can be readily recognized. Cyanosis is, in reality, a blood disease, its pathological state consisting in a deficient oxygenation of this fluid, or in an excess in it of carbonic acid, and probably of carbonaceous products. It should be placed in the same category with leucocythæmia and melanæmia.

Statistics show that cyanosis is, with very few exceptions, due to malformation in the circulatory system, and at the centre of circulation, namely, in the heart and in the large vessels which arise from this organ. In exceptional cases the cause of the cyanosis is located in the lungs, and is

in all or nearly all instances either extensive emphysema in both lungs, firm and thick fibrinous exudation over both lungs, compressing them by its contraction and causing, perhaps, carnification in parts of them, or the cause is compression of the lungs from caries of the vertebræ, and consequent depression of the ribs. These causes pertain to youth and manhood rather than to infancy and childhood. On account of this fact and the rarity of such cases they need not be considered in this connection.

Literature of Cyanosis.

The ancient physicians, so far as can be ascertained from their writings still extant, were ignorant of cyanosis; whether they overlooked it, or whether those early ages were exempt from it and the malformation on which it depends is peculiar to a posterity physically degenerate. The blue disease described by Hippocrates (*De Morbis*, lib. ii, sec. v, page 485, Ed. de Foë's, 1621) was probably some acute febrile affection. Galen, whose voluminous writings, with an excellent index, are still extant, and whose comprehensive mind embraced the whole range of medical science of the second century, makes no mention of it, so far as I can find. In the middle ages, as appears from a remark of Boerhaave (*Diseases of the Humors*, Acad. Lect., § 732), the common people believed the cyanotic to be the victims of evil spirits; and it is probable that physicians, during this long period of superstition and intellectual lethargy, embraced the popular belief.

On the revival of learning, pathological anatomy began to be more thoroughly and intelligently studied; but it is evident that before the great discovery of Harvey, in the 17th century, it was impossible to refer cyanosis to its true cause. In the latter part of the century so auspiciously opened by Harvey's genius, malformations of the heart were observed and described by some pathologists on the continent, in cases in which cyanosis must have been present; but it is uncertain, from the brief records which they have left, whether any of them understood the dependence of this disease on the abnormal state of the heart. Boerhaave, in the beginning of the 18th century, attributes "a livid or black color diffused throughout the whole skin," evidently referring to cyanosis, to "1, a relaxation of the vessels, while the *vis a tergo* remains the same, or, 2, to a too sudden increased pressure behind, without a relaxation of the vessels." Vieussens, who was a contemporary of Boerhaave, and was more thorough in the examination of morbid as well as healthy structures, narrated the history of a cyanotic patient, with a description of the malformation, but the one who first gave particular attention to the blue disease was Morgagni. This Paduan professor, far excelling his predecessors in thoroughness of observation and accuracy of deduction, published a theory in explanation of the disease which now, after the lapse of more than a

century, has many adherents. In the same century with Morgagni, the 18th, but subsequently to his time, Drs. Pulteney, Wm. Hunter, Baillie, Wilson, and Abernethy in Great Britain, and Jurine and Sandifort on the continent, may be mentioned among those who contributed to a knowledge of cyanosis by the publication of cases, with a description of the malformations. Yet, when the present century commenced, no monograph or dissertation had appeared on this disease; and, notwithstanding the publication of cases from time to time, the profession generally were almost totally unacquainted with its nature. No better idea can be given of the prevailing ignorance, in reference to cyanosis at this period, than by quoting from a case related by Ribes in 1814. (*Bull. de la Fac. de Méd.*, 1815.) The patient had some time previously received an injury of the finger. "Many physicians of Amsterdam," says he, "were at different times consulted on the subject of this affection, no one of whom understood its true cause, its essential character. One considered it as partaking of the nature of epilepsy, and caused by the irritation in the nervous system which the wound in the finger had produced. Others attributed it to the presence of intestinal worms. Some physicians pronounced it an injury of the liver or spleen. Many held it to be a scorbutic affection. One only believed it to be the result of an unknown organic disease."

Since the commencement of the present century the blue disease has received a large share of attention. According to *Forbes's Medical Biography*, the first dissertation on this subject appeared in 1805, from the pen of Seiler, and from this time till 1832 no fewer than twenty-eight dissertations or mongraphs were published, either on cyanosis or on malformations which produce it or at least relate to it. In the list of writers are some of the most eminent names in the profession, as Louis and Bouillaud. The number who have written on this subject since 1852 probably exceeds the number of previous writers. Of those who have contributed most to our knoweldge of the disease may be mentioned Farre, Chevers, and Peacock in Great Britain, Gintrac on the continent, and Moreton Stillé in this country. Farre, Chevers, and Peacock wrote on malformations of the heart, alluding incidentally to cyanosis, but their writings contain valuable matter for statistics bearing on the latter subject. Farre's book was published in 1814, and is out of print; Chevers published his papers in the *London Med. Gazette*, commencing in the year 1845 and running through several successive volumes. Peacock's treatise was published in 1858. It contains several original cases, previously narrated by him to the London Pathological Society. The paper by Moreton Stillé, which has attracted much attention, especially in Europe, was his inaugural thesis, and was published in the *Amer. Med. Journ. of Med. Sci.* in 1844. This paper relates entirely, in the words of the author, to "the laws of the causation of cyanosis." The only really complete statistical

paper on the blue disease is that by M. Gintrac, published in 1824, in Paris, and embracing all the cases which had been accurately reported up to that time, namely, fifty-three. He, indeed, exhausted the subject for the period in which he wrote, but on account of the accumulation of material since, his monograph now seems incomplete.

Two theories in explanation of the occurrence of cyanosis have divided the profession: the one attributing it to obstruction at the centre of circulation, and consequent venous congestion; the other, to admixture of venous and arterial blood through openings in the septa of the heart, or through the ductus arteriosus. The former of these theories originated with Morgagni more than one hundred years ago, and is essentially the same as that advocated by Stillé. Stillé errs in placing Morgagni among the advocates of the other system. The second theory, or that which attributes cyanosis to admixture of venous and arterial blood, is said by Dr. Peacock to have originated with Hunter, but its ablest supporter was Gintrac. Of late there are some pathologists who do not believe that either theory is sufficient to explain the cause of cyanosis, but that the true explanation lies somewhere between the two. Among the most conspicuous of these is Prof. Walshe, of London. These theories will be considered in the proper places.

Sex.—Writers on cyanosis state that there is a preponderance of males to females affected with it. Aberle, of Vienna, says that two-thirds were males in an aggregate of 180 cases which he collated. In Gintrac's cases, 28 were males and 16 females; in Stillé's, 41 were males and 31 females. The sex is recorded in 134 of the cases collected by me, of which 78 were males, 56 females; and if those cases are excluded in which cyanosis was due to obstruction at the mouth of the pulmonary artery, the number of the two sexes is the same. In the five years commencing with 1858, according to the mortuary returns, 207 died in this city from cyanosis, of which number 117 were males, 90 females. In England, for two years, 418 males died of cyanosis, and 273 females. Although statistics of different cities and countries agree in the fact of an excess of males over females, there does not appear to be that great preponderance of males, which the earlier writers on this disease believed to exist.

Causes of the Malformations.—Mothers sometimes attribute the malformations, and probably correctly, to strong mental impressions felt during utero-gestation. The mother of a patient treated by Dr. Peacock stated that "two months before her confinement, she was frightened by seeing a child killed, and never recovered from the shock she sustained." (*Malf. of Heart*, p. 37.) In another case "the mother was much out of health, and stated that, when pregnant with the child, she was greatly alarmed by seeing a man who was dying of asthma." (Op. cit., page 57.) In another instance the mother was frightened at the fifth month of pregnancy (page 41); and in still another case, recorded by Dr. Peacock, the

mother, four or five months before her confinement, "was greatly alarmed by her husband, who was insane, standing over her for two hours with a loaded pistol." (Page 43.)

Occasionally the malformation appears to be due to some vice or taint in the system of one or both parents. In a case quoted in the *Gazette Médicale*, for December 28, 1850, from another continental journal, it is stated that "the mother, who had formerly suffered from rickets, gave birth to five children, all of whom died immediately or shortly after birth with symptoms of cyanosis. The father died at the age of thirty-six of phthisis." Dr. Peacock relates a case in which the father was livid, and had the "pigeon-breast" common in the cyanotic. In the history of a patient, which was communicated by Cooper to Farre, it is related that "vices of conformation of the heart appeared to have been inherent in the family. Of 12 infants only 4 survived, and more presented signs of heart disease." Dr. Buchanan relates the history of a child which was the second that had suffered and died in the same family in the same way. A patient treated by Mr. Leonard was the sixth child of the family, who had died at about the same age, with symptoms of cyanosis. Such instances are, however, exceptional. Ordinarily, the cyanotic have not only healthy parents but healthy brothers and sisters.

A patient whose history is given by Dr. William Hunter was born at the eighth month, but in nearly all other cases the full period of intra-uterine existence was reached.

The opinion was expressed by Gintrac that the number affected with cyanosis, to the entire population, varies in different countries. It is probable that the occurrence of the blue disease is not greatly, if at all, influenced by the nationality, but it is certainly dependent to a considerable extent on the condition of society. It is less frequent in a community in comfortable circumstances, and engaged in wholesome and quiet occupations. Pure air and outdoor exercise, plain, nutritious diet, freedom from cares and anxieties, in fine, causes which promote the physical well-being, diminish the liability to an ill-formed and cyanotic offspring. And, conversely, impure air, improper and insufficient diet, grief, etc., increase the percentage of cyanotic cases. Hence, it is a rare disease in the rural districts, and comparatively frequent in the cities, especially in a large city like New York, which contains a numerous indigent and careworn population, living from year to year in the midst of agencies which operate stealthily but certainly to enervate the system and undermine the health.

These remarks are abundantly substantiated by statistics. In New York city for the six years ending with 1860, there was one death from cyanosis to 436 deaths from all causes; and in Brooklyn the proportion estimated for two years was about the same. On the other hand, in the State of Kentucky, which contains few large cities, and in the death re-

ports of which cyanosis is included in the general term malformation, there was, during a period of five years, one death from malformation to 2469 from all causes. In the State of South Carolina, for three years, there was one death from cyanosis to 5018 from all causes. In the State of Massachusetts, for two years, there was one death from cyanosis to 1136 from all causes, and two-thirds of the cyanotic cases occurred in the counties of Suffolk, Essex, and Worcester, which contain large cities. In London there was one death from cyanosis to 755 from all causes during a period of three years. On the other hand, in England, including the city of London, there was, for the ten years ending with 1857, one death from cyanosis to 1589 from all causes; and in the rural districts of Monmouth and Wales there was only one death from cyanosis to 5578 deaths from all causes during a period of two years.

Time of Commencement.—It is an interesting and somewhat remarkable fact that cyanosis, though dependent on a malformation, does not always commence at birth, or, at least, that it does not exist in degree sufficient to produce the cyanotic hue till some time has elapsed after birth. In 138 of the cases of cyanosis which I have collected, the time at which lividity was first observed is stated as follows: In 97 it was within the first week, and generally within a few hours of birth. In the remaining 41 cases it commenced as follows:—

In 3 at 2 weeks.	In 6 from 2 years to 5 years.
" 1 " 3 "	" 1 " 5 " " 10 "
" 2 " 1 month.	" 6 " 10 " " 20 "
" 7 from 1 to 2 months.	" 1 " 20 " " 40 "
" 5 " 2 " 6 "	" 1 over 40 years.
" 5 " 6 " 12 "	—
" 3 " 1 year to 2 years.	41

In these 41 cases, in which blueness did not occur till after the age of one week, if the patient were less than two years old when it commenced, there was frequently no obvious exciting cause, but above this age, with three exceptions, such a cause is known to have been present. It is interesting to observe how trivial the exciting cause frequently is, and equally interesting to note how long patients have enjoyed good health, not having the least lividity, although the anatomical vice, to which the final development of cyanosis was due, had existed from birth.

Dr. Theophilus Thompson relates, in the *Medico-Chir. Trans.*, vol. xxv, the history of a lady, thirty-eight years old, who was well till an attack of Asiatic cholera, after which her health was permanently impaired. Two years before her death she passed through a course of fever, and from this time was cyanotic. In the *Philadelphia Medical Examiner*, June, 1850, Dr. Waters relates a case, in which cyanosis began at the age of six years in an attack of measles. In a case published by Mr. Napper, in the *London Medical Gazette*, 1841, the child fell at the age of six

months, and from this time had cyanosis. A female, whose history is given by Prof. Tommasini, of Bologna, and quoted by Bouillaud, became cyanotic at the age of twenty-five in consequence of difficult parturition. In the London *Lancet*, 1842, Mr. Stedman relates a case, in which cyanosis began at the age of ten weeks in an attack of convulsions. In the *American Journal of Medical Sciences*, 1847, Dr. John P. Harrison published the history of a baker, twenty years old, in whom cyanosis began five years previously after great effort in carrying wood. Louis and Bouillaud quote from M. Caillot the case of a child, who became cyanotic at the age of two months in an attack of hooping-cough. Louis also narrates a case in which hooping-cough had the same effect at the age of twelve years. Ribes treated a child in whom the blue disease began at the age of three years from a severe contusion of the fingers. In a case related by Marx it commenced at the age of ten months from a blow on the back, inflicted by the mother. In the *Medical Times and Gazette*, for 1855, Mr. Speer gives the history of a female, who at the age of thirteen years was put in a place requiring considerable exertion, and from this time was cyanotic. A patient, whose case is related by Cherrier, fell into a deep ditch in the winter season, and immediately after had a low fever, from which the blue disease commenced. In a case published by Tacconus the exciting cause was believed to be fright, in consequence of a fall from a great height, and in another, related by Bouillaud, it was a blow received on the epigastrium after the patient had passed the age of fifty years. Similar cases are related by Mayo and Peacock.

It will be seen that the exciting cause of cyanosis is usually such as produces a profound impression on the system, and affects the action of the heart. Precisely in what way it operates to develop the disease has not been satisfactorily explained. Mr. Mayo conjectures, that in the case related by him there was previously some compensation which ceased, or became inadequate in consequence of some change produced in the economy. Although cyanosis may not appear for months or even years, there is rarely improvement when it is once established. Appearances of amendment are deceptive. The disease when not stationary is progressive, and this explains the fact, that few survive the middle period of life.

Symptoms.—The symptoms of cyanosis vary in intensity in different patients, and in the same patient at different times, being milder if he is quiet and the mind calm, more severe if active, or if the mind is agitated. In mild cases, in a state of rest, they nearly or quite disappear, so that a stranger would not suspect that there was any serious ailment. They are aggravated by any cause which accelerates the action of the heart. In some, cyanosis is increased by the most trivial disturbing influences, among which may be mentioned nursing, dentition, crying, coughing, and slight emotions of joy, sorrow, or anger. In more than one case it has

been perceptibly increased by the stimulus of digestion, the color being deeper after a full meal than before.

The cyanotic hue varies in different individuals from duskiness to a deep purple, almost black color. It is usually most marked in the visage, especially the palpebræ, cheeks, nose, and lips, in the ears, fingers, and toes, and upon the mucous surfaces. It is sometimes, without any assignable cause, confined to a portion of the body. In a case related by Mr. Steel in the London *Lancet*, 1838, the upper part of the body was livid and œdematous, and the lower part pallid and shrunken, and yet the malformation was of the kind which is commonly present in cyanosis. In the *London Medical Times*, March 8, 1845, copied from the *Gazette Médicale*, is the history of a child six years old, in whom the color was deeper on the right than left side. There had been, however, hemiplegia of this side in infancy, but this had entirely passed off. On the other hand, in a case of rare malformation communicated by Cooper to Farre, in which the upper part of the system was supplied chiefly by arterial and the lower by venous blood, the discoloration was general. In exceptional instances livid maculæ, like those of purpura, have been observed upon the skin.

Those affected with cyanosis have generally at birth been well formed and of the usual size, and in most cases, for a considerable period after birth, the appetite is good, bowels regular, and the system well nourished. But when cyanosis becomes so severe, as it does sooner or later, that its symptoms are rarely absent, digestion is imperfectly performed, and the body becomes either emaciated or stunted and puny. It may be stated, as a rule, that nutrition is in inverse proportion to the gravity of cyanosis. In thirty-three out of forty-one cases, in which the condition of the system, as regards nutrition, was recorded either a short time previously to death or at the autopsy, the body was either considerably emaciated or else diminutive, and those who were well nourished were usually such as had died early, or of some intercurrent disease.

In this connection may be mentioned two abnormalities which have been observed in the cyanotic. The chest is often flattened laterally with a projecting sternum, so as to present an appearance generally described in the records as "pigeon-breasted." Sometimes the most prominent part is directly over the heart, and in one or two cases the sternum was observed to be deflected towards the left. In the majority of the records, however, no mention is made of the external appearance of the chest.

The other abnormal development is more remarkable, and has not been satisfactorily explained. In twenty-eight cases it is stated that the tips of the fingers or toes, or both, were bulbous. This hypertrophy, if slight, is likely to be overlooked, and that it was observed and recorded in so many cases renders it probable that it was present in a much larger number. In one case the anatomical character of this enlargement was examined, and was found to consist chiefly of hypertrophied connective tissue. The nails

are often incurvated over the deformity. At a meeting of the Lond. Path. Soc., in 1859, Mr. Ogle narrated the history of a laborer, fifty years old, who had swelling, numbness, and lividity of the left arm, from pressure of an aneurism, and the fingers on this side were clubbed as in cyanosis. A patient whose history is related in the *Glasgow Medical Journal*, and who was believed to be cyanotic in consequence of a highly emphysematous state of the lungs, had a similar development of the tips of both fingers and toes. Why this bulbous growth should occur in consequence of the circulation of non-oxygenated blood is unknown.

An interesting feature in cyanosis is the low grade of animal heat. The temperature of the body is in all cases below that of health. This is especially noticeable in the extremities. There has not been a sufficient number of accurate thermometric observations to determine whether the internal heat is usually reduced. The following only have been recorded: Mr. Fletcher relates the history of a young man in the *Medico-Chir. Trans.*, vol. xxv, in whom the thermometer placed in the mouth did not stand above 80° Fahrenheit. Hodgson reports the case of a man, twenty-five years old, in whom the thermometer placed on the tongue rose to 100°, while in his own case it was two or three degrees below that term. In an experiment, recorded by Nasse, the instrument placed in the mouth fell little if at all below the healthy standard; applied to external parts, it stood at about 21° Reaumur.

The lack of heat is the source of great discomfort to a cyanotic patient. In mild weather he requires a fire to keep him warm, or an amount of clothing which to others would be intolerable, and in cold weather slight exposure strikes him with a chill. Nor can he increase his heat by active exercise, since his infirmity disqualifies him for this.

Although the temperature of the surface is so low, the occurrence of perspiration, sometimes profuse, is mentioned in several of the records.

In severe cases of cyanosis the generative system is imperfectly developed. In the female, menstruation is scanty or delayed, and in the male signs of puberty are feebly manifest. If the disease is so mild that the symptoms are absent when the patient is in a state of repose, these organs attain nearly or quite their normal development. The catamenia have appeared as early as the age of sixteen years; and a cyanotic patient treated by Cherrier had two children, but they both died of scrofulous affections.

The action of the heart is necessarily much affected. In mild forms of the disease, if the patient is quiet, this organ may beat with considerable slowness and regularity, but in all cases exercise or excitement, which in a state of health would scarcely have any appreciable effect on the pulse, embarrasses its movements, and produces palpitation. In severe cases palpitation is rarely absent, and the pulse is frequent, feeble, and often

intermittent. In a large proportion of patients bruits are produced by the irregular circulation through the heart.

The respiration corresponds with the action of the heart. It is accelerated in proportion to the frequency of the pulse. The suffering in this disease is largely due to paroxysms of palpitation and dyspnœa. These occur sometimes without any apparent exciting cause, and when the patient is quiet, but they are commonly induced by those causes which we have already mentioned as aggravating the symptoms of cyanosis. They come on suddenly, and are attended by increase of lividity, distension of the jugulars, and sometimes of the cutaneous veins, and by a sensation of present suffocation. They last only a few minutes, and are succeeded by great depression of the vital powers. In infants, on account of greater nervous irritability and feeble power of endurance, these paroxysms generally end in convulsions, which occasionally are fatal. A cough is sometimes present, but is usually slight.

Pain is not a common symptom. Some of the patients complain occasionally of headache, with or without vertigo, and occasionally also of pain in the chest, but it is uncertain to what extent or whether these symptoms are dependent on the cyanotic disease. The secretions do not appear to be affected, so far as has been ascertained. The same may be said of the intellectual and moral faculties. In a case related by Dr. Chevers, the child was even said to be precocious. (*Lond. Med. Gaz.*, vol. xxxviii.) The mind is capable of steady application and acquisition, as in health, provided that the emotions are not unduly excited.

Those who are affected with cyanosis are liable to various forms of hemorrhage, but this liability, if we may judge from recorded cases, is greater in youth and adult life than in infancy. In two cases blood was vomited, in one passed by stool, in one it escaped from the gums, in two from the mouth, in eight from the nostrils, and in sixteen it was expectorated. Pulmonary phthisis was, however, usually present in these last cases. In the *Western Journal of Medicine* for 1829, an interesting case is related by Dr. Wm. M. Voris of a girl, nine years old, in whom hemorrhage occurred under the scalp, producing great tumefaction, and nearly closing the eyelids. An incision was made, from which a pint and a half of dark blood escaped, and it was estimated that more than half a gallon was lost during the ensuing two weeks, at the expiration of which time the incision closed. The patient recovered from the hemorrhage, but not from the cyanosis.

Towards the close of life there is occasionally more or less anasarca, especially around the ankles, sometimes in the eyelids and face, and rarely to a certain extent over the whole body. In certain patients it coexists with effusion in the serous cavities.

It is evident that one who is affected with the severer form of cyanosis is disqualified for the duties of active life. The sports of childhood and

the useful labors of mature years require an exertion for which he is physically unfit. He has not the ability even to engage in animated conversation, for he is overcome by emotions, whether of joy or sorrow. He lives almost an idle spectator of the world around him, prevented by his infirmity from engaging in its pursuits.

Intercurrent diseases, especially those of childhood, are badly tolerated; but hooping-cough is the one which these patients are especially ill-fitted to endure. Still, they sometimes pass safely, not only through hooping-cough, but through some of the most dangerous febrile diseases. It is a question of interest, but about which little is known with certainty, whether these intercurrent maladies are influenced by the cyanotic or venous condition of the blood. The symptoms of these maladies are no doubt more alarming, mainly on account of the embarrassed action of the heart, and not on account of the state of the blood; still it is reasonable to suppose that malignant and asthenic diseases are rendered worse by the lack of oxygen, and excess of carbonic acid in the circulating fluid.

Probably cyanosis does not furnish immunity from any other disease, although this statement has been made by a high authority. Rokitansky says: "*All forms of cyanosis, or rather all the diseases of the heart, great vessels, and lungs adapted to produce cyanosis, in a greater or less degree, cannot coexist with tuberculosis. Cyanosis affords a complete protection against it, and in this circumstance may be found an explanation of the immunity from tuberculosis which many conditions of the system, apparently very different in their character, afford.*" (*Handb. der. Pathol. Anat.* II. Bd.) This opinion of the distinguished pathologist, nothwithstanding his ample opportunities for observation and known accuracy as an observer, is not substantiated by statistics. So far from its being true, the low degree of vitality in cyanosis appears to favor the occurrence of tubercles. I have records of twenty-six cases of cyanosis in which tuberculosis was also present, in several of which the lungs contained cavities. This is about thirteen per cent. of the whole number in my collection—a large proportion, since so many die in early infancy, at which period the tubercular disease is not apt to occur. Cyanosis appears, also, to favor the development of cerebral diseases, especially congestion and coma, as will be seen presently.

Prognosis.—This is unfavorable. Most cyanotic individuals die young. The age which they attain has been made the subject of statistical inquiry by Aberle. He states that in an aggregate of 159 cases, 57, or 35 per cent., died before the end of the first year; 108, or more than two-thirds, died before the age of eleven years; 30 between the ages of eleven and twenty-five years; and of the remaining 21, only 5 lived more than forty-five years.

The age at which death occurred is given, in 186 of the cases collected by myself, as follows:—

In 17	under the age of	1 week.	In 21	from 5 years	to 10 years.
" 10	from 1 week	to one month.	" 41	" 10 "	" 20 "
" 12	" 1 month	to 3 months.	" 20	" 20 "	" 40 "
" 11	" 3 months	to 6 months.	" 4	over 40 "	
" 17	" 6 "	to 12 "			
" 12	" 1 year	to 2 years.	186		
" 21	" 2 years	to 5 "			

Sixty-seven, then, or more than one-third, died before the close of the first year; 121, or more than three-fifths, before the age of ten years; only 24 survived the age of twenty years, and four the age of forty years. Of course, the duration of life depends on the nature and extent of the malformations. Some of these are such as render a speedy death inevitable.

Mode of Death.—The mode of death is recorded in ninety-five cases, as follows:—

19 died in a paroxysm of dyspnœa.
10 " suddenly (the exact manner not stated).
14 " in convulsions (infants).
2 " of apoplexy.
7 " from hemorrhage.
6 " of phthisis (though, as we have seen, twenty others had this disease).
2 " of exhaustion, without hemorrhage.
10 " of coma.
2 " of abscesses in the brain.

One died of each of the following diseases: cerebral irritation, congestion of brain, effusion in the cranial cavity, acute hydrocephalus, paralysis from acute softening of the brain, dysentery, inflammation of heart, syncope, mucus in the air-passages, thoracic inflammation, choleraic diarrhœa, pneumonitis, bronchitis, scarlet fever, croup. One died in trying to walk, one after a spasmodic cough in pertussis, one after a long agony, one after an agony of ten or eleven hours; one is recorded to have died gradually, and three quietly.

The ten who are stated to have died suddenly probably died in paroxysms of palpitation and dyspnœa, which, we have seen, are easily excited, and of common occurrence in cyanosis. If so this was the mode of death in 29 cases. Infants, with few exceptions, so far as appears from the records, died in convulsions. Nineteen died of cerebral affections, exclusive of convulsions, and in thirteen of these the cause of death was congestion, apoplexy, or coma. The hemorrhage of which seven died was probably, in most instances, dependent on phthisis, and six are said to have died directly of phthisis. We may, then, regard paroxysms of palpitation and dyspnœa, convulsions, congestive affections of the brain, and phthisis, as common modes or causes of death in cyanosis.

The malformations of the heart and great vessels which give rise to

cyanosis are quite numerous. The following table exhibits their character and relative frequency :—

	Cases.
1. Pulmonary artery absent, rudimentary, impervious, or partially obstructed	97
2. Right auriculo-ventricular orifice impervious or contracted	5
3. Orifice of the pulmonary artery, and the right auriculo-ventricular aperture impervious or contracted	6
4. Right ventricle divided into two cavities by a supernumerary septum	11
5. One auricle and one ventricle	12
6. Two auricles and one ventricle	4
7. A single auriculo-ventricular opening : inter-auricular and inter-ventricular septa incomplete	1
8. Mitral orifice closed or contracted	3
9. Aorta absent, rudimentary, impervious, or partially obstructed	3
10. Aortic and the left auriculo-ventricular orifices impervious or contracted	1
11. Aorta and pulmonary artery transposed	14
12. The cavæ entering the left auricle	1
13. Pulmonary veins opening into the right auricle or into the cavæ or azygos veins	2
14. Aorta impervious or contracted above its point of union with the ductus arteriosus ; pulmonary artery wholly or in part supplying blood to the descending aorta through the ductus arteriosus	2
Total	164

From the above table it appears that in more than one-half of the cases of cyanosis the congenital vice which gives rise to it is located in the pulmonary artery. It is located also, in general, in that part of the artery which is nearest the heart. Its character is different in different cases. Sometimes there is an arrested development of this vessel, and in its place we find simply a ligamentous cord extending from the heart as far as the ductus arteriosis, while beyond this point the artery and its branches are pervious ; rarely the entire artery is ligamentous and, of course, impervious ; in other cases this vessel is open through its whole extent, but the part nearest the heart is so small as to be properly considered rudimentary ; in others still there is adhesion of the valves to each other as the chief congenital defect, and, finally, in rare instances the obstruction in the pulmonary artery is due to an adventitious membrane, which stretches across the vessel like a diaphragm. These last malformations, namely, adhesion of the valves and the formation of an adventitious membrane, are, doubtless, due to inflammation occurring in the artery before birth, and some attribute the arrested development and ligamentous state of the vessel to the same cause.

In most cases of cyanosis, due to obstructive malformations, there is deficiency in the inter-auricular and inter-ventricular septa. This deficiency obviously results from the obstruction, for the septa are formed in the heart after fœtal circulation is established, and the blood, being prevented by the vicious formation from flowing in its proper channel, neces-

sarily passes to the opposite side of the heart. More or less blood being forced from one auricle or one ventricle to the opposite cavity, it is evident that a permanent aperture must result in the septum. The aperture in the septum ventriculorum is ordinarily at its base; in the septum auriculorum it corresponds with the foramen ovale.

In most of the obstructive malformations one and rarely two abnormal cardiac murmurs have been observed. The single murmur accompanies the ventricular contraction. As it has been observed in cases of complete as well as incomplete obstruction, it seems to be due mainly to the flow of blood through the apertures in the septa.

Modes of Compensation.—In most cases of cyanosis, the congenital defect is partially obviated by modes of compensation. In the most frequent malformation, that in which there is obstruction in the pulmonary artery, and a considerable part if not all the blood flows directly from the right to the left side of the heart, the ductus arteriosus not only remains open, but is greatly enlarged, through which a current of blood enters the pulmonary artery from the aorta, and passing to the lungs is oxygenated. The bronchial arteries have also been found greatly enlarged, and it is believed that though they are the nutrient arteries of the lungs, the blood which they convey to these organs is decarbonized in its circuit through them. In a case published by Mr. Le Gros Clark, in the *Medico-Chir. Trans.*, vol. xxx, the bronchial arteries were not only enlarged, but a "branch from the internal mammary artery, which accompanied the phrenic nerve, was nearly equal in size to the parent trunk, and expended itself principally in the adjacent adherent lung." Branches of the intercostal arteries have also been found enlarged, and entering the lungs, or connecting with vessels which enter the lungs. By such modes of compensation cyanosis is rendered milder, and life is prolonged. To these we must attribute the fact that some have very considerable malformation, and yet do not become cyanotic.

Morbid Anatomy.—This, as regards the circulatory system, has been sufficiently dwelt upon. No chemical analysis, so far as I am aware, has yet been made of cyanotic blood. We know that it is dark, its coagulability feeble, that it contains an excess of carbonic acid, and is deficient in oxygen. From the nature of cyanosis, it would be inferred that in many cases there is a degree of passive congestion in the cavities of the heart, and consequently in the capillaries of the systematic system, giving rise to more or less serous effusion. Statistics show that this is so. The quantity of pericardial fluid is in some patients increased. I have records relating to this fluid in fifty-one cases. Usually it was pure serum. In seventeen the quantity was half an ounce or less, if we include in the number those in which the amount is expressed in such terms as "due quantity," "unusual amount," and "small amount." In twenty-four cases the serum exceeded half an ounce; usually estimated at from one to six

ounces, but in two it exceeded the latter quantity. In one of the twenty-four the serum was sanguinolent. In two cases the records state that there was a small quantity of blood in the pericardium, and in the remaining patient the two pericardial surfaces were agglutinated by inflammation.

In some of the autopsies serum was found in the pleural cavities, usually in connection with pericardial effusion, and in at least one instance the serum was tinged with blood. Old adhesions between the costal and pulmonary pleura were observed in a few instances. The condition of the lungs was recorded with more or less minuteness in one hundred and ten cases. Mention has already been made of the large number affected with tubercular disease, which was either confined to the lungs, or was chiefly exhibited in these organs. In thirty-five patients the records state that the lungs were of small size, either by compression, or sometimes, apparently, by the continuance of the fœtal state over a greater or less portion of the organ. The compression was produced either by the distended pericardium or by effusion in the pleural cavities. In thirty-five cases the lungs presented a dark color. This hue in some specimens accompanied the unexpanded or fœtal state of the organ, but in others there was the normal inflation, and the dark color was due to engorgement or congestion. In other cases the lungs are stated to have been natural, except the color. In nine there was emphysema in a part of the lungs, in two pneumonitis; in two the color was pale, in one a bright crimson; in one the lungs were larger than natural, in one the right lung was absent, and in seventeen these organs were recorded healthy.

I have records of the state of the liver in twenty-six cases, in sixteen of which it was enlarged, and in four of those enlarged it was congested. Congestion was present in eight other cases, in which no mention is made of the volume. The parenchyma had a natural appearance in nine cases, but in some of these there was enlargement. From these statistics it is probable that the liver is commonly enlarged in cyanosis, and not infrequently congested. In a few cases the condition of the other abdominal viscera is mentioned; in some as healthy, in others as congested. There were fifteen examinations of the brain, in seven of which congestion is recorded, and in three abscesses in the cerebral substance, in one of which cases the lateral ventricle was also filled with pus; in two there was softening of a portion of the brain, in three the brain was firm or compact, in three the quantity of fluid in the cranial cavity exceeded the normal amount, and in one it was less.

Theories Relating to the Etiology of Cyanosis.—Although in nearly all cyanotic patients there are direct communications between the two sides of the heart, it is shown by many observations that these communications or apertures are not sufficient in themselves to produce cyanosis. This opinion was expressed half a century ago by Louis, who published an excellent monograph on the subject of these communications,

basing his remarks on an analysis of twenty cases. Since the publication of this paper, the belief has been pretty general in the profession, and observations continue to substantiate it, that, although the apertures may be of considerable size, if the two sides of the heart, with their orifices and vessels, are in their normal state, so that they act symmetrically and without obstruction, cyanosis will not occur. In proof of the correctness of this opinion many cases might be cited of a pervious, and some of a largely dilated foramen ovale without the cyanotic hue, cases which have been published in the journals since the appearance of Louis's monograph. Still, in cases of obstructive malformation, unless the obstruction is complete, cyanosis is more apt to occur in consequence of these apertures, for were they absent a larger amount of blood would be propelled through the narrowed orifice, and a larger amount consequently be oxygenated.

Allusion has already been made to the two theories which prevail in the profession; the one attributing cyanosis to the intermingling of venous and arterial blood; the other to obstruction at the centre of circulation, and consequent venous congestion. There are serious objections to the acceptance of either theory as an explanation for all cases. That admixture of the two kinds of blood is not essential to the production of cyanosis, is apparent from the following facts. In one case in the *Fourth Malformation*, there was no communication between the two sides of the heart, and the ductus arteriosus was closed, so that admixture was impossible. Again, in the *Eleventh Malformation*, or that in which the aorta and pulmonary artery are transposed, the blue disease evidently does not depend on the admixture of the two currents. On the other hand, in this curious state of the heart, the more the admixture the less the cyanosis, since the only way in which the systemic current of blood can be arterialized is by passing to the opposite side of the heart. An argument against this doctrine may also be found in the fact that the modes of compensation are not such as in any way diminish or obviate the admixture. It is admitted that in the more frequent malformations cyanosis is increased by the apertures, which allow the intermingling of the venous and arterial currents, but it is more reasonable to consider the intermingling and the cyanosis as the direct results of the malformation, neither having the precedence of the other, than to consider that they are related to each other as cause and effect, or as proximate and remote results. Viewed in this light, the admixture must be considered simply a concomitant of the cyanosis.

The second theory, that of venous congestion, has numbered among its advocates many who have given special attention to the subject, as Morgagni, Louis, and Stillé, but it seems to have even less claim for acceptance than the theory of admixture. It has been seen that in nearly all cases of cyanosis the two sides of the heart communicate freely, so that if the current of blood meets with an obstruction, as it commonly does, it readily escapes to the opposite side where the artery is large and gives it

free passage. In this way congestion, if not prevented, is greatly diminished. Again, it will be seen that, although certain of the viscera are frequently found at the autopsy more or less congested, congestion is not uniformly present in the organs, as it would probably be were it the proximate cause in all cases of cyanosis.

Moreover, in some patients the malformation is not obstructive. The cavities and their orifices are of the normal size, and cyanosis is due entirely to malposition of the vessels. It cannot be said that in these cases there is venous congestion from arrest at the centre of circulation. If there is any congestion, it must be due to the fact that venous blood does not circulate as readily as the arterial in the capillaries. It is true that in the paroxysms of dyspnœa there is sometimes more or less congestion; the distension of the jugulars show this, but it subsides with the paroxysms, and it probably is no more than usually occurs when the respiration is greatly embarrassed.

In fine, attempts to express the immediate pathological state producing cyanosis in the terms of a general law have failed. However plausible the above theories may appear in regard to certain cases, there are others to which they are manifestly inapplicable. Those who advocate these theories seem to lose sight of the obvious fact that the chief want of the economy in cyanosis is decarbonization of the blood, and it is hardly supposable that there can be any correct theory of its causation which is not founded on this fact. With this physiological state in view, it does not seem difficult to express a theory in comprehensive terms which is applicable to all cases, such as the following: *Cyanosis is due to vices or defects in the organism, usually congenital, which prevent the free and regular flow of blood to, through, or from the lungs.* So comprehensive a statement includes not only cases of malformation and malposition of the heart and its vessels, but also those few cases in which the lungs are in fault. In most patients, as we have seen, the current of blood *towards* the lungs is obstructed, and the current of blood *from* the lungs, in those comparatively rare cases in which the malformation is on the left side.

Treatment.—From the nature of cyanosis it is evident that the treatment should be more hygienic than medicinal. The patient should be warmly clad and kept in a warm room, and all agencies calculated to embarrass or disturb the functions of the body or excite the emotions, and thereby accelerate the heart's action, should be studiously avoided. The diet should be nutritious, but simple and easily digested.

Those who have attributed cyanosis wholly to apertures in the interauricular and inter-ventricular septa, and the consequent flow of blood from the right to the left side of the heart, have considered it an important part of the treatment to keep the patient reclining on the right side, so as to diminish this flow by the effect of gravitation. The reader, however, must be convinced from the nature of the malformations that little benefit

can accrue from following such advice. Still, patients are sometimes less cyanotic and more comfortable in one position than another. In a case reported by Mr. Howship (*Edin. Med. Jour.*, 1813), "the only easy and indeed comfortable position in which the child could remain was that usual in nursing. When erect, the dusky color of the face and neck became a dark-blue." In a case related by Mr. Spackman (*Lond. Med. Gaz.*, 1833), the patient was easiest on the hands and knees. Louis reports a case (*de la Commun. des Cav., etc.*) in which the selected position was with the head elevated; Wm. Hunter a case (*Med. Obs. and Enq.*, vol. vi) in which the patient avoided paroxysms by lying on the left side. Struthers and King each reports a case in which the patients seemed most comfortable while lying on the right side (*Monthly Jour. of Med. Sci.*), while, on the other hand, Professor White, of Buffalo (*Buf. Med. Jour.*, 1855), and Dr. Jas. Carson (*Amer. Jour. of Med. Sci.*, 1857), report cases in which position on the right side failed to produce any alleviation of symptoms. Other similar observations might be cited, but enough have been mentioned to show that no one position should be recommended for cyanotic patients. Some obtain most relief by lying on the back, others on the right side, others on the left, some when on the hands and knees, some when reclining on either side indifferently, while, finally, others suffer least when erect.

There was a time when the paroxysms were treated by venesection, but depletion has long since been abandoned. Physicians now rely on stimulants, antispasmodics, friction to the chest, and mustard pediluvia, to relieve the urgent symptoms, although this treatment is but partially successful. It is probable that of all internal remedies digitalis is the most useful, from the fact that it is an efficient heart tonic, and more than any other medicine gives strength and equality to the heart beats. In the cities where oxygen gas can be procured for daily inhalation, it seems not improbable that the urgent symptoms might in some instances be partially relieved by the use of this agent.

SECTION V.

SKIN DISEASES.

CHAPTER I.

ERYTHEMATOUS DISEASES.

Under this head are included erythema, roseola, and urticaria. They consist in an active congestion, inflammatory it is believed, of the skin, which soon declines, with or without slight furfuraceous desquamation. The color of the affected cuticle is bright-red in erythema, rosy in roseola, and pale-red in urticaria. Febrile symptoms often precede for a few hours the occurrence of the eruption, and abate as it appears.

Erythema.

The eruption of erythema occurs in patches of different sizes, the largest ordinarily not exceeding four or five inches in length, and most of them have considerably smaller dimensions, their margins being in some instances diffused, and in others circumscribed and well defined. The patches are slightly swollen from engorgement of the capillaries of the skin and slight serous effusion, and are accompanied by a sensation of heat and itching.

Erythema is idiopathic or symptomatic. The *idiopathic* form is subdivided into erythema simplex, intertrigo, and læve. Erythema simplex is produced by external agencies of an irritating nature, as heat, cold, friction, chemical and mechanical irritants, applied to the skin. A common example of this form of the disease is the efflorescence about the anus in cases of infantile diarrhœa due to acidity of the evacuations. Erythema intertrigo is produced by the friction of opposing surfaces of the skin, and it therefore occurs mainly in the folds of the neck, about the groins, and behind the ears. This inflammation is sometimes slight, disappearing in two or three days with proper treatment; in other cases the epidermis becomes denuded, the surface is tender and moist, and even superficial excoriations occur. In severe cases the ulcers extend more deeply and give rise to considerable purulent discharge, the skin and even subcutaneous connective tissue being more or less infiltrated and indu-

rated. The confinement of the perspiration, and the moisture, which is exuded between the folds of the skin, increase the inflammation. The effused liquid does not in ordinary cases stiffen linen, as in eczema. Erythema læve is the name applied to the inflammatory hyperæmia of the skin, which often occurs over œdematous parts. Its most common seat is about the ankles and upon the legs. In children it is most frequently observed in the œdema which results from scarlatinous nephritis and from heart disease.

Symptomatic erythema, which results from a general or constitutional cause of a pyrexial character, has several subdivisions. The simplest and mildest form of it is erythema fugax, which comes and goes quickly. The erythema which occurs upon the features in acute meningitis is a typical example. It is common in various inflammatory and febrile affections. If the erythematous patch is circular, with normal skin in its centre, it is sometimes designated erythema circinatum, and, if the margin is well defined, marginatum. Erythema papulatum, tuberculatum, and nodosum are applied to the same form of the disease, one or the other term being employed according to the stage or size of the eruption. In erythema papulatum the eruption begins as small red spots, which soon become papular, and attain a size varying from that of a pin's head to a split pea. It occurs especially on the neck, breast, arm, and back of the hand, and fades away, with a slight desquamation, in about three weeks. In erythema tuberculatum and nodosum the eruptions have a greater diameter, and are usually more prominent. In the latter variety they often have a diameter of two or more inches, and occur most frequently upon the anterior aspect of the leg. These three forms of erythema, which might be described as one, occur chiefly in young people. Erythema tuberculatum is most common in servants, especially those recently from the country. The tumefaction is due to the effusion of serum in the corium, and, when the eruption has considerable prominence, also in the subcutaneous connective tissue. The color is at first a bright-red, then dark-red or purple, and it fades away like the discoloration of a bruise as the eruption declines. Rheumatism is often and diarrhœa occasionally associated with these forms of erythema, and rheumatic pains are occasionally present, as well as more or less febrile movement.

Prognosis.—This as regards the erythema is always good. An unfavorable result in any case is due to cachexia, or some coexisting disease. The duration of the milder cases is only a few hours, while those of a more severe type, as erythema nodosum, last two or three weeks.

Diagnosis.—The ordinary forms of erythema are distinguished from *erysipelas*, by the absence of any very decided burning pain, and tumefaction of the integument, and tendency to spread, and by less marked constitutional symptoms. In those cases of erythema in which there is infiltration and swelling of the skin and subcutaneous connective tissue, the

patches are distinguished from those of erysipelas by being multiple, of smaller size, less hot and painful, not extending, and presenting as they disappear the phenomena of a bruise. In *urticaria* the wheals that come and go suddenly with a peculiar stinging sensation, and the irritability of the skin in consequence of which these wheals are produced by slight friction, differ so much from the symptoms and appearances of erythema that the differential diagnosis of the two is easy. In *roseola* the eruption ordinarily occurs over a large part, if not the entire surface, in points and small patches with healthy skin between, and presenting a rosy instead of a bright-red color, characters which sufficiently distinguish it from erythema. Erythema when extensive is sometimes mistaken for the scarlatinous eruption, but the redness of the fauces, graver constitutional symptoms, vomiting, persistence of the eruption, etc., serve to distinguish the latter from the former affection. In cases of doubt it is proper to defer the diagnosis for a day or two, when if the rash is erythematous it will fade. Erythema sometimes occurs in the initial stage of variola, when, on account of the grave general symptoms, it may be mistaken for scarlatina. I have more than once known this mistake to be made in the hurried visit of the physician. A more careful examination would prevent this error. There is little danger of confounding erythema with measles, or the various papular, vesicular, or pustular skin diseases.

Treatment.—Erythema fugax requires no special treatment, unless occasional dusting the surface with lycopodium or powdered starch. Those forms of erythema which are due to mechanical or chemical irritants soon disappear when the cause is removed. In erythema around the anus, produced by the irritation of the urinary and alvine evacuations, the diaper should be changed as soon as soiled, and if the stools are frequent and acid, the alkaline treatment proper for the diarrhœa is useful also for the erythema. In inflammation from this cause as well as in erythema intertrigo, the following prescriptions will be found beneficial:—

℞. Pulv. zinc. oxid.,
Lycopodii, āā equal parts. Misce.
To be frequently dusted upon inflamed surface. It is better to apply vaseline first, and dust upon this.

℞. Zinci oxid., ʒij;
Glycerinæ, ʒij;
Liq. plumb. subacetatis, ʒiss;
Aquæ calcis, ℥vj to viij. Misce.

In obstinate cases a weak solution of nitrate of silver, sulphate of copper, or better, as it does not stain the linen, sulphate of zinc, will frequently be followed by immediate improvement.

℞. Zinci sulphat., gr. vj;
Glycerinæ, ℥ij;
Aq. rosæ, ʒiv. Misce.
To be constantly applied between the folds of the skin on linen.

Chlorate of potash, internally, to correct the acidity of the transpiration from the skin in protracted and obstinate cases, and in certain instances cod-liver oil and the syrup of iodide of iron, are called for. If the derangement of the system upon which the erythema depends appear to be of a rheumatic character, colchicum or alkalies may be required. Erythema papulatum, tuberculatum, and nodosum occur most frequently in reduced states of the system, and therefore need tonics.

Roseola.

The term roseola is applied to rose-colored spots or patches of greater or less extent, accompanied by a degree of febrile reaction, and often by redness, with little or no swelling of the faucial surface. It is attended by a sensation of warmth and slight itching. The following groups and subdivisions embrace the recognized varieties of this disease :—

ROSEOLA.

Idiopathic.	*Symptomatic.*
Infantilis.	Variolosa.
Æstiva.	Vaccinia.
Autumnalis.	Miliaris.
Annulata.	Rheumatica.
Punctata.	Arthritica.
	Cholerica.
	Febris continuæ.
	Syphilitica.

The color of the eruption gradually fades from a rose-red to a duller hue, and often disappears in two or three days. In other instances the eruption lasts a week or more. Roseola may occur in any season, but it is most common, especially the idiopathic form, in the warm months. Those varieties of the idiopathic disease which are designated infantilis, æstiva, and autumnalis are the most common in early life. They are in reality identical, or nearly so, and may be described as one disease.

SYMPTOMS.—Roseola infantilis, æstiva, or autumnalis may be partial, appearing upon the arms and legs, or general. It is often preceded by febrile movement, languor, and in those old enough to describe their sensations, pain in head, back, and limbs. There is great difference, however, in different cases as regards the severity of the prodromic symptoms. They may be absent or so slight as scarcely to be appreciable. Occasionally vomiting, diarrhœa, or other symptoms of derangement of the digestive apparatus immediately precede the eruption.

The eruption of roseola, when general, usually commences upon or about the neck and face, and in the course of twenty-four to thirty-six hours

appears upon the rest of the surface. It bears considerable resemblance to that of measles. The patches are irregular in shape, a quarter to half an inch in diameter, and, though of a rose color at first, they soon present a dusky hue as they begin to fade; by pressure the redness disappears. In the majority of cases the eruption has nearly faded by the fifth day. The redness of the faucial surface, together with the itching or tingling, disappears with the subsidence of the rash.

Roseola annulata is a rare disease. It commences with constitutional symptoms, which are slight or pretty severe, and which cease when the eruption appears. This occurs in the form of red circular spots, which enlarge to the diameter of an inch or thereabout and assume the shape of rings inclosing healthy skin. The rash fades in a few days, often leaving a bruised appearance. The ordinary location of this form of erythema is upon the abdomen, and about the thighs. In roseola punctata the eruption is of small size, and it occurs upon a large part of the surface.

Symptomatic roseola, which appears in the course of various diseases, need only be alluded to. The diseases in which it is developed are, with the exception of syphilis, chiefly of an acute febrile or inflammatory character. This eruption is often really, as stated by Tilbury Fox, a rose-colored erythema, but in other instances it presents the typical form and appearance of roseola. Thus I have known it to occur about the eighth or ninth day of vaccinia in rose-colored spots over the whole surface, and producing much anxiety on the part of parents, lest impure virus had been employed.

Causes.—These are in a measure obscure. The delicacy of the skin in infancy and the active cutaneous circulation no doubt predispose to roseola and erythema, and hence the frequency of their occurrence in acute febrile and inflammatory affections. Summer weather, with the derangements of system which it produces, has been in my experience much the most frequent cause of idiopathic roseola in young children in this city. In certain summers, as in that of 1868, a large proportion of the infants have been affected by it, and I have been led to consider it a favorable prognostic sign as regards the diarrhœal affections which are so common in the warm months.

Prognosis.—Roseola is always a mild and favorable disease.

Diagnosis.—Roseola is distinguished from measles, by the absence of catarrhal symptoms, a less degree of fever, less uniformity in the size of the eruption, and the absence of any history of contagion. Roseola is distinguished from erythema by the smaller size of the eruption and its rosy or dusky red color. The boundary line, however, between the two diseases is not well defined, and certain forms of roseola might be described as erythema. The general but punctiform efflorescence, increase of temperature, acceleration of pulse, and the peculiar appearance of the tongue and fauces, serve to distinguish scarlet fever from roseola. There

is little danger of confounding roseola with urticaria, since the wheals of the latter appear in no other disease.

Treatment.—This is simple. If roseola occur in connection with gastro-intestinal derangement or disease, the remedies which relieve the latter exert a curative effect upon the former. In all cases the state of the system should be inquired into, and any departure from a state of health corrected. Roseola needs no farther constitutional treatment. If there is itching or tingling of the surface, a lukewarm lotion, containing equal parts of liq. ammon. acetat. and mistura camphoræ, has been recommended, or a lotion containing a drachm of hydrocyanic acid to a pint of an emulsion of bitter almonds, used warm. The purpose of such lotions is simply to relieve the unpleasant sensation. Cold applications, or others which would repel the eruption, should be avoided; such an effect might be injurious. In cases of acidity of stomach alkaline remedies are useful, and in certain cases tonic treatment is indicated.

Urticaria.

The name by which this disease is designated is derived from the term *urtica*, the nettle, the sting of which produces this form of eruption. The eruption occurs suddenly in wheals or pomphi, attended by tingling and burning, and suddenly disappearing. Urticaria is often accompanied by no very decided general symptoms, but in other cases there are febrile movement, and lassitude, with perhaps epigastric pain and headache. The wheals may occur over the whole body, but more frequently are confined to a portion of it. Their shape may be round, oval, irregular, or band-like, and their length varies from a few lines to several inches. In one affected by urticaria the wheals can be readily produced by scratching or rubbing the surface. The eruption is thus clearly described by a recent writer: "At first a bright flush appears, the centre of this becomes slightly elevated, and pales, hence appears of lighter color; the tint may be rosy, but more generally it is whitish." The margin of the wheal, the diameter of which varies, always remains red. This eruption appears to be produced by active congestion of the cutaneous capillaries, some serous effusion, and spasm of the muscular fibres of the skin. The effusion of serum in certain localities is quite apparent from the œdema which occurs. The subsidence of the eruption is without desquamation. Urticaria is ordinarily an acute disease. It is sometimes chronic in the adult, but rarely so in children. Several varieties of it are described by dermatologists, according to the cause, appearance, and duration.

Causes.—These are external and internal. Various irritants apart from the nettle applied to the surface produce the wheals, as the bites of certain insects and sometimes turpentine. The following are the principal internal causes, as summarized by Hillier: 1st, profound and sudden men-

tal emotion; 2d, certain articles of diet, as shell fish, pork, sausage, cheese, etc.; 3d, certain medicinal substances, as copaiba, valerian, and turpentine; 4th, intestinal worms, though it is probable that these seldom operate as a cause; 5th, uterine ailments, as hysteria.

Prognosis—Diagnosis.—The prognosis is good, though the chronic form is sometimes tedious and troublesome. The occurrence of the wheals and the possibility of producing them by friction serve to distinguish this disease from all others.

Treatment.—In urticaria due to any recent ingesta of an irritating or indigestible character, an emetic of ipecacuanha is useful, followed by a saline, and better also alkaline aperient, as Rochelle salts. An aperient of this character is useful ordinarily in acute cases, attended by febrile reaction. The diet for several days should be simple, and such as is readily digested, as fresh beef, bread, or other farinaceous food, and milk. Occasionally the wheals appear periodically, when a few doses of quinine effect a prompt cure. After the above measures have been employed, the subsequent treatment, whether tonic or otherwise, depends on the condition of the patient. Little benefit accrues from local measures. Sponging the surface with cool water to which a little vinegar is added relieves, in a measure, the heat and tingling of the wheals.

CHAPTER II.

PAPULAR DISEASES.

STROPHULUS.

The three papulæ, namely, lichen, prurigo, and strophulus, which are characterized by small and firm elevations upon the skin, occur in children; but the two former are not common, and, as they do not differ in any essential particular from the same diseases in the adult, they will not be treated of in this connection. Strophulus, on the other hand, is a disease peculiar to children. It is known as the red gum or white gum according to its appearance, and also as the tooth rash. This eruption appears usually on parts which are exposed, as the face, neck, and extremities, the papules being in some patients of the size of, or even smaller than, a pin's head, while in other cases they are as large as a millet-seed.

The varieties of strophulus described by dermatologists are:—

S. intertinctus.
" confertus.
" albidus.
S. candidus.
" volaticus.
" pruriginosus.

The following are the characters of these varieties: S. intertinctus, papules bright red, and occurring chiefly upon the cheeks, forearm, and back of hand; often *intertinctured* with blushes of erythema; it lasts from two to four weeks, and is most common in young infants. S. confertus, papules numerous, and closely aggregated, paler, continuing longer than in strophulus intertinctus, and likely to recur, appearing about the time of dentition, and most frequently upon the arm. Sometimes certain of the patches become chronic, slowly disappearing, and leaving the skin rough and dry. S. volaticus appears usually upon the arms and cheeks in patches of about a dozen, fewer or more, papules, which soon disappear. These patches reappear at intervals for two or three weeks, and are attended by heat and itching, though not intense. S. albidus, so called, should really be placed among the diseases of the sebaceous glands, and described under another name. It appears in the form of small white elevations as large as a pin's head, commonly upon the face and neck, and produced by distension of the sebaceous glands with the secreted product. The term strophulus candidus is applied to large whitish papules, which appear upon the sides of the trunk, shoulders, and arms of infants of one year or thereabouts, and disappear in about one week. They are apt to be associated with the papules of strophulus confertus. S. pruriginosus is really a form of lichen, occurring chiefly over the age of one, and under that of eight or nine years. The papules, which are small and discrete, usually appear over a large extent of surface, ordinarily upon the back, front of the chest, the face and arms, and, as they are scratched from the itching, minute dark points of blood collect and dry upon their apices. This form of strophulus is more protracted than the others, and, in consequence of the irritation produced by the scratching, pustules of ecthyma often occur among the papules. The apparent cause of strophulus pruriginosus is a mode of life which impoverishes and vitiates the blood, such as uncleanliness, residence in damp, dark, overheated, and overcrowded apartments. Atmospheric heat also operates as a cause, and it is a not infrequent disease in the cities during the summer months.

The various eruptions included under the term strophulus have such different anatomical characters, that a proper classification would locate some of them in other groups of skin diseases. One form of it, as we have seen, is produced by distension of the sebaceous glands; in other and the majority of cases, as appears from the recent observations of Mr. Fox, its seat is the sweat glands, and in others still the papillary layer of the skin, as in lichen, the papules being produced by an exudation.

Treatment.—Personal cleanliness, with frequent change of linen, and daily ablution without the use of soap, should be enjoined. Local irritants, which might aggravate or cause the disease, should, so far as practicable, be removed. Alkalies in cases of acidity of the *primæ viæ*, and occasionally mild aperients, are required; the food should be bland, but nutritious,

and if the child is nursing, it may be necessary to attend to the health of the wet-nurse. Favorable hygienic conditions important for the successful treatment of all forms of strophulus are especially required in strophulus pruriginosus. Nutritious diet, fresh air, quinine, iron, cod-liver oil, etc., should be prescribed for those affected by it. The following formula is recommended for sponging the surface in cases of strophulus :—

℞. Sodæ carbonat., ℈j ;
Glycerinæ, ℥ij. ;
Aq. rosæ, ℥vj. Misce.

CHAPTER III.

ECZEMA.

This is one of the most common maladies of the skin. It constituted one-third of Devergie's cases, and one-sixth of Hillier's. In the commencement of the eczematous eruption the skin presents a superficial redness, and upon this inflamed area numerous minute and closely aggregated papules, vesicles, or, more rarely, pustules, soon appear. These are very fragile, so that they soon rupture, the epidermis is broken and destroyed, and the surface is moistened by an effusion which appears to be serum, and cannot be distinguished from it by the microscope. This liquid when dry stiffens linen. As it dries thin crusts form, of a light-yellow color, in most localities, but thicker, and of a deeper yellow color upon the scalp. The crusts consist mainly of pus, epithelial cells, and granular matter.

Anatomy.—Biesiadecki has described the formation of the eczematous eruption. According to him the papules are produced from the papillæ, which increase in size by cell formation in their interior. The connective-tissue corpuscles enlarge, and are unusually "rich in fluid," and their number increases. Under the microscope spindle-shaped corpuscles are observed, filling the papillæ, and extending up from them into the rete Malpighii, crowding apart the cells of this layer, and reaching and elevating the epidermis. The epithelial cells in the immediate vicinity of the papillæ also become swollen. This cell-growth produces the eczematous papule.

If the cell formation continues within a papilla, certain of the cells are ruptured, and as they are very moist a liquid is effused, which raises the epidermis over the summit of the papilla. This produces the eczematous vesicle. Occasionally pus mixes with this liquid, and the eruption is then vesico-pustular.

In acute eczema the upper part of the true skin is infiltrated and swollen, while the lower part is commonly unaffected, except in the most severe cases. The older the eczema the greater the extent of the infiltration, so that in chronic eczema the whole thickness of the skin is more apt to be involved than in acute forms of the malady. The discharge of the eczematous surface is irritating, and healthy skin, with which it may come in contact, is often reddened by it and made eczematous, from its irritating effect. This eczema occurring upon a part of the surface which is in contact with an opposite surface of sound skin, commonly affects the latter, and as Neumann has stated, a nurse, by carrying an infant having eczema upon its nates, may contract the same disease upon her arm, although there is no contagious principle in this malady.

Etiology.—Eczema is often produced by irritating substances applied to the skin. Croton oil, certain soaps, the finger nails in scratching, a hat, truss, or belt, by pressure may produce it. Those having a tender and delicate skin are more liable to it than others. The constitutional causes are often obscure. It is sometimes obviously due to indigestion, or a diet which disagrees, for we see it occur in nursing infants as a result of sickness of the mother. Anæmia and scrofula are occasional causes. Among the city poor eczema is common, and many of the children who have it are scrofulous, but a large proportion show no evidence of struma, and in the better classes of society a majority do not.

Varieties—Symptoms—Course.—Eczema is sometimes designated according to its location as *E. faciei*, *capitis*, etc. Another designation, which has more scientific value, is according to the form and stage of the eruption, by which we have the following recognized varieties, to wit: Eczema papulosum, vesiculosum, pustulosum, rubrum, impetiginosum, and squamosum. A simpler and still more convenient classification is into eczema simplex, rubrum, impetiginosum, and squamosum.

Eczema of the scalp is common in infancy, occurring as an eczema rubrum or impetiginosum. The eczematous exudation mingling with the secretion of the sebaceous glands, which are numerous upon the scalp, forms a thick yellow crust. It is apt to extend beyond the hairy portion to the forehead and around the ears. This extension aids in establishing the diagnosis between eczema and certain other cutaneous eruptions of the scalp. Eczema of the external ear is sometimes primary, but in other instances it is consecutive to that of the scalp, and due to the extension of the latter. Its common seat is in the angle behind the ear, and upon the lobe of the ear, whence it often extends along the auditory meatus, narrowing its calibre, and impairing the hearing temporarily, or even for years. Eczema upon the forehead commonly occurs in children from extension of the eruption from the scalp. The cheeks, lips, and chin are often also affected by eczema, which in this situation is commonly eczema rubrum, and is attended by redness, swelling, and troublesome itching.

The swollen and red appearance with the crusts and marks produced by scratching often greatly disfigure the countenance. In children, when eczema occurs upon other parts, it is usually associated with that of the scalp, face, or ears—that in the latter situations being the most severe and obstinate.

Eczema simplex is common in the summer months, being produced by the heat of the atmosphere, aided perhaps by other causes. The patient may appear well, or be somewhat indisposed, having febrile symptoms, and soon an erythematous patch of greater or less extent appears, upon which a cluster of the characteristic papules or vesicles soon occurs. These break, forming slight crusts, which are detached, and the eczema declines, or it may continue longer, with successive crops of the eruption.

In eczema *rubrum*, since it is a more severe form of the disease, the febrile movement and the local symptoms are greater than in the preceding variety, and the eczematous patch presents the appearance of a more intense inflammation. The papules or vesicles are often so minute as to be with difficulty recognized. They are soon broken, when they form with the secretion and exudation from the surface yellowish or brownish-yellow scabs. The discharge is more irritating as it is more abundant than in eczema simplex, and the adjacent skin is usually more inflamed from its contact.

Eczema *impetiginodes* is common in young debilitated children, in whom, in consequence of the cachexia, inflammations, of whatever character, are apt to be suppurative. This form of eczema presents at first the symptoms and features of eczema rubrum, but the transparent liquid of the vesicles soon becomes opaque, from the generation and admixture of pus-corpuscles. The crusts, which form from the rupture and desiccation of the vesiculo-pustular eruptions, are thick and greenish-yellow, and in infants the sebaceous glands, which are involved in the inflammation, pour out an abundant secretion, increasing the thickness of the crusts. This form of eczema is most common in infancy, and its usual seat is upon the scalp.

Diagnosis.—Eczema presents in different instances so different an appearance that it is not always readily diagnosticated. It will aid in its diagnosis to recollect that it is in its nature a catarrh, affecting primarily and chiefly the upper portion of the derma and the Malpighian layer, and although it may, at present, present a dry or scaly appearance (E. squamosum) yet its history will show that there has been a discharge or moisture. In a large proportion of cases, the physician is not able to detect papules or vesicles, since they are fragile and transient, breaking in the first thirty-six hours, and not reappearing. Still, when they are absent, we sometimes observe around the margin of the patch an appearance which indicates that they have been there. Their minuteness is occasionally such that they may escape notice, on a cursory inspection, when they are present and well defined. Acute eczema, affecting a considerable extent of surface, is often attended by febrile movement, and might be mistaken for one of

the eruptive fevers, but the absence of certain distinctive appearances, which characterize these fevers, and the speedy appearance of the eruption and moisture, establish the diagnosis. Eczema can be readily diagnosticated from ordinary erythema, which is a superficial inflammation without moisture. The location of erythema intertrigo serves for its diagnosis, as it is evidently produced by the attrition of opposite surfaces of the skin. Moreover it lacks the elevated papillæ, and the discharge does not stiffen linen like that of eczema. Lichen, when acute, presents some resemblance to eczema, but it is dry and papular, the papules, though small, being detected by the finger as well as sight. The large and irregular phlyctæna, intense inflammation and œdema, and mode of extension of erysipelas; large, scattered, and non-inflammatory vesicles of sudamina; scattered and acuminate vesicles, without surrounding inflammation, of scabies; are so different from the eczematous eruption that the differential diagnosis is readily made. Herpes circinatus can be distinguished from eczema by its circular shape, larger size, and greater permanence of the vesicles, and the delicate, branny scales, which consist rather of epithelial cells than the product of exudation as in eczema.

Treatment.[1]—Every case of eczema should be cured as quickly as possible, as we know that there is no danger of any other disease arising from too rapid cure of any skin affection, and also know that a long continued eczema may not only seriously interfere with the general health of a child from the constant irritation and restlessness which it produces, but also that from the cutaneous irritation the neighboring lymphatic glands may become inflamed and undergo a caseous degeneration, which in turn can produce a tubercular formation in the lungs or meninges. The treatment of eczema is both local and constitutional. Some cases do well with local treatment alone, but in the majority internal treatment is of great assistance, even when we are unable to detect any dyscrasia or special condition of the blood or general system. If any special dyscrasia is present, as scrofula, etc., then the child must be treated with the appropriate agents for this in addition to the means employed against the eczema. No one line of treatment is suitable for every case, and therefore a large number of remedies have been used and recommended. Among the city poor strumous cases are common, and cases also in which without any pronounced diathetic state the cause is apparently a reduced state of the system from innutritious diet and other anti-hygienic conditions. Such cases require better diet and a mode of life more in accordance with the sanitary requirements. On the other hand, I have observed cases of eczema which seemed to be produced by a plethoric state of the system in the nursing infant, when the milk of the mother or wet-nurse was unusually rich and

[1] I am indebted to Dr. A. R. Robinson of the Dermatological Society for the revision of the pages which relate to the treatment of eczema. J. L. S.

abundant. While, therefore, ill-nourished and weakly children require better regimen, with perhaps vegetable and ferruginous tonics, the plethoric require reducing treatment, though of a gentle kind. For the latter the following prescription will be found useful :—

℞. Pulv. rhei, ʒss ;
Sodæ bicarb., ʒj ;
Aquæ menth. piperitæ, ℥iv. Misce.
Dose, one teaspoonful three or four times a day for a child of two years of age.

In such cases, also, an occasional purgative dose of calomel has been recommended by some dermatologists. In addition to measures designed to meet the special indications of a case, there is one internal remedy, arsenic, which has been found of signal benefit, whatever may have been the fault of system from which the eruption originated. As I have stated in the chapter relating to therapeuties, children tolerate arsenic much better than adults do, consequently it can be given to them in larger proportionate doses. A most useful combination is that of arsenic with alkaline diuretics, as the latter exert a marked beneficial influence upon eczema, frequently not inferior to that of arsenic. In fact, at the commencement of an acute eczema, it is better to give the alkaline diuretics alone, and, later in the disease, when there is less redness and irritation of the skin, to combine the arsenic with them. The dose of the latter is to be regulated according to its effect upon the child and also upon the eruption. Always give as large a dose as the child will bear well, so as to obtain the best results from its action. The following formula is for a child one year old :—

℞. Potassæ acetatis, ʒiss ;
Liq. potassæ arsenitis, gtt. xxiv ;
Spits. etheris nitrosi, ʒij ;
Syrupi aurantii, ʒvj ;
Aquæ carui, ℥iij. Misce.
Dose, one teaspoonful three times a day.

If the arsenic produce intestinal irritation, paregoric should be added to it.

Local Treatment.—This varies according to the condition of the skin at the seat of the eruption. In all cases of acute eczema with irritable skin, soothing applications must be employed, and not irritating salves. The part should not be washed with water, as it irritates and aggravates the eruption. When the surface is red, angry looking, and discharging a thin watery secretion, lead or alkaline lotions are useful, as the following :—

℞. Liq. plumbi subacet., ℥j ;
Glycerini,
Aquæ, āā ℥iv. Misce.
To be applied two to four times a day with a camel's-hair pencil.

One of the most useful applications for the treatment of eczema in children is a salve made of equal parts of vaseline and simple lead plaster. If this proportion is too strong for an individual case, it can be made milder by increasing the amount of vaseline. It should be applied twice a day by spreading it either on linen or waxed paper. Sometimes the oxide of zinc ointment answers very well for the early stages of the disease. The ointment of the pharmacopœia is, however, generally too strong, so that it may irritate—five grains to the ounce of simple salve being frequently strong enough. Sometimes the part is so tender that only a dusting powder can be used to protect the surface from the air whilst internal treatment is employed. When the discharge has become thicker and more purulent, and forms scabs, the above mentioned ointments are to be used. If the scabs are very thick they can be removed by soaking the part with oil and washing once with soap and water. In eczema of the scalp, if the hair is long it should be cut as short as possible, otherwise a salve cannot be applied with any benefit. When the eruption has arrived at that stage when almost all discharge has ceased, and the surface is simply hyperæmic, with more or less branny scales, some tar preparation should be used. These remove the last traces of the eruption, and stop the itching which is present.[1] They are to be used as long as any itching or trace of the disease is present, since, until they both disappear, there is danger of a return of the eruption to an acute condition. The oil of cade can be used of full strength or diluted with alcohol or mixed with cod-liver oil to any desired extent. It must be well rubbed into the part, and applied about once a day. In eczema rubrum situated in the flexures of the joints, we have obtained good results by the constant wearing of a solid rubber bandage on the part until cured. If the eczema occupy a large portion of the surface of the body, then it is advisable to endeavor to cure the eruption by the internal use of the potash and arsenic mixture given above, combined or not, according to the effect produced, with alkaline or bran baths. In cases of intertrigo, either the lead lotion can be used or the part kept as dry as possible with lycopodium powder, to which can be added some subcarbonate of bismuth. Flannel should on no account be worn next the inflamed surface, since woollen material irritates and keeps up the eruption. On account of this irritating action it should not be worn next the skin after the eruption has disappeared, lest it might cause a return of the disease.

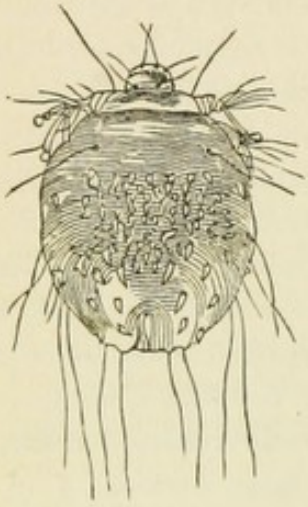
Scabies.

The diseases of the skin previously considered are non-contagious. Scabies, on the other hand, is one of the most contagious diseases by contact.

[1] The Sisters in the New York Foundling Asylum employ the tar soap in these cases, with, they state, an almost uniform good result.

It is produced by an animal parasite, known as the itch-mite, or *acarus scabiei*. The inflammation is caused by the female only, which burrows, making for itself a canal, or cuniculus, in which its eggs are deposited. The male does not burrow, but conceals itself under the scales or crusts which result from the inflammation produced by its partner, or it burrows only sufficiently to produce a covering and shelter. From observations made by Eichstedt, Gudden, and others, the female has been found within half an hour after being placed upon the skin to have concealed herself in the epidermis, and the burrow which she constructs is arched and tortuous, and four or five lines in length, shorter or longer. The acarus has the shape of a tortoise. It can when fully grown be detected by the eye as a minute whitish point. The young acarus has six, the mature eight, articulated legs, with suckers upon the two anterior pairs, and hairs

Fig. 26. Fig. 27. Fig. 28.



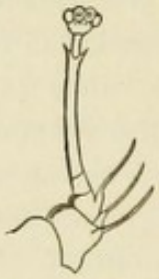
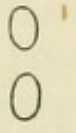


Fig. 29.



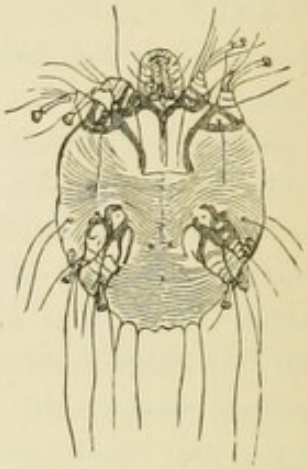


Fig. 26. The itch animalcule, acarus scabiei, viewed upon the back, showing its figure and the arrangement of its spines and filaments. The female, which is somewhat larger than the male, has a length of 1-80th to 1-60th of an inch.

Fig. 27. The foot and last joints of the leg of the itch animalcule.

Fig. 28. The male itch animalcule, viewed upon the under surface, showing its legs and lobulated feet.

Fig. 29. Ova of the itch animalcule.

on the posterior. The head, which can be elongated or retracted, is provided with two jaws. The upper surface is covered with spines directed backwards so as to prevent retrogression in the burrow. She leaves behind her in the cuniculus, as she advances, her moulted skin, excreta, and eggs, which hatch on the eleventh day. The mother acarus is always found at the remote end of the burrow, where it can be seen by the unassisted eye as a minute whitish or sometimes brownish speck, and from which it can be lifted by the point of a needle to which it clings. The cuniculi can also be seen by the naked eye, looking, says Niemeyer, like the "scars of needle scratches," and containing the young acari in various stages of growth.

The acarus by its burrowing produces an irritation and troublesome itching, which is the chief cause of the suffering of the patient. At the point where the acarus penetrates the cuticle the inflammation gives rise to a single, small, and acuminate vesicular or papular eruption, the cuniculus extending away from it. We often find ecthymatous pustules and abrasions intermingled with the vesicles, the result of the frequent scratching. The itching is most intense, and the acarus most active, at night, when the patient is warm in bed. Scabies most frequently appears, especially in adults, first upon the hands, between the fingers, where the skin is thin, and it extends thence along the forearm, and over the thighs and abdomen. In children it not infrequently occurs upon the buttocks, thighs, feet, etc., while the hands and forearm escape.

Diagnosis.—Correct diagnosis is important, because the treatment required is different from that in any other exanthem, and because the suspicion of having this disease always renders one solicitous to know the exact nature of the eruption. Scabies can be diagnosticated from those diseases for which it might be mistaken by the following characters: its occurrence where the cuticle is thin and delicate, as between the fingers, along the anterior aspect of the forearm, upon the abdomen, thighs, and inside of the feet; small size, acuminate shape, and isolated position of vesicles: the intermingling with the vesicles of other forms of eruption, as papules and pustules, and the presence of linear scars and abrasions produced by the scratching; itching most intense at night; absence of fever; absence of the disease from posterior aspect of body and arms, and from head and face. Scabies may be distinguished by the vesicular character of the eruption from all other exanthematic affections except eczema, sudamina, and herpes. Eczema is most common on the scalp and face, where scabies does not occur, and unlike scabies its vesicles are round and thickly aggregated in clusters; in eczema there is a smarting or prickling sensation very different from the intense itching of scabies. In herpes the vesicles are large, rounded, and in clusters, and attended by a burning or pricking sensation, with but little itching. The eruption in sudamina is vesicular and discrete, as in scabies, but it is globular, and accompanied by no itching or other local symptoms.

Treatment.—As scabies is due to a species of acarus which burrows in the epidermis, it can only be treated successfully by measures which destroy this animalcule. If it is destroyed, the disease gets well of itself. Sulphur has been employed for a long period for this purpose, since sulphurous acid, which is evolved from the sulphur, is destructive to the animalcule. The unguentum sulphuris, if thoroughly applied, will rarely fail to eradicate scabies. The internal use of sulphur aids the external treatment, since a portion of the gas which is generated escapes through the pores of the skin. The chief objection to the employment of sulphur is its exceedingly unpleasant odor, which is noticeable, however disguised

by perfume. Sulphur or any other substance employed externally has more effect if it is preceded by a bath, which softens the epidermis, and therefore favors the entrance of the remedy into the pores of the skin and the cuniculi.

Helmerich's ointment is very effectual in the treatment of scabies. It consists of two parts of sulphur, one of carbonate of potash, and eight of lard. "M. Hardy afterwards perfected the method, so as radically to cure the disease in two hours. He proceeds in the following manner: The patient first undergoes a friction of his whole body for half an hour with soft soap, in order to cleanse the skin and break up the burrows; a warm bath of an hour's duration follows, during which the skin is thoroughly rubbed, in order to complete the destruction of the burrows; after which frictions for half an hour and upon the whole surface are practised with Helmerich's ointment. This completes the cure. Out of four hundred patients subjected to this treatment, only four returned to the hospital." (Stillé's *Therapeutics, etc.*, vol. ii. p. 516.)

M. Albin Gras experimented with different substances, in order to ascertain their relative destructiveness to the acarus. The following table gives some of the results of his experiments:—

Immersed in pure water the acarus was alive after three hours.
" saline water the acarus moved freely after three hours.
" Goulard's solution the acarus lived after one hour.
" olive, almond, or castor oil the acarus lived more than two hours.
" lime-water the acarus died in three-fourths of an hour.
" vinegar " " twenty minutes.
" alcohol " " " "
" turpentine " " nine "
" iodide of potassium the acarus died in four to six minutes.

It is seen that vinegar, lime-water, alcohol, turpentine, and iodide of potassium destroy the acarus in a short time. They may be employed in the same manner as the sulphur ointment. Camphor is also destructive to this animalcule, and the linimentum camphoræ, thoroughly applied, is a good remedy for uncomplicated scabies.

In order to avoid the odor of sulphur, which is so offensive, one of the following ointments may be employed, if the patient is fastidious:—

℞. Unguent. hydrarg. ammoniat., ℥j;
Moschi, gr. ij;
Ol. lavendul., gtt. ij;
Ol. amygdal., ℥j. Misce. (From *Wilson*.)

This should not be used if the scabies is extensive, but the following, which is recommended by Bazin, and is said to cure the disease with three applications:—

℞. Anthemis pulv.,
Adipis,
Ol. olivæ, āā ℥j. Misce.

In cases which have been protracted, and in which ecthymatous and other secondary eruptions have occurred, the scabies can ordinarily be readily cured, while the other eruptions remain and disappear more slowly. A knowledge of this is important, since the sulphur, or other ointment employed for the cure of scabies, should be discontinued when the itching ceases and vesicles no longer appear, and tonic, or other treatment appropriate to cure these secondary eruptions, should be employed instead. The sulphur ointment continued, after the scabies is cured, does harm, as it irritates the cuticle. It is essential in the treatment of scabies that the linen be frequently changed.

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PREFACE.

"In the rapid progress of modern research, few subjects have of late years received greater accessions of facts than the group of sciences connected with materia medica and therapeutics. The new resources thus placed at the command of the pharmaceutist and physician have seemed to the authors to justify an attempt to make, from the advanced standpoint of the present day, a concise but complete statement of all that is of practical importance to both professions—a digest in which that which is old and that which is new shall be so brought together as to give to the reader, within the most moderate practicable compass, all the details in pharmacology, pharmacy, and therapeutics which he is likely to need in his daily avocations. In the almost infinite accumulation of material, this has required a careful and conscientious sifting to discard that which is obsolete, untrustworthy, or comparatively trivial, without impairing the practical completeness of the work. That they have wholly accomplished their object the authors do not venture to claim; but they can say that years of constant labor have been devoted to the task of producing a work to which the inquirer may refer with the certainty of finding everything which experience has stored up as worthy of confidence in the subjects embraced within its scope.

"To this end there have been included all crude drugs and chemical and pharmaceutical preparations officinal in the Pharmacopœias of the United States and Great Britain, together with the more important medicines of the French Codex and German Pharmacopœia, which are to some extent prescribed here or which may serve for comparison with similar articles in the English and American standards. Besides these, a large number of drugs which are not recognized by any Pharmacopœia, are often kept in the shops because they are prescribed by physicians or used in domestic practice. Some of these give promise of future importance, and in making a selection among this class of remedies, it was deemed best not to err on the side of exclusiveness. Not only have many of them been admitted as separate articles, but a large number have found place as *allied drugs* under the heading of more important substances. To these allied drugs reference can readily be made by means of the Index.

"The alphabetical order of arrangement has been adopted throughout, as being on the whole the most convenient for reference. In this the non-officinal medicines have been included with the officinal, the latter being distinguished by an affix, showing the Pharmacopœia to which they have been admitted. The title of each article is followed by a full synonymy, English, French, and German, together with Latin appellatives and popular names, such as are occasionally used in prescriptions and standard works, or through which articles may be recognized. As all substances have thus their appropriate place in the body of the work, but

little is left for the Appendix, in which may be found the leading reagents, tables of weights and measures, comparisons of the scales of different hydrometers, alcoholometers, and thermometers, etc.

"In the treatment of the separate articles, detailed botanical descriptions have generally been omitted as being of no practical value, but plants yielding drugs have been briefly characterized as to their general aspect and habitat, while fuller descriptions have been given of those which are native or naturalized, or which seemed to require it from the nature of their product. The treatment which drugs undergo before they reach the hands of the pharmacist also receives attention, because the physical appearance and chemical composition are sometimes influenced thereby. Especial care has been bestowed upon both the external and the structural characteristics of drugs, so that they may be readily identified and distinguished from those which resemble them, and, in aid of this object, a limited number of illustrations has been introduced representing their outward forms as well as their histological appearances revealed by the microscope. Their proximate constituents, when of practical interest, have received special attention, and the effort has been made to decide between the conflicting statements of which these have been the subject. Chemical formulas have been expressed in the new notation, together with the molecular weights of the principal chemicals. Whenever products can be advantageously prepared by the pharmacist, one or more processes have been given and explained as fully as seemed necessary. Attention has been drawn to adulterations and impurities, and the means for detecting them have been pointed out. The officinal processes for pharmaceutical preparations have in most instances been detailed in the language of the Pharmacopœia, followed, when requisite, by explanatory and critical remarks, and practical observations for the guidance of the operator.

"With regard to Pharmacodynamics, there is presented, for the first time in a Dispensatory, a succinct account of the physiological action of medicines. The results of experiments are stated as clearly as possible, and occasionally in the theoretical language of the day; but, as a rule, terms have been employed whose meaning is not likely to become obsolete or unintelligible. Whenever it seemed possible, an attempt to apply the results of physiological experiments to therapeutical uses has been made; for although the two fields of inquiry may not be so organically connected as to render the former a guide to the latter, it is, nevertheless, true that a scientific explanation of the curative powers of medicines must be sought in the results of their experimental operation upon the animal functions.

"In treating of Therapeutics, the most trustworthy results of clinical experience are concisely set forth, without discussing the grounds on which they rest. This method has proved laborious, and has often required a prolonged judicial examination to arrive at a conclusion expressed in a few lines. Its object has been to spare the reader the labor of a personal investigation, which could only be made with facilities which comparatively few possess.

"Another feature, novel in a Dispensatory, is the Therapeutical Index. Care has been taken to render it as complete as possible, in order that the inquirer may be enabled to learn by its means all the more important medicines that have been employed in the treatment of each disease. Such an Index thus becomes, to some extent, a therapeutical classification of medicines, and it is believed must greatly enhance, by its suggestiveness, the working value of the book to the practitioner."

The very thorough manner in which the authors have carried out their plan, may be judged from the extent of the Indexes. Thus, the "Index of Materia Medica" covers 55 triple-columned pages, and contains about 10,400 references. The "Therapeutical Index," which gives under the head of each disease the principal remedies recommended for its treatment, occupies 33 double-columned pages, and contains about 3750 references.

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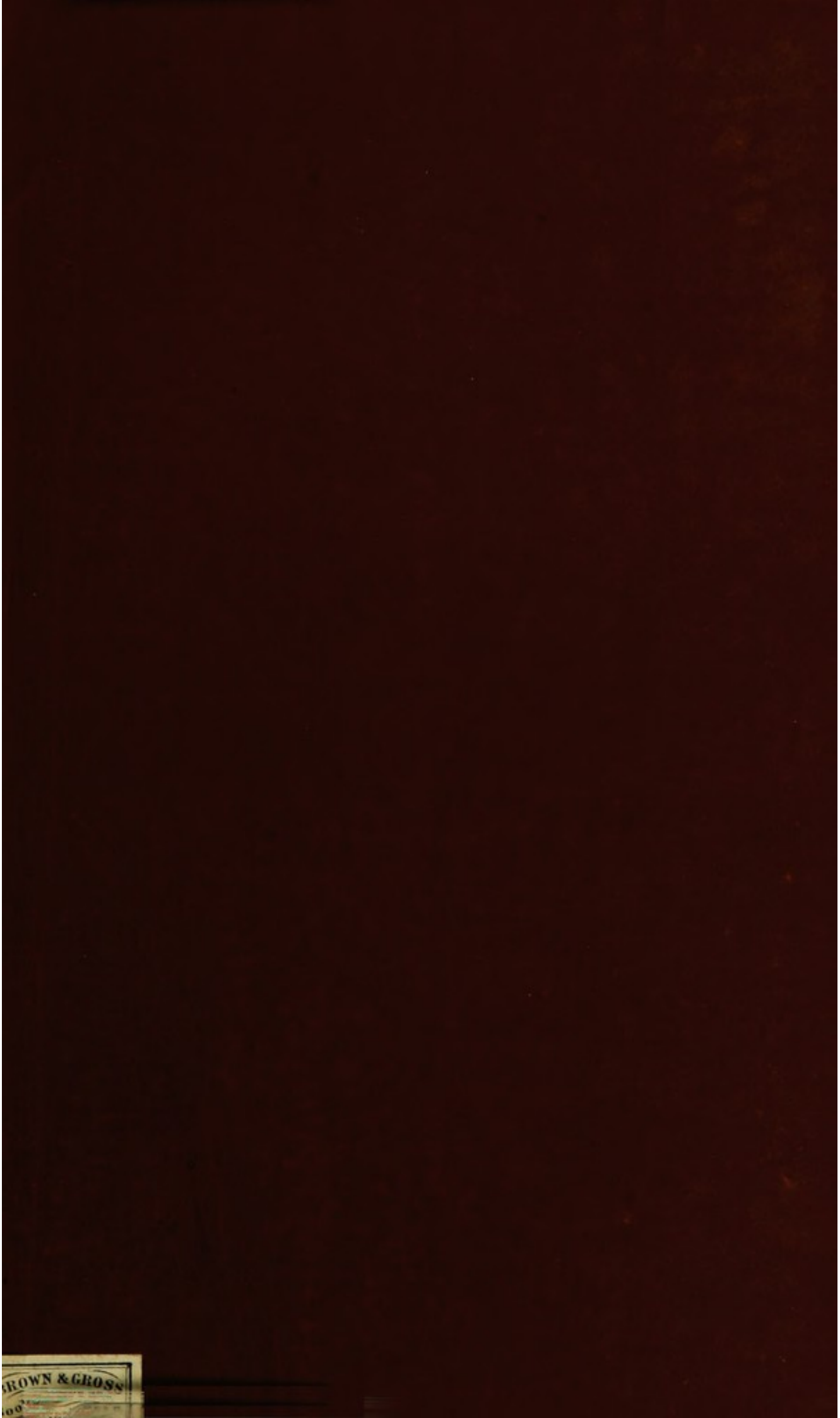
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