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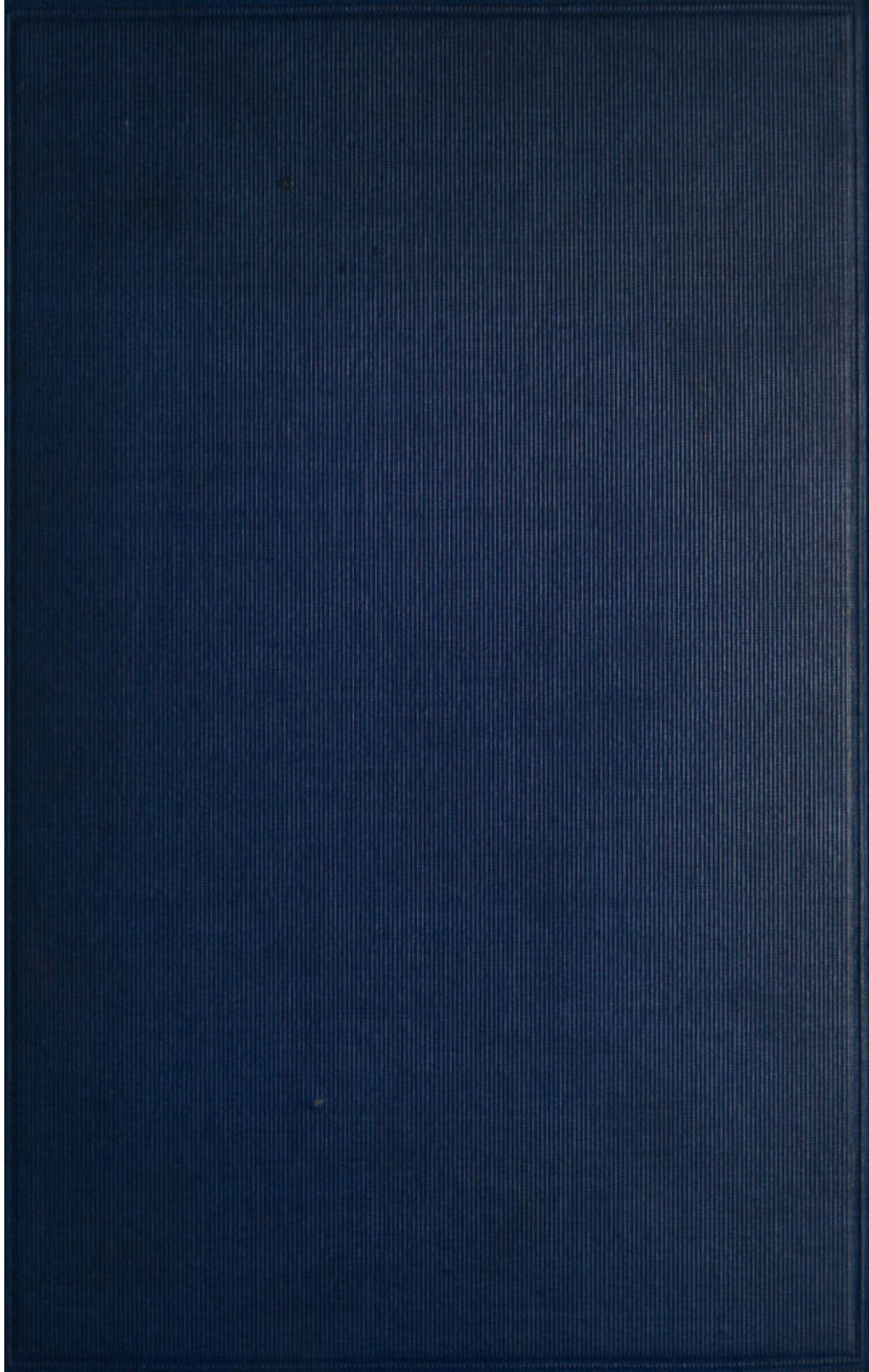
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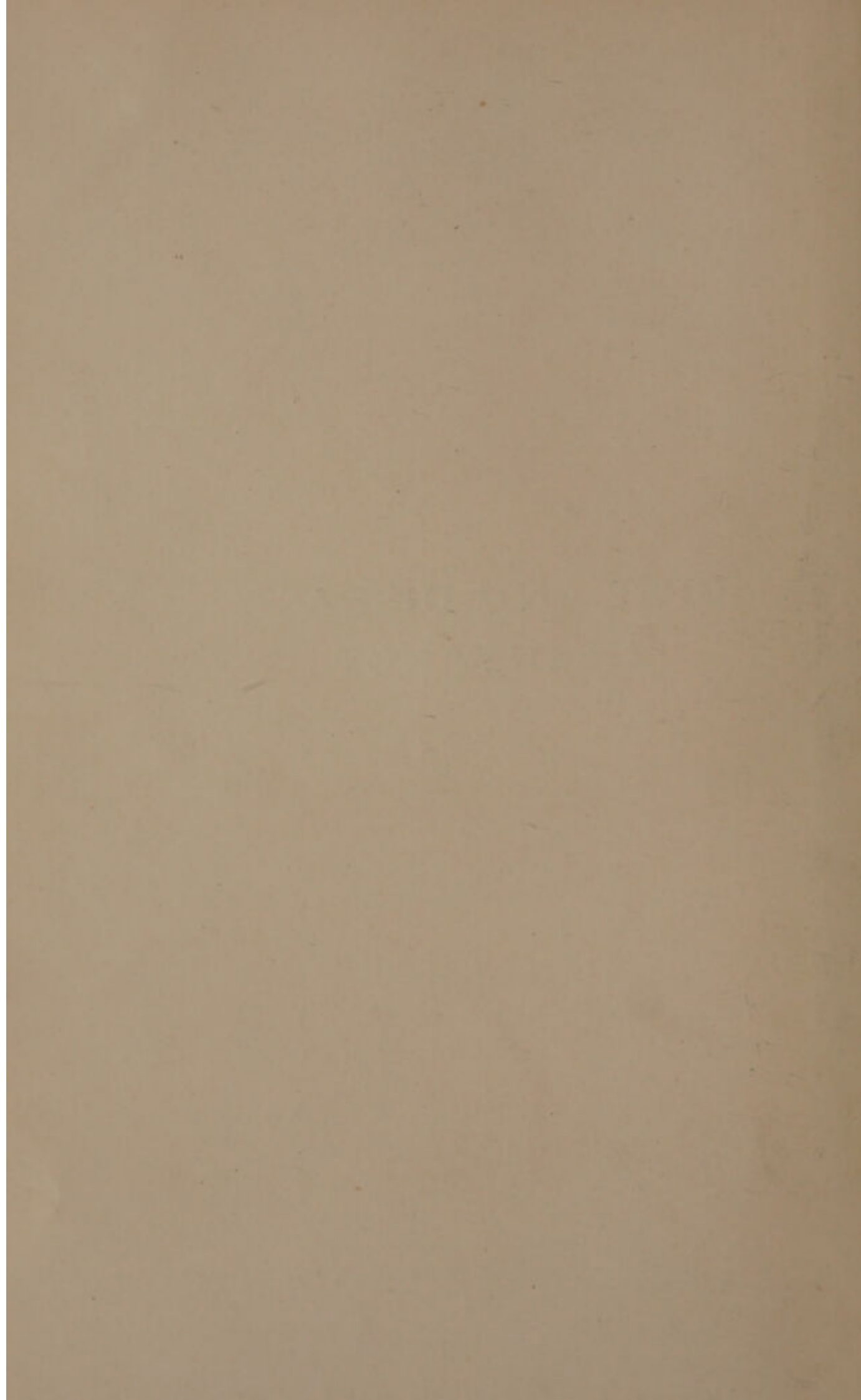
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DIET AND DISORDER
IN INFANCY



DIET AND DISEASE IN INFANCY

BY

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*With Four Coloured Plates and
Thirteen Text-figures*



LONDON

J. & A. CHURCHILL

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PREFACE

IN what follows I have dealt with the common disturbances of nutrition in infants during the first year of life from a standpoint which is entirely clinical. Although I am not without hope that some part of what I have written may prove helpful to that large and increasing body of men and women who are to-day interesting themselves in the wide subject of Infant Welfare, nevertheless I have addressed myself chiefly to medical men, and to senior students of medicine. The dietetic disorders of infancy and the infective disorders of infancy stand to each other in a relationship which is constantly changing, and together present a combination in which it is not always possible to distinguish cause from effect. For that reason I feel strongly that the control of the diet of infancy should be exercised by medical men, and by them alone; and that it is not possible to recognize any opinion which is uninstructed in the wider field of general medicine as having authority in the disturbances of infantile digestion.

In endeavouring to present an account of the common disorders of digestion and nutrition in infancy, which may commend itself to students of medicine, I am conscious that I am attempting a task of great difficulty. It may be argued with force that the time is not yet ripe for such an attempt, and that our ignorance of much that is fundamental is still too profound to permit of a complete and logical presentation of the subject. On the other hand there are medical men who deny that the subject possesses any complexity at all. To-day there are still those who seek, and even some who claim that they have found, a single diet which is universally applicable both in health and disease. Of the two objections, the first appears to have more weight. It is well that the emphasis should be laid upon the difficulties of the subject. If success could always be achieved by paying strict attention to rules of cleanliness, dilution, dosage, and so forth,

the subject could retain but little interest, at least for medical men. It would then rightly fall within the province of the trustworthy and trained nurse.

In so small a book it has not been found possible to quote authorities at length. I would desire to acknowledge my indebtedness to the writings of Barlow, Forsyth, Finkelstein, Meyer, Czerny, Budin, and many others. My thanks are especially due to Dr. Janet Lane-Claypon, who has placed at my disposal her great knowledge of the milk supply of this country, and has written Chapters II and III, which deal with that subject. To two of my colleagues, Dr. M. S. Pembrey, the lecturer in Physiology, and Dr. J. H. Ryffel, the lecturer in Pathological Chemistry, in the Medical School of Guy's Hospital, I am indebted not only for much valuable advice, but for their daily co-operation in the study of the cases in the wards.

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CHAPTER I

INTRODUCTION

THE child thrives best upon the milk from his mother's breast. Save in exceptional cases, which will be studied later, the natural diet leads to a perfectly satisfactory result. With an unnatural or artificial diet, also, good results are commonly achieved. Yet in the case of artificially fed infants deplorable accidents are comparatively frequent, and all the care and skill in the world cannot always avail to prevent serious disturbance, and even occasionally a fatal issue. Among the poor, when the ill effects of faulty hygiene are added, the mortality directly due to the practice of bottle feeding becomes considerable.

The dangers of artificial feeding are especially great during the first few weeks of life. After three months the infant's digestion acquires a certain degree of stability, and absolute intolerance for artificial food of all sorts is rarely met with. If State provision could be made to enable all working mothers to absent themselves from factories for three months in order to devote themselves to nursing their infants, the good effects upon the statistics of infant mortality would be very apparent. At first, the limits of tolerance for artificial food may be extraordinarily narrow. A slight excess of food, or a transient infection, such as a trivial catarrh of the air passages, may produce a serious and prostrating dyspepsia. Although recovery from this may take place, the tolerance for food is apt to be impaired for some time afterwards, so that a second attack is produced even more easily than was the first. In early infancy one attack of dyspepsia, by lowering the tolerance for food for the time being, predisposes to a repetition of the disturbance. Finally, when, after repeated attacks, the amount of food which is necessary to produce growth and development has become also the amount which suffices to

produce a serious disturbance, there arises the condition known as marasmus.

If, on the other hand, an attack of dyspepsia is avoided for the first few weeks of life, the infant acquires a high degree of tolerance for food of all kinds. So long as sudden changes are avoided, so long as increase in the amount of food given is gradual, the older infant has a great power of adapting himself to the particular diet adopted, so that we find babies thriving upon foods of the most varied composition, which may offer a complete contrast to the natural diet. It is indeed this remarkable adaptability of healthy infants, living under good hygienic conditions, which constitutes one of the difficulties of the study of infant feeding (Finkelstein). If babies, as a rule, were less tolerant of faults in their dietary we should know perhaps more than we do of the rules which should govern our prescriptions. As matters are, there is not unnaturally a great tendency for mothers and nurses to draw conclusions from particular cases with which they have had to deal, and on the ground of a single successful experience to advise the change haphazard to some particular diet. This, too, is the fallacious argument of the proprietors of patent foods.

On the other hand, individual infants will show a pronounced idiosyncrasy against certain forms of diet or certain components of food. Czerny has done good service by insisting upon the importance of the diathesis or constitution of the child in the production of digestive disorders.

The part played by inherited anomalies of digestion is a very wide one, and will be fully discussed in a later chapter. It is most apparent in breast-fed infants, because other causes of failure are much fewer. Certain infants, although nursed at regular intervals upon a breast which contains a sufficiency of milk, fail to thrive and continue meagre, restless, and dyspeptic for weeks and even for months. Formerly such ill effects were attributed to faults in the mother's milk. Czerny has urged that the idiosyncrasy is found commonly not in the mother, but in the child. It is the great service which he has rendered to the study of infant dietetics that he has taught us to recognize at least one clearly cut and definite anomaly of constitution—the exudative diathesis. The subjects of this diathesis may be recognized from the first

weeks of life, when they are apt to force themselves upon our notice by a refusal to thrive even upon their mother's breast. Such infants may be transferred from one wet nurse to another without improvement, although the milk of these women may simultaneously be providing absolutely satisfactory results in normal infants.

Our knowledge of the properties peculiar to mother's milk which render it, as it were, specific for the human infant, is not yet altogether complete.

1. Long experience has taught us that the frequent failure of artificial diets, judged by the standard of the results achieved by feeding at the breast, does not depend upon rough differences in the percentages of protein, fat, sugar, or salts. It is a comparatively easy task so to modify the proportions of these substances in cow's milk that the resulting figures are in agreement with those obtained by an analysis of samples of human milk. Yet great accuracy in estimating these percentages has not greatly decreased the chances of failure, while infants may commonly be met with who can digest with perfect success mixtures whose percentage composition is in complete contrast to that of breast milk.

2. It is more important to realize how dissimilar is the chemical structure of the various constituents of human milk and cow's milk. For example, the protein of cow's milk is not only present in larger amounts—it has a widely different chemical composition. The same is true of the fat and of the salts. No modification of cow's milk can overcome such fundamental differences.

The digestive organs of the infant at birth, and for some time afterwards, are adapted only for a particular task—the digestion of food with a particular structure. They are less well adapted to deal with food of a different chemical composition.

3. Of recent years much has been written of the so-called "biological" properties of milk, and it has been suggested that the superiority of human milk is to be attributed to the presence of certain ferments.

At the present time such statements cannot be allowed to pass unchallenged. There is abundant evidence to show that milk collected aseptically from a cow by a catheter contains no digestive ferments. Such ferments as do occur—katalase

and peroxidase—are found in small amount compared with that present in the blood stream, from which they have passed by passive filtration.

Whatever “protective substances” are present in the mother’s blood are present in greatly reduced quantities in the milk. Colostrum is especially rich in these bodies. Their presence is of value only in the early days after birth, and during that period the young infant acquires a passive immunity towards the same substances as that possessed by the mother. After the close of the colostrum period the immune content of the infant’s blood does not rise as a result of taking milk which contains a high content of immune substances. The passive immunity acquired from the colostrum in the early days of life gradually declines as the infant himself develops the power of forming immune substances.

These observations, although they emphasize the importance of breast feeding in the early days of life, show that in the later months of lactation the advantages of breast feeding cannot be attributed to the “biological” properties of the milk.

4. In the case of infants nursed at the breast there is a very complete provision against the possibility of serious over-feeding. The amount of milk secreted by the breast depends upon the vigour of the child’s suction and appetite. A temporary surfeit is followed by a temporary decline in the appetite, and the diminished suction leads to a corresponding diminution in the amount of milk secreted. Only with returning appetite and renewed vigour of suction does the breast again secrete readily. This accurate adaptation of the amount of food to the varying needs of the child is wanting in artificial feeding, when the milk flows readily in response to a minimal effort on the part of a child rendered thirsty by the loss of fluid which diarrhoea and vomiting entail, with the result that before convalescence from dyspepsia is established large meals may be taken, and the limits of tolerance may again be overstepped.

To sum up, we may say that the peculiar chemical constitution of the fats and proteins, perhaps, too, of the saline constituents, renders mother’s milk especially adapted to the digestive powers of the infant. To “humanize” cow’s milk is an impossibility, if by that is meant the attempt to

produce a fluid having the specific character of mother's milk. An additional safeguard in breast feeding lies in the efficient protection against over-feeding.

Unfortunately, under our present conditions of life, it is certain that all infants cannot be fed at the breast. We are therefore forced to ask ourselves what the best substitute may be. Cow's milk is that almost universally adopted. It is the cheapest and it is the most easily accessible. Except in the case of young infants, when trouble is more frequent, it is usually well borne. The prescription of forms of artificial diet, other than cow's milk, is to be looked upon as a therapeutic measure undertaken with a definite purpose.

To obtain a satisfactory supply of cow's milk is the first difficulty which presents itself among the problems of infant feeding. Milk, as it is exposed for sale in most countries, is unsuitable for the direct consumption of infants. The child unfortunate enough to be deprived of its mother's milk suffers not only the disadvantages of an unnatural diet, but is, in addition, exposed to the risks arising from the presence in the milk of extraneous matter which has gained access to it in the passage from the udder of the cow to the child's mouth. Some degree of contamination is unavoidable save by measures which are so complicated and expensive that their use is out of the question for ordinary purposes. To find a name to express that degree of contamination which is unavoidable and therefore permissible is a matter of some difficulty. The term "germ-free" is clearly inapplicable, because milk is never completely free from germs. The same objection applies to the use of the word "pure." The expressions "nursery milk," "infant's milk," and so forth have no real meaning, and are frequently applied to milk differing in no essential from the ordinary market milk. In the United States of America the term "high-grade" is applied to milk which is considered to have attained a satisfactory standard, and on the whole this appears to be the most satisfactory expression.

It cannot, however, be stated too clearly that when we have been successful in procuring a satisfactory high-grade milk we are still very far from having provided a solution to the difficulties which beset the artificial rearing of infants. In the disturbances of infantile digestion, in the production of diarrhoea and vomiting, although the part played by bacteria

is of great importance, we must not hope to find by bacteriological research alone an explanation of the high infantile mortality from diarrhoeal disorders.

That acute infective enteritis exists in infancy there can be no doubt. Not a few epidemics have been carefully studied in which gastro-intestinal infection has produced a severe disease, localized primarily in the large intestine, and leading often to a generalized infection of the whole body. The diagnosis of such a condition is based upon the characteristic bacteriological picture of the stools and upon the demonstration, not infrequently, of the same organism in the urine, blood, or cerebro-spinal fluid. Streptococci, the bacillus pyocyaneus, the bacillus proteus, the dysentery bacillus of Flexner, and many other organisms have all been identified as the causal organisms in outbreaks of acute infective enteritis in infancy, characterized by the passage of watery, muco-purulent, and blood-stained stools, tenesmus, colic, vomiting, and a variable degree of pyrexia.

In the vast majority of the cases which we meet with in practice, which are characterized by diarrhoea and vomiting even of the utmost severity, there is no evidence at all of such a local infection of the bowel wall. No doubt marked changes in the growth and nature of the micro-organisms within the alimentary canal occur, but these changes are secondary to pathological alterations in the character and reaction of the bowel contents. For example, the high acidity of the intestinal contents in infants fed upon a diet rich in carbohydrates, and especially in sugars, is due to the exaggerated and uncontrolled growth of those organisms of fermentation which thrive in an acid medium, and themselves produce an increase in the acidity by the disintegration of the carbohydrates of the food.

The purgation and colic which result from the increased fermentation of the carbohydrate part of the food are due to bacterial overgrowth. They must not be regarded as evidence of an infective enteritis. The present trend of opinion is in a direction away from the old exclusive and one-sided bacteriological standpoint, while attention is being more and more attracted to disturbances of digestion, assimilation, and metabolism. The extreme importance of securing a pure milk supply should not induce us to overstate our case, and

to represent the disturbances of infantile digestion as invariably or even commonly due to specific infection of the milk.

The frequency with which we encounter disturbed digestion and the symptoms of diarrhœa and vomiting in infancy is easily understood if we remember that the infant, though born with almost all other faculties in abeyance, is yet able to absorb and utilize every day a bulk of food equal to one-fifth or one-sixth of his body weight without ill effects. A function so highly developed is necessarily easily disturbed. The ill effects of over-feeding and under-feeding, of excessive heat and excessive cold, or of a slight pyrexial disorder due to infection of some part of the body remote from the bowel, are too marked and too constant in their occurrence to permit us to doubt that these stand to the resulting disturbance in the relation of cause and effect.

Specific infective enteritis is not the most common, though a well-authenticated, cause of diarrhœa in infancy.

CHAPTER II

THE STANDARDS REQUIRED FOR A " HIGH-GRADE " MILK

Two aspects must be considered in connexion with the conditions under which alone milk can be classed as high-grade—the chemical and the bacteriological aspects. If the chemical aspect be considered the fat is the constituent upon which up to the present time most attention has been bestowed. This arises largely from the ease with which the fat content in milk can be estimated by dairymen, as compared with the comparatively lengthy and difficult methods which must be employed for the estimation of the other constituents. The importance of the different constituents of milk from the point of view of nutrition is not here under consideration, since all the constituents of milk are of importance to the infant. Inasmuch, however, as fat is indispensable to the adequate growth and development of the normal infant, and in view of the ease of its estimation, it forms a sufficiently convenient basis upon which to gauge a routine examination of the quality of the milk. Other constituents should be estimated at intervals which may be less frequent than the fat estimations.

THE FAT CONTENT OF A HIGH-GRADE MILK

Experts are not unanimous as to the standard which should be set for the fat content of a high-grade milk. A great amount of attention has been paid to this subject in America. The various medical milk Commissions of the United States have fixed different standards for the fat content as well as for the other constituents of milk. For the most part the fat content has been fixed at a higher figure in America than in other countries. The latest report, issued in 1912 (" Report of the Commission on the Milk Standards appointed by the New

York Milk Committee—Public Health Reports," No. 78), proposes the standard of 3.25 per cent. for fat and 8.5 per cent. for "solids not fat," as being suitable for a high-grade milk. These figures can be looked upon as affording a reliable standard. They have been arrived at after many years of experience in all branches of the work concerned in the production of a high-grade milk. The estimations concerned are such as can be easily carried out in a laboratory of a Health Department. The standard 3.25 per cent. corresponds very closely with the standard of 3 per cent. which obtains in this country. The production of a milk having a constant fat content will be considered later.

THE BACTERIAL CONTENT OF A HIGH-GRADE MILK

A consideration of the bacterial content which may be deemed permissible in a high-grade milk opens up very large issues. Both the absolute number of organisms present and the varieties must be considered. The amount of harm occasioned to infants by the ingestion of large numbers of bacteria in the milk has never been satisfactorily demonstrated, although it has formed the subject of much discussion and dogmatic assertion, and such a demonstration is almost impossible in view of the great complexity of the factors concerned. The varieties of bacteria found in milk are very numerous. In one sample the comparatively harmless organisms derived from the air predominate, while in another sample there may be a relatively large number of bacteria derived from the animal organism, and of these some may be harmful even in small numbers. It is the number of these harmful organisms, and not the absolute number of organisms, which must be considered dangerous. *Ceteris paribus*, however, the greater the actual number of organisms the greater the likelihood that harmful organisms may be present, and on that account a low bacterial content should be considered an essential for a high-grade milk.

The American Medical Milk Commissioners unanimously fixed the bacterial content of the highest class of milk, known as the "certified" milk, at 10,000 organisms per c.c. Although this is a high standard, in practice it has not been found

unattainable. A farm in America producing such "certified" milk must have a record showing that in samples selected at random from the milk as delivered to customers the average results of a weekly examination have not exceeded 10,000 organisms per c.c. on the preceding quarter-year's records. In New York a second-grade milk is allowed to be sold, under the title of "Inspected Milk," which may have a bacterial content of 100,000 per c.c. In European countries no fixed bacterial standard is in force. In a few towns special regulations have been made as to the standard required for milk for infants. The standard required has not usually been so exacting as 10,000 per c.c. On the farm belonging to the municipality of Berlin, where milk of excellent quality is produced, there is no set figure for the bacterial content. The average count is said to be from 30,000 to 40,000 per c.c.

It may be asked whether so high a standard as is denoted by a bacterial count of 10,000 organisms per c.c. is to be regarded as essential in a high-grade milk. If a direct reply either in the affirmative or in the negative is required, then probably a negative answer must be given. A consideration of the circumstances necessary for the production of a high-grade milk, however, has shown that with the necessary care and practice on the part of the dairy staff it is almost as easy to produce a milk having a bacterial content of 10,000 per c.c. as one conforming to a lower standard. The experience of the Medical Milk Commissioners in America and of Sir Thomas Barlow's Milk Committee of this country has shown that a bacterial count of 10,000 per c.c. can reasonably be required as a standard for high-grade milk.

The *varieties of bacteria* present in milk depend upon the source from which they are derived. Bacteria may pass into the milk from the udder, others enter after the milk has left the teat of the cow. Of the organisms which are passed out with the milk, some are comparatively harmless. Investigation has shown that the orifices of the teats and the main ducts become infected with organisms in the intervals between milking. These organisms in all probability have obtained entrance from without and have passed up the teat. They are present in relatively high proportion in the first jets of milk, and although they are comparatively harmless in character, in the production of a high-grade milk they should

be avoided by milking the first 100 c.c. or more into a separate receptacle. The first milk from the teat may be used for milk of a lower grade; it should not be mixed with milk intended to be of a high-grade quality. If the milk from a healthy cow, after the rejection of the first few jets, is collected by means of a milking tube, it is found incapable of giving rise to any growth when plated out on a suitable medium. The milk from a healthy gland should not as such contain any bacteria. The milk derived from an unhealthy udder, on the other hand, may contain any organisms which are present either as a causative agent or as a secondary result of disease, *e.g.* tubercle bacilli or staphylococci or streptococci. It does not appear that it is necessary for a tuberculous lesion to be present in the mammary gland itself. Tubercle bacilli can be excreted in the milk when the tuberculous lesion is in some other part of the body.

The findings of the Royal Commission on Tuberculosis and the experience of physicians generally leave no room for doubt that tuberculosis can be caused in children by the ingestion of bovine tubercle bacilli, even although the relative frequency of such a mode of infection may still be under dispute. Since the possibility of such infection has been established, it follows that no high-grade milk should contain tubercle bacilli. How far this condition can be fulfilled in actual practice will be considered in the next chapter.

CHAPTER III

CONDITIONS NECESSARY FOR THE PRODUCTION OF "HIGH-GRADE" MILK

THE FARM BUILDINGS

A GOOD deal has been written and spoken during the past few years, especially in America, about the buildings which are necessary on a farm where high-grade milk is to be produced. It is no part of the purpose of these chapters to enter into any account of the actual structure of such premises, but a few preliminary remarks are essential.

A general statement may be made to the effect that if there is no separate milking-shed, special precautions as to cleanliness must be taken in the building where the cows are kept. Any such building must be clean, well-lighted, and well-ventilated. It does not appear that the fulfilment of these requirements need involve expensive buildings. If a separate milking-shed is used much difficulty is overcome. When, however, this is not the case, the floor of the barn must be impervious and straw litter should not be used. It is almost, if not quite, impossible to keep the bacterial count sufficiently low if milking is carried out in the midst of straw litter.

Whatever building is to be used as a milking-shed, it should be near the dairy, or connected with it by some means of rapid and easy transit, and there must be an abundant supply of pure water. Perhaps the best arrangement of the cattle is to have them facing each other with a gangway of not less than eight feet between the rows. The concrete floor has a trough on either side to catch the excreta from the cows. The floor is thoroughly washed and the excreta removed between each milking. The gangway has some form of feeding-trough at each side, and the food can be fed to the cows from a central trolley-line. Perhaps the best method of holding the cows is

by means of an iron stanchion at the head which allows considerable freedom of movement in the vertical, and but little in the lateral, direction.

THE CHOICE OF A HERD

Two main points are to be considered in choosing a herd. The cows must be capable of producing a milk with the required fat content and of sufficient quantity for commercial success, and they must be free from any suspicion of ill-health. To achieve the first essential, many of the producers of high-grade milk arrange the cows in groups, in each of which are some animals whose milk is rich in fat, and others whose milk is less rich in this constituent but is greater in quantity. The milk from a group of cows is mixed after milking. Some farmers state that they can secure a satisfactory fat content by altering the food of the cattle.

HEALTH OF THE CATTLE

The procuring of healthy cows is a more difficult matter, owing to the great prevalence of tuberculosis. The American Medical Milk Commissions enforce the testing with tuberculin, every six months, of all cattle used for the production of certified milk. Such a procedure, although it detects the cattle which are tuberculous at the time of injection, does not prevent the infection of one or more of the animals during the interval between the tests. In practice it has been found that virulent tubercle bacilli have been excreted in the milk of animals so tested, the disease having been acquired since the preceding injection. Testing at six-monthly intervals should on no account be omitted, but this cannot be looked upon as providing an absolute guarantee against the presence of tubercle bacilli in the milk. In addition the cows should be inspected regularly by a competent veterinary surgeon. The practice with regard to this inspection varies; in some farms it is carried out weekly and in others at monthly intervals.

Any new cow should be segregated for six months and then tested with tuberculin before admission to the herd.

The conditions under which the cows are kept are of great importance and have already been referred to in connexion with the farm buildings. The cows must be kept scrupulously clean and well-groomed. Their hind-quarters, tails, and

udders should be washed before milking. There is some divergence of practice as to the use of cold or warm water. The skin should be left moist only and not wet.

THE EMPLOYEES

All the employees in the dairy should undergo a preliminary medical examination, and should be kept under careful medical supervision. Special precautions must be taken to detect "disease-carriers." All cases of sickness of whatever nature should be reported at once and the sick person suspended from duty until return to work is permitted by the medical officer. The workers must exercise the most scrupulous cleanliness. They must realize that after the hands have once been washed they must touch nothing except the teats and the milk-pail, both of which have been previously cleansed. The milking-stools should be scrubbed before use. In some farms they are strapped on to the workers and need not be touched at all. The overalls and caps worn during milking are either sterilized or are merely washed and changed at frequent intervals.

PRECAUTIONS DURING MILKING

Bacteria may readily gain entrance to the milk during the act of milking. They may be rubbed off the sides and udder of the cow and fall into the milk. The movement of the cow's tail provides an additional risk of such contamination. Excremental matter which has become adherent to the cow's body may fall into the pail, or contamination occur owing to defæcation during milking. Some farmers secure the cow's tail during milking and clip the hairs on the udder. The milker must not rub his head on the side of the cow and must constantly be on guard against the possibility of fæcal contamination.

It is customary among many milkers to moisten the hands with saliva. Apart from the revolting nature of this practice, which is known as "wet milking," it is extremely dangerous. The saliva always contains a variety of organisms even in the healthy individual, and the moisture, combined with the friction of the act of milking, produces a mixture of epithelial debris and organisms, derived both from the milker's hands

and the teats, some of which will inevitably fall into the milk. Where the milker's mouth is the seat of dental caries or when he is suffering from other disease, the procedure becomes infinitely more dangerous and provides a ready means for the transmission of tonsillitis, tubercle, diphtheria, and a variety of other infections. Dry milking has been regarded as an impossibility by the old-fashioned milker. If the practice is tried, however, the milker becomes convinced against his will, and can usually be persuaded to abandon for ever the disgusting habit of wet milking.

Much contamination during milking can be avoided by the use of a suitable form of pail. This has been shown both in America and by Sir Thomas Barlow's Milk Committee already mentioned. In an experiment, using all precautions as to cleanliness, the number of bacteria per c.c. in a sample of milk selected at random which had been milked into an ordinary pail was found immediately after milking to be 9786. In milk collected under precisely the same conditions, except that a pail was used which was covered save for an aperture of sufficient size to allow the milk to enter, the count was found to be only 1150. The best results are said to be obtained with a can having a protected aperture at the side. By this means contamination by particles falling vertically is avoided.

As soon as the milk from each cow has been collected the full can should be weighed, and by deducting the known weight of the can the quantity of milk given by the cow can be determined. A suitable plant must be provided for the sterilization of all pails, churns, bottles, &c., used in the production of the milk.

THE TRANSIT OF MILK

Immediately after milking, the milk should be filtered directly on to the cooler, over which it passes in a thin stream, and is at once run into bottles or churns, which are sealed. Milk should be kept cool either in running water or in an ice-chest until the time of transit. In this country there are no facilities such as are found in America for cool transit by train, and the whole subject is one which urgently demands attention.

It has been abundantly shown by experiment that if milk

is collected with the precautions described, not only will the bacterial content fall below the standard of 10,000 per c.c., but the organisms will show hardly any increase for many hours provided that the milk is kept sufficiently cool. If the milk is sent in churns to be bottled in the town, precautions as to cleanliness and sterilization must again be taken. The risk of contamination is, of course, considerably increased by this further manipulation.

An excellent summary of the requirements for the production of high-grade milk is given by the "Report of the New York Commission" already referred to. It is as follows:

It, *i.e.* milk of this quality, should be produced at dairies subjected to periodic inspection and the products of which are subjected to frequent analysis. The cows producing such milk must be properly fed and watered, free from tuberculosis as shown by the tuberculin test and physical examination by a qualified veterinarian, and from all other communicable diseases and conditions likely to deteriorate the milk. They must be housed in clean, properly ventilated stables of sanitary construction, and must be kept clean. All persons who come in contact with the milk must exercise scrupulous cleanliness and must not harbour the germs of typhoid fever, tuberculosis, diphtheria, scarlet fever, septic throat, or other infections liable to be conveyed by the milk. Milk must be drawn under all precautions necessary to avoid infection, and be immediately strained and cooled, placed in sterilized bottles, and kept at a temperature not exceeding 50° F. until delivered to the customers. Pure water as determined by inspection and by chemical and bacteriological examination is to be provided for use throughout the dairy-farm and dairy. Milk of this class should contain less than 10,000 bacteria per c.c.

In America it is not unusual to boil even certified milk in order to render doubly sure all precautions against tubercle.

A milk of the highest grade cannot be produced at the ordinary market price. It must remain a luxury for those who can afford it, or for children in institutions and hospitals. A question may fairly be asked as to the necessity for the production of such milk. To this it may be answered that a high standard must be set in order to raise the general standard of milk-production throughout the country. There can be no doubt of the educational value of the production of a high-grade milk in teaching dairymen and their employees the advantages of clean and careful methods in milk production and distribution, and the means whereby such may be brought about. Moreover, as milk of this quality can only be produced

from herds entirely free from tuberculosis it provides a stimulus to farmers to free their herds from this disease. It should be no longer possible for the general milk-supply to contain, as it does, a large amount of dust and excremental matter and to have a bacterial growth of such magnitude that, were pure milk transparent, cloudiness due to the presence of innumerable micro-organisms would be readily visible. The boiling or pasteurization of milk cannot remove the necessity for care in its production, and the presence of millions of dead micro-organisms is highly undesirable.

CHAPTER IV

THE TREATMENT OF MILK IN THE HOME AND THE PREPARATION OF THE FOOD

PASTEURIZED AND BOILED MILK

MILK should be delivered to the customer, cooled, in sealed bottles. On arrival it should be placed in an ice-chest or some other cool place with a temperature below 50° F.

It is now generally accepted that infants can be fed on boiled milk without incurring any special danger of rickets or scurvy, and in comparative safety from tubercle and other bacteria. Milk can be either boiled or pasteurized, the difference depending solely on the temperature. Milk should never be heated in any form of pan directly over the fire. In all cases it should be placed in one or more vessels, which are then immersed in a larger vessel containing water. Where pasteurization is intended the temperature is not allowed to exceed 180° F. When this temperature is reached the heating is stopped and the milk rapidly cooled. Only a certain proportion of the living bacteria are destroyed by this means. When milk is boiled the temperature of the water is allowed to reach boiling-point. The temperature of the milk will be a few degrees below boiling-point. Strictly speaking, "boiled" milk means milk which has just reached boiling-point and then been rapidly cooled. When the temperature is allowed to remain at this point for any period that period should be stated, *e.g.* "boiled for ten minutes" means that it has been at or near the temperature of boiling water for ten minutes.

The term "sterilized" is frequently loosely used to denote milk which has been boiled for prolonged periods. This is a misnomer, since in effect milk is extremely difficult to render sterile, and it can only be accomplished by heating the milk to a temperature well over that of boiling water.

In pasteurizing or boiling milk the meals for the ensuing twelve hours may be prepared at the same time. The food after mixing should be poured into as many bottles as there are meals. Each bottle is closed at one end by a rubber valve which, when heated, allows the escape of air, and which, when cooled, is sucked back by the vacuum produced, rendering the whole air-tight. An alternative plan is to use plugs of cotton-wool wedged into the mouth of the bottle. The bottles, supported vertically in a wire cruet-frame, are then placed in a deep saucepan containing cold water to the level of the milk. The water is raised to the desired temperature, when the wire frame is withdrawn and immersed in cold water or placed upon ice. To avoid cracking the bottles, it is well to pour a little cold water into the saucepan before withdrawing the frame.

COOLING OF MILK

Whether boiling or pasteurization is selected, it is important to remember that the subsequent rapid cooling of the milk is at least as important as the preliminary heating. For this purpose a simple form of ice-chest is of the utmost value, and should find a place in a well-equipped nursery. When this is unobtainable, the vessel or the frame supporting the bottles should be immersed in cold water which is frequently changed, or in running water.

CLEANLINESS

It is needless to reiterate the necessity for absolute cleanliness in preparing and mixing the food. The nurse's hands must be washed with the utmost care, and all measures, spoons, &c., scalded immediately after use. The bottles should be cleansed by washing with hot water and soda, scrubbing the inside with a wire brush, rinsing thoroughly with cold water and finally by scalding. They should be allowed to stand mouth downwards after use.

Rubber teats should be turned inside out, cleansed and scrubbed in boiling water, and should be kept in a basin of cold water or, perhaps preferably, allowed to remain dry in a clean sterilized and covered glass receptacle.

Graduated measures should be used. The markings upon the feeding-bottle are often inaccurate.

THE MODIFICATION OF MILK

The healthy child possesses in a high degree a capacity for adapting himself to the nature and even to the amount of his diet. On breast or on bottle, on whole milk or on diluted milk, on a diet rich in sugar or on a diet rich in fat, children over three months of age may daily be seen thriving and developing satisfactorily, provided only that they have never up to that time suffered from any of those digestive disturbances which leave in their train a serious diminution of tolerance for food of all sorts.

To draw up any table which shall express the limits of tolerance of the average child for the foods at our disposal is to attempt an impossibility. Individual peculiarities are too frequent and of too marked a character. The same diet which will secure the satisfactory development of one infant may, if persisted in, provoke a fatal disturbance in another. Even in the same infant a diet which produces satisfactory results during cold weather may overstep the tolerance in a season of great heat (*vide* p. 115).

In general terms, however, it may be said that most infants after the first three or four months of life will thrive upon a diet of undiluted cow's milk if certain precautions are taken.

THE INTERVAL BETWEEN MEALS

The meals must not be given at too frequent intervals. It is no uncommon thing to meet with infants of three or even six months of age who are being fed at intervals of two hours. Such frequent feeding is a common cause of dyspepsia. For many healthy children, after the first few weeks of life, five or six meals in the twenty-four hours are sufficient. Digestion can only proceed normally if the stomach is completely emptied before the intake of food. Fats and proteins leave the stomach much more slowly than carbohydrates, and cow's milk is rich in both of the former and poor in the latter. The dense curd of casein which is characteristic of cow's milk passes the pylorus with especial difficulty. The stomach of a breast-fed infant is probably emptied in from one and a half to two and a half hours; the stomach of an infant fed on cow's milk

much more slowly. A three-hourly and often a four-hourly interval between meals is not too long.

THE TOTAL OF COW'S MILK TAKEN PER DIEM

Secondly, the amount taken in the day must not be too large. Although individual variations are considerable, in general it may be said that an infant soon after birth requires, approximately, one-seventh of his body-weight of milk. At three months of age one-eighth may be required, at six months one-ninth, and between nine months and twelve months of age one-tenth. Since a fluid ounce of milk weighs, approximately, 1 oz., we have only to divide the weight of the body expressed in ounces by the appropriate number in order to obtain approximately the amount of milk required. Thus a child of about four months of age weighing 12 lb., or 192 oz., will require $192 \div 8$, or about 24 oz. of milk *per diem*. A child of about seven months of age weighing 17 lb. will require $17 \times 16 \div 9$, or about 30 oz. More than 2 pints of milk should never be given. In instituting artificial feeding in a healthy child we should always be careful to give a less amount than the child is capable of digesting without disturbance. After some days, if the gain in weight is unsatisfactory but there is no diarrhoea and vomiting, we may gradually increase the amount given until the weight-curve ascends at a proper angle. For each child we aim at giving the minimum amount of food which produces a satisfactory rise in weight.

THE SIZE OF SEPARATE MEALS

The amount given at a single feed can be calculated by dividing the total amount taken in the day by the number of feeds. A child of three months taking 18 oz. of milk *per diem* in six feeds takes 3 oz. at each meal. A child of nine months taking $1\frac{1}{2}$ pints of milk *per diem* in five meals takes 6 oz. at each meal.

THE ADDITION OF SODIUM CITRATE

When undiluted milk is used it is well to add sodium citrate in amounts equal to 2 grains for every ounce of milk. The

number of grains required for each feed may be dissolved in a teaspoonful of water. In any one feed not more than eight grains should be given. The action of sodium citrate will be discussed in a later chapter (*vide* p. 30).

THE TEMPERATURE OF THE MILK

Before being given to the child the bottle should be immersed in hot water for some minutes, in order to raise the milk to a temperature approximately that of blood-heat. The bottle should be so warm that it can be comfortably held in contact with the nurse's cheek.

THE POSITION OF THE CHILD WHEN DRINKING

During feeding the child should be held in the arms of the nurse with head and shoulders a little raised. Slight traction on the bottle, so as to afford some resistance to the child's suction, will often assist. The child should never be left unattended with the teat in his mouth. If the bottle is not kept at the proper angle there is danger that a large amount of air may be swallowed. A teat with the smallest aperture which allows the milk to enter steadily should always be used.

It is not to be claimed, in spite of all assurances to the contrary, that a diet of whole milk given with all care always achieves satisfactory results and never gives rise to disturbances. In infants under three months of age, and especially in infants in the first few weeks of life, a whole-milk diet will produce dyspepsia in a considerable percentage of cases. In very young children it is safer to dilute the milk to an extent which diminishes with the increasing age of the child, until whole milk is reached at the end of the third or during the fourth month of life. The special difficulties met with in the feeding of very young children will be considered in a later chapter (*vide* p. 123). Nor is it to be supposed that even in children in the later period of infancy a whole-milk diet will confer freedom from all digestive disturbances. Certain types of disorder are, indeed, peculiar to such a diet and are by no means of infrequent occurrence. These also will be dealt with in a later chapter (*vide* p. 83). Before entering

upon the discussion of the diseases of nutrition among the artificially fed in greater detail it is sufficient to state here that, with these reservations, a diet of cow's milk offers the best substitute for breast milk as the permanent diet of an infant. After three or four months of age any elaborate modification of the milk, as a routine practice, is unnecessary. *To foretell exactly how an infant will react to an artificial diet is always impossible. A diet of reasonable composition must be prescribed and modified, if necessary, later, in the light of the symptoms which result.*

CHAPTER V

THE COMPOSITION OF VARIOUS FORMS OF DIET

BEFORE we can be in a position to appreciate the characteristic symptoms which indicate different faults in the composition of the diet, and before we can understand the principles which guide us in modifying the diet in order to relieve particular symptoms, it is necessary to have some knowledge of the various foods at our disposal. We must consider, firstly, the part played in the economy of the child by proteins, fats, and carbohydrates, and, secondly, how these are combined in the usual food mixtures.

THE IMPORTANCE OF THE CONSTITUENTS OF THE DIET

The *protein* of the food performs a threefold function :

- (1) It gives the stimulus for growth and cell division. Without protein life cannot be carried on.
- (2) It can serve dynamic purposes and maintain the heat and energy of the body.
- (3) It replaces the nitrogen which is lost in the wear and tear of the body—the nitrogen, for example, which is lost in the intestinal juices evacuated from the bowel.

In breast-fed infants practically all the protein of the food is absorbed; the faeces contain only that small amount of nitrogen which is derived from the intestinal secretions and from the bodies of bacteria. Of the nitrogen taken in the food the most part is excreted in the urine. A small part is retained in the body.

Carbohydrates are the chief source of muscular energy and of the production of heat. They are necessary for the metabolism of fat, and have the power of increasing the retention of protein in the body. A deficiency of carbohydrate results in delayed growth and development and in a subnormal temperature (*vide* p. 86, Fig. 5).

Fats. A considerable percentage of fats passes through the intestine unabsorbed, and appears in the fæces as neutral fat, fatty acids, and soaps. Fats can replace carbohydrates to a certain extent in the diet, but the presence of carbohydrate is necessary for the undisturbed metabolism of fat.

THE COMPOSITION OF COW'S MILK

The following table contrasts the composition of cow's milk and human milk :

	Human milk.	Cow's milk.
Protein, Casein	0.6	3.25
Lactalbumin	1.4	0.75
Fat	3.5	3.5
Carbohydrate	7.0	4.0

It will be seen that cow's milk, compared with human milk, is very rich in casein and relatively poor in carbohydrate.

PROPERTIES OF COW'S MILK

The casein of cow's milk has certain peculiar properties. It forms with the rennin in the infant's stomach a dense white coagulum, which in part may be passed on through the pylorus into the intestines. The casein cannot from its nature readily undergo any fermentative changes and cannot give rise to such fatty acids as result from the fermentation of sugars.

The use of whole milk, in which the casein content is high and the sugar content low, is therefore associated with an alkaline rather than with an acid reaction in the bowel and with constipation rather than with diarrhœa. As a result of the alkalinity of the bowel contents much of the fat of the milk is excreted in combination with calcium as soap, and this excess of soap gives rise to the bulky, grey or white, formed stools, with alkaline reaction, often seen in infants fed upon cow's milk (*vide* p. 85, Plate IV). This property, so characteristic of cow's milk, of causing an alkaline reaction in the bowel and producing bulky, alkaline stools may be made use of, as will be seen, in checking the acid fermentation of carbohydrate dyspepsia. The property is diminished or lost if cow's milk is subjected to great heat. It is therefore less marked in condensed or dried milk. It is diminished by peptonizing milk, by the process of souring milk, and by greatly diluting milk.

In infants fed upon food containing excess of carbohydrate the fermentative changes are encouraged. In all cases the changes probably are of the same nature—deficient secretion of hydrochloric acid in the stomach, excessive formation of fatty acids which gives rise to excessive stimulation of the peristaltic movements of the bowel, and excessive growth of those micro-organisms which thrive in the acid medium. The stools are watery, and contain much mucus from irritation of the bowel wall; the colour is green and the reaction in severe cases may be acid. The profuse flow of alkaline intestinal juice in many cases, however, determines an alkaline reaction of the whole, although individual particles of the stool may retain their acidity. Both the vomit and the stools may have a characteristic sour odour from the presence of volatile fatty acids.

We have, further, to consider the composition of the following foods, which are often used in the dietary of infants :

DRIED MILKS, CONDENSED MILKS, AND PROPRIETARY FOODS

(1) Dried milks when suitably diluted produce a fluid with, approximately, the same composition as fresh milk. As a result of subjection to heat, changes have taken place in the combination of the salts, gases have been expelled, the acidity has fallen, and the dense coagulum formed by the fresh casein in the stomach has become finer and more flocculent.

Examples : Glaxo, Truemilk, " Cow and Gate " dried milk.

Indications : Useful in times of great heat, during journeys, and at other times when good fresh milk cannot be obtained. The substitution of a dried milk for fresh milk in cases of dyspepsia does not produce any modification which is likely to be therapeutically very successful. When good results have followed the change the improvement is generally to be attributed to the subsidence of some infective disorder of which the gastro-intestinal disturbance was symptomatic, or we must conclude that the disturbance was due to bacterial contamination or to want of freshness in the milk, to excessive or too frequent feeding, to the addition of sugar in excessive amounts, or to a too high percentage of fat. In dried milk the fat is commonly not above 3 per cent. The sugar may be raised to about 7 per cent.

(2) Condensed milk without added sugar, when suitably diluted, can also produce a fluid approximately of the same composition as fresh milk.

Example : Nestlé's Unsweetened Condensed Milk.

Indications : Although it does not keep so well and is therefore less convenient, unsweetened condensed milk may be used in place of dried milk under the same circumstances.

(3) Sweetened condensed milk has a high percentage of added cane-sugar.

A heaped teaspoonful of Nestlé's sweetened condensed milk added to 3 oz. of water produces a mixture with, approximately, the following composition : protein, 1 per cent. ; fat, 1 per cent. ; sugar, 6 or 7 per cent.

Indications : Not a few young infants are unable to digest the fat of cow's milk even when two or three volumes of water are added. In such cases the half-digested contents of the stomach, containing the characteristic dense curds of casein, are vomited. That the change in such cases to a sweetened condensed milk is often successful in allaying the vomiting is everyday experience.

The disadvantage of sweetened condensed milk, even as a temporary measure, lies in the increased tendency to cause diarrhœa as a result of the increased fermentative changes produced in the bowel by an excess of cane-sugar. In great dilution—as, for example, in the proportions mentioned above—this drawback is commonly not apparent. As the permanent diet of an infant, sweetened condensed milk is far too deficient in fat and protein to achieve satisfactory results. As the child grows older, the necessary increase in the concentration of the mixture raises the percentage of sugar to a dangerous height and tends more and more to the production of diarrhœa in susceptible children.

(4) Malt-sugars to be added to fresh milk.

Examples : Mellin's Food, Hovis Babies' Food No. 1.

Indications : All observations and all experimental evidence go to show that maltose preparations are less fermentable and less liable to produce diarrhœa than lactose or cane-sugar in similar amounts. For infants in whom cane-sugar readily causes disturbance extract of malt or one of the above-mentioned preparations, which may be looked upon as desiccated extract of malt, may be substituted.

(5) Dried milks with added malt in which all the carbohydrates are in soluble form and no unaltered starch is present.

Examples : Allenbury's No. 1 and 2, Horlick's Malted Milk.

Indications : Especially suitable for young infants when the fat of cow's milk causes vomiting. The tendency to produce diarrhoea is certainly less than with condensed milk with added cane-sugar.

(6) Cereal foods to be added to milk. During preparation, by ferment action the starch becomes converted to some extent, but not entirely, into soluble forms, chiefly dextrins and maltose.

Examples : Benger's Food, Savory and Moore's Food, Allenbury's Malted Food.

Indications : Useful for children over six months of age in whom a satisfactory gain in weight is not achieved upon a milk diet or in whom the tolerance for fat is low. Exceptionally the starch-containing foods may be successfully used at an earlier age.

(7) Cereal foods to be added to milk, consisting almost entirely of unaltered starch, in the form of baked flour.

Examples : Ridge's Food, Neave's Food, Frame Food, Hovis Food No. 2.

Indications : Useful for children in the later months of infancy who require a plentiful supply of carbohydrate. A much larger amount of carbohydrate can be given without any danger of producing diarrhoea if a second kind of carbohydrate is added in the form of starch and the whole is not supplied as sugar. As a general rule these foods are not suitable for infants under six months of age.

USES OF PROPRIETARY FOODS

The intelligent use of these foods as temporary substitutes for cow's milk or as additions to cow's milk may achieve good results. It is wrong to condemn them unconditionally because of their low content in fat. In cow's milk we have a fat-rich food ready to hand which is cheap and easily procurable. In certain infants the fat of cow's milk disagrees; in others a much higher percentage of carbohydrate than is found in cow's milk is necessary for growth and development. These foods place at our disposal in convenient form a variety of diets which are generally poor in fats and rich in carbohydrate

of one sort or another. They achieve success by reason of the contrast which they offer in composition to cow's milk, not, as is sometimes claimed by their proprietors, because of any similarity to mother's milk. They are especially useful in treating the constipation and retardation of growth which sometimes develop in susceptible infants on a diet of cow's milk (*vide* p. 83). Most of them possess the disadvantage that the high carbohydrate percentage is somewhat liable to produce diarrhœa, especially in times of great heat when the tolerance and need for carbohydrate falls. In practice, although convenient, they must be used with care because the extravagant claims of the advertisements, which set forth their merits, are apt to impose upon mothers and nurses. When possible it is better to have the necessary combinations of milk, malt, and baked flour prepared in the home than to encourage the belief that any special virtue lies in the particular proprietary combination.

To alter profoundly the whole character of the diet by trying first one and then another advertised food in the hope of finding one which "suits," is a sure way to induce and prolong disturbances of digestion. It is a safe rule that no food will "suit" so long as the excessive gastric and intestinal fermentation lasts. Diarrhœa and vomiting are protective reactions set up for the defence of the child, the object of which is to empty the bowel. Unless this object is assisted by temporary starvation or limitation of food, the symptoms are sure to be aggravated and the illness prolonged.

The reputation which proprietary foods gain in individual cases is often little deserved. In infancy dyspepsia is often symptomatic of some obscure and unrecognized infection of parts remote from the bowel, and the symptoms of digestive disturbance may well persist, regardless of changes in diet, until the subsidence of the infective process, when the cure is apt to be attributed to the diet last tried. Such an accident may induce mothers and nurses to persist in a diet which is in reality less suitable than others which have been discarded as dangerous, or to recommend the food as a panacea for disturbances of infantile digestion of whatever nature. The use of proprietary foods should always be regarded as a temporary therapeutic expedient and should always be controlled by expert advice.

ADDITION OF SODIUM CITRATE TO MILK

In this country, while the practice of whole-milk feeding has found considerable favour, it is very often combined with the prescription of small doses of sodium citrate. Sodium citrate is the most recent of a number of substances which have been recommended from time to time with the object of diminishing the density of the casein clot, such as lime-water, barley-water, and sodium bicarbonate. Several of these still have some vogue, but it may be doubted whether any of them except sodium citrate effectively modifies the normal process of casein coagulation. Barley-water and sodium citrate have both a slightly laxative action which may help to overcome the tendency to constipation produced by the alkalinity of the intestinal contents which results from a diet of undiluted milk. Moreover, the addition of an alkali—no new treatment in acid dyspepsia—may be useful in neutralizing the products of excessive fermentation in the stomach. In moderate doses sodium citrate has no ill effect. The erythematous and urticarial rashes which have been attributed to its use are anaphylactic phenomena, which, as will be seen later, sometimes, although rarely, attend the use of cow's milk in susceptible infants (*vide* p. 87). Similarly constipation, so often induced by a diet of whole-milk, has been attributed to the sodium citrate. Although its action is a mild one, sodium citrate belongs to the group of saline cathartics. The chief service which it renders to us in the difficulties of artificial infant-feeding probably lies in the increased rapidity with which the stomach is emptied by its use. The addition of sodium citrate lessens the coagulation of the casein and allows the contents of the stomach to pass the pylorus quickly and in a fluid state. This increase in the rate at which the stomach is emptied diminishes stasis and secondary fermentative changes in the stomach, and favours the secretion of hydrochloric acid because the stomach is emptied before a new meal is taken.

To sum up, we may say that cow's milk tends to produce constipation and an alkaline reaction in the bowel, while a diet rich in sugar encourages fermentation and increases the risk of diarrhoea. The high fat content of cow's milk is apt to produce delay in the emptying of the stomach and vomiting of undigested or partly digested milk.

CHAPTER VI

THE MANAGEMENT OF NURSING AT THE BREAST

THE MANAGEMENT OF THE BREASTS DURING PREGNANCY

It is important to pay attention to the breasts during the last months of pregnancy. The nipples, if at all depressed, should be drawn out with all gentleness and rolled between finger and thumb so as to mould them into shape. It is sometimes recommended that eau-de-Cologne or spirit should be applied daily to minimize the risk of so-called "cracked nipples." Such applications are not needed, and may even do harm by hardening and drying the skin, thus rendering it more liable to the very condition it is desired to avoid. A little lanoline may be used to make the manipulation of the nipple more easy. All pressure of the clothes upon the enlarging breasts should be avoided.

THE FIRST ATTEMPTS AT NURSING

The infant comes into the world with the sucking reflex well established. The centre for innervation of the muscles concerned is situated in the medulla oblongata. The act is entirely reflex and involuntary. As has been often observed, an-encephalic monsters are perfectly capable of powerful suction.

As a rule the infant, when it has been washed and dressed, falls immediately into a deep sleep. For twelve or twenty-four hours after birth signs of hunger are seldom shown, and for that space of time it is needless and useless to attempt nursing. A little boiled water, sweetened with saccharin, may be given. On the second day the child should be put to the breast. This generally succeeds best when the infant is laid alongside of the mother in the bed, while she bends over

sufficiently to bring the nipple on the corresponding side to the child's mouth. Many infants will at once grasp the nipple and suck strongly; in others, however, the matter is not so easily managed, and the child may fumble clumsily or, turning away his head, resolutely refuse the breast.

In such cases nothing is to be done but to persist in offering the breast at regular intervals, and in patiently endeavouring in every way possible to induce the child to suck. If the pelvic condition of the mother permits, on the third day she may be propped up into a sitting position and the baby held to the breast in the usual way. Any over-extension of the child's neck must be avoided as a sure way to make him leave go of the nipple.

FACTORS WHICH DETERMINE THE SECRETION OF MILK

The amount of milk which the child receives in the first few days is very small—as a rule only a few ounces *per diem* until the third, fourth, or fifth day, when the milk “comes in.” The child should be placed to the breast at regular three-hourly intervals, and one nursing only should be allowed between 10 P.M. and 6 A.M.

A complete absence of milk secretion does not exist. Every mother secretes milk. There are, however, striking variations in the readiness and ease of the flow. All that we know from experiment and from practical experience teaches us that the establishment of a satisfactory supply of milk is dependent upon the vigorous and effective suction of the child and in the regular and complete emptying of the breasts. If the infant fails to complete his task and residual milk is allowed to accumulate in the breast, the amount secreted rapidly declines and the breast becomes stubborn and difficult. If, on the other hand, the breast is regularly emptied, the milk secreted increases, at first rapidly until the needs of the child are fully met, later more slowly, keeping pace with the increased demand of the child. The provision of a proper supply of milk is dependent upon the complete and regular emptying of the breast. If the amount of milk is small we must endeavour to find the cause which has interfered with the suction of the child and rendered it ineffective.

By an examination of the mother we may find the cause in any one of the following conditions :

- (a) Depressed or badly formed nipples.
- (b) Cracked nipples, so painful that prolonged nursing becomes intolerable.
- (c) Hyperæsthesia of the nipple and of the breast.

By an examination of the child we may find the cause in any one of the following conditions :

- (a) Prematurity.
- (b) Dyspnœa from bronchitis, broncho-pneumonia, atelectasis pulmonum, congenital syphilis with "snuffles," overgrowth of adenoid vegetations, nasal catarrh, congenital heart disease, lack of development of the nasal passages.
- (c) Pyrexial disorders and the toxæmias of the newly born (*vide* p. 155) which diminish or completely abolish appetite.
- (d) Cleft-palate, hare-lip, Bednar's aphthæ, and other local conditions in the mouth. Because the tongue takes no part in the infant's sucking movement, "tongue tie" does not interfere with suction.
- (e) There remains a group of congenitally feeble infants with insufficient suction, not a few of whom show early in life unmistakable signs of the exudative diathesis of Czerny (*vide* p. 166).

These disturbances of early infancy which interfere with early breast nursing, and may prolong the period of inanition, which normally lasts three or four days (physiological inanition) over many weeks, will be fully dealt with in a later chapter (*vide* chap. xiv, "Inanition").

It is enough to insist at the outset that delay in the establishment of the milk-supply is due to some one of the causes, which directly interfere with the proper suction of the infant. Formerly absence of an adequate supply of milk was looked upon as evidence of a maternal idiosyncrasy. To-day it is certain that the fault lies in a mechanical interference with the suction of the infant, or, if an idiosyncrasy does exist, that it is an idiosyncrasy of the child and not of the mother.

The belief that there are women in whom the function of lactation is altogether absent is not supported by evidence. If the nipple of the mother is well formed, and if the child is healthy and can be induced to suck, all mothers can nurse their children at birth and for some time thereafter. It is true that in the later months of lactation the milk of not a

few women tends to become insufficient in amount. We are not here speaking of a failure of lactation to continue, but of a failure in its first establishment.

Except in those cases in which a definite contra-indication exists, all women should be urged to nurse their children. In systematically conducted lying-in hospitals, where a good technique of nursing is established, nearly all women can be made to nurse effectively, although at the same time it is apparent that in some cases a strong and continuous stimulus is necessary and that women differ considerably in the response to a given stimulus. Nurses and others frequently advise the abandonment of breast nursing upon the most trivial grounds. It is not to be denied that we shall often be forced to give supplementary feeding, but we must do so only after a full examination of the circumstances in each case and with a clear appreciation of the risk of complete weaning involved.

The treatment of the causes which interfere with suction which are to be found in the child is dealt with in a later chapter (*vide* p. 107). Here we must deal only with those which concern the mother especially.

DEPRESSED NIPPLES

If manipulative treatment is undertaken in the later months of pregnancy, depressed nipples can nearly always be drawn out and moulded into a suitable shape.

Even if this has been neglected and the condition is found after the birth of the child, much can be done by steady pressure with oiled fingers. The vigorous suction of a healthy child will itself work wonders. If the child is kept warm and given sufficient water flavoured with saccharin in a spoon, we may be content to wait patiently for many days in the expectation that the formation of the nipple will steadily improve. To give supplementary bottle feeding is to make it almost certain that the child will desist from all attempts at emptying the difficult breast.

After each nursing the mother should express all residual milk. This may be done effectively by a breast-pump made upon the principle of a Bier's suction-pump. Often, however, the breast can be very completely emptied by drawing it forwards and upwards with one hand, while steady pressure

is exerted by the other hand from the periphery to the nipple. The expressed milk should then be given to the infant.

Finally, an india-rubber shield-nipple may be tried. In mild cases this is not necessary, and it has to be confessed that it is not often effective in severe cases where simple manipulation, subsequent emptying of the breast, and the exercise of patience have failed.

A sudden or persistent fall of the infant's weight in the second or third week of life will render supplementary feeding necessary.

CRACKED NIPPLES

On the second and third day after the labour there is often a comparatively sudden increase in the swelling and tension of the breasts. They may become hard and tender and throb painfully. At the same time, the mother may complain of headache, and there may be some rise of temperature. The pain and tension in the breasts are apt to be especially great when for any reason the suction of the infant is defective—as, for instance, with a premature child. Gentle manipulation and emptying of the breast will give relief. The nipple and the breast-tissue immediately around should be gently squeezed between finger and thumb, and a little milk expressed. Then the whole breast should be raised and drawn forwards, whilst it is gently massaged with oiled fingers from the periphery to the areola.

If this so-called “caking” of the breasts persists in spite of the regular suction of the child, combined with these simple measures, a breast-pump should be used and the milk drawn off. Hot fomentations applied to the breast, leaving the nipples uncovered, will ease the pain. The bowels should be opened by a purgative.

After nursing, the nipples should be washed with boiled water and very carefully dried. A pad of gamgee tissue should be pinned to the clothing so as to be in contact with the breast. When one breast is being used there is sometimes a tendency for a little milk to escape from the other. In such cases these precautions must be extended to both breasts at nursing.

Insufficient emptying of the breasts, failure to dry the nipple, and nursing prolonged beyond twenty minutes and

undertaken at too frequent intervals, are the most important causes of cracked nipples.

If this condition should result in spite of all precautions, a strip of gauze soaked in compound tincture of benzoin should be applied, or the fissure may be repeatedly painted with a 1 per cent. solution of silver nitrate. The following preparations are recommended :

Arg. nitrat.	.	.	.	.	gr. 15
Bals. peruvian.	.	.	.	.	3 2½
Ung. paraffin.	.	.	.	.	q.s. 3 3
S. Ft. Unguentum.					

or Tannin-alcohol, which is composed as follows :

Acid. tannic.	.	.	.	.	gr. 30-75
Glycerin.	.	.	.	.	5 5
Spirit. rectificat.	.	.	.	.	q.s. 3 3
S. Ft. Mist. Apply frequently.					

The child may be removed from the affected breast for twenty-four hours, but if this is done the breast must be regularly emptied by a breast-pump. To allow the milk to accumulate will only aggravate the condition and increase the risk of mastitis. Longer than twenty-four hours, if possible, the child should not be kept from the breast.

The degree of pain caused by cracked nipples is very variable. A small excoriation may cause great pain, or we may meet with large, yet almost painless, fissures.

If pain is severe, orthoform in powder or an ointment containing cocaine may be applied for the time during which the child is removed from the breast, or an india-rubber nipple may be used over the application.

If mastitis develops, the breast and the arm on the same side should be bandaged and kept absolutely at rest. Cold compresses should be applied to the breast. If an abscess forms, the condition must be treated surgically.

Neither cracked nipples nor mastitis afford an indication for the permanent withdrawal of the child from the breast. Indeed, such a withdrawal aggravates the condition. If the child is removed for some time from the breast the flow of milk becomes deficient and slow. It requires great patience and firmness to induce an infant to persist in the suction necessary to restore the milk flow, when close at hand lies the other breast which runs more readily and is full of milk. We

must guard against the tendency of the mother to put the child more and more to the breast which is sound, and so avoid the subsequent involution of that which was affected.

I have often persuaded mothers to begin to use the breast which after mastitis has lain idle for many weeks—in one case for eleven weeks—and with a little patience the attempt has often been successful.

THE NUMBER OF MEALS PER DIEM

During the first fortnight, and until the secretion is fairly established, the child should be put to the breast at three-hourly intervals. After the first few weeks, if the child is vigorous and thriving, six meals in the twenty-four hours are usually sufficient. In a minority of cases more frequent feedings produce better results. The practice of laying the baby to the breast ten or twelve times in the twenty-four hours is responsible for many of the troubles which sometimes beset nursing at the breast.

The normal course of digestion requires the complete emptying of the stomach between meals—a process which in breast-fed infants requires from one and a half to two and a half hours. Even in slight cases of fermentative dyspepsia this time is considerably lengthened. Frequent feeding increases the fermentative changes and diminishes the secretion of hydrochloric acid.

Mild cases of fermentative dyspepsia in infants fed at the breast are not uncommon, and they are due as a rule to too frequent feeding. Inasmuch as dyspepsia at once gives rise to a loss of appetite and to refusal of food, the condition is usually transitory. The flow of milk becomes less free because the breast is incompletely emptied, and this persists until convalescence is established. Nevertheless, there are not a few breast-fed infants to be met with who suffer from a constant succession of trivial disturbances, characterized by colic, flatulence, slight diarrhoea or vomiting, "possetting," fretfulness, and disturbed sleep. Such a condition is quite compatible with a gain in weight and with progress in other respects. Serious symptoms of collapse and prostration, such as are common enough in the dyspepsias of bottle-fed infants, are absent. Over-feeding at the breast is apt to make a child

ill-tempered and fretful ; it seldom makes him seriously ill. These slight disturbances, however, are alarming to the mother, bring discredit on breast nursing, and give rise to fears, quite unfounded, that the milk is unsuited to the child. They can usually be completely controlled by the adoption of longer intervals between nursing.

I know of no single piece of advice which is more often required in practice or which gives more uniformly satisfactory results. Infants who suffer from over-feeding at the breast are usually by nature the strongest and most vigorous. If fed five times a day vigour persists, but fretfulness disappears.

On the other hand, too frequent feeding may have just the opposite effect and the child be permanently under-fed. The infant which is seldom or only intermittently hungry because of too frequent feeding often sucks ineffectively and half-heartedly, with the result that the breast is incompletely emptied. Deterioration both in the quantity and in the quality of the milk follows.

The majority of healthy infants, after the establishment of the milk secretion, will do well if nursed five times in the day—at 6 A.M., 10 A.M., 2 P.M., 6 P.M., and 10 P.M. ; and once at night if necessary. It is obvious that in this way the strain upon the mother is very much lessened. There are few women who do not become exhausted in body and mind by a rule which enjoins two-hourly nursing. A minority of infants require more frequent nursing.

THE TIME SPENT IN NURSING

The child is allowed to drink until he is satisfied.

As a rule some twenty minutes is spent in this way, but by far the greatest amount is taken in the first five minutes. Of a meal of 192 grammes of milk, 112 grammes were taken in the first five minutes, 64 in the second, and 16 in the third (Feer). The infant should be removed from the breast when the sucking becomes halting and feeble and the child sleeps or begins to play with the nipple.

THE POSITION FOR NURSING

The mother should be seated on a low chair, the seat of which may preferably have a backward slope.

The knee on the side corresponding to the breast used should be held a little higher than the other to support the head of the child, which is steadied by the hand of the same side. The other hand is free to regulate the flow by pressure on the nipple with the fingers and to keep the breast from pressing on the child's nostrils.

Great care must be taken to keep the child's head flexed; over-extension renders swallowing difficult.

THE EVIDENCE OF SUFFICIENT OR INSUFFICIENT MILK-SUPPLY

(1) The most reliable guide as to whether or not the child is having sufficient food from the breast is provided by regular and systematic weekly weighing.

Except in serious and dangerous disturbances, daily weighing is unnecessary, and may do harm by alarming the mother.

(2) Close observation of the child at the breast may encourage the belief that the milk is insufficient in amount. When milk is flowing freely a little may escape from the child's mouth and be seen upon his cheeks and chin. The swallowing movements follow after every three or four sucking movements in regular sequence and can be counted by placing a finger upon the larynx. If no swallowing movement follows after repeated sucking movements and if no milk appears on the lips or tongue, it is probable that the flow for the time being is deficient.

(3) Some information is gained from a *test meal*—that is to say, a calculation of the amount swallowed obtained by weighing the child immediately before and immediately after nursing. The number of ounces which the child's weight has increased represents the number of ounces of milk obtained at the meal. If a satisfactory figure is shown it is probable that the breast is capable of doing its work well. If, however, a small and insufficient meal is taken, no direct indication for weaning is afforded. Healthy and thriving children will often refuse to take more than one or two ounces at some particular meal. It is not to be forgotten that a test meal is a measure not so much of the secretory capacity of the breast as of the suction and appetite of the child. It is therefore essential that at least four hours should have intervened

between the last nursing and the experiment of a test meal. Moreover, if the rules of good nursing have been neglected and the child has been nursed irregularly and at frequent intervals, the mere provision of a single long pause before the experiment is carried out will not of itself be successful in producing a free flow. We can conclude that the breast-milk is insufficient only after strenuously persisting in the rules of nursing for some weeks without good effect.

(4) Little information of value is obtained from an analysis of a single sample of milk drawn off for the purpose. Not only do the solids, and especially the fats, vary widely from hour to hour, but the proportions of fat and other solids increase progressively during the same milking. The first drawn milk contains less than 2 per cent. of fat, that last expressed may contain as much as 8 per cent. Haphazard and inefficient emptying of the breast causes a rapid diminution in the amount of fat. The composition of a sample of milk is too much the accident of the moment to afford any indication for weaning.

THE AMOUNT SECRETED IN THE TWENTY-FOUR HOURS

The amount taken during twenty-four hours by a healthy baby at the close of the second week is about 15 oz. The total rises slowly until at the end of three months it reaches 25 oz. and at the end of six months 35 oz., beyond which it does not usually go. The amount taken during the day, even with healthy infants, is subject to considerable fluctuation. Variations from day to day of 5 or 6 oz. are quite common (Forsyth).

If two children are put to the breasts of a strong, healthy young woman the amount almost exactly doubles itself. Even for three children three times as much milk is supplied. When one is removed the amount almost immediately falls to its former level. Similarly, if a nurse with abundant milk who is nursing an infant of nine months is separated from this child and a newly born infant put to her breast, the amount of milk within a few days adapts itself to the new and lesser stimulus. These everyday observations testify to the importance of providing a strong suction stimulus. The effects of diet, of drugs, of exercise, &c., upon the mother exert an effect that is in comparison almost negligible; yet in much

that is written upon the subject the emphasis is laid upon these relatively less important factors.

THE AMOUNT OF MILK AT A SINGLE MEAL

A child of three months after a four hours' interval will often take 5 or 6 oz. at a single meal; an infant of six months or older 6 or 7 oz.

With shorter intervals between feedings the amounts are smaller and more variable. With too frequent feeding the child feeds capriciously; at one time much is taken, at another time hardly any at all.

An infant of eighteen weeks actually took 15 oz. at a meal without ill result (Feer). On the other hand, healthy children will often take only 1 or 2 oz. at some particular meal (Forsyth).

The amount taken is not to be measured simply by the capacity of the stomach. Under the X-rays the milk is seen to begin to leave the stomach and pass the pylorus while the meal is still in progress.

THE DIET OF THE NURSING MOTHER

The diet of nursing mothers should be ample and nutritious. Their special need is for extra fluid; most nursing mothers are naturally thirsty, and a pint or more of milk is usually taken readily enough in the twenty-four hours.

The bowels should be regulated and abundance of fresh air and rest provided. Moderate exercise should be taken in all weathers.

PSYCHICAL STIMULI

Mental shocks and psychical stimuli of all sorts have no power seriously to alter the composition of the milk or permanently to diminish its amount. Such causes are frequently adduced by mothers to explain the decline which irregularity and interruption of the routine of nursing have produced. Mothers of a nervous and excitable temperament fail more often than other women to carry out the necessary routine successfully. During menstruation there is often a slight temporary decline in the amount secreted, but the return of menstruation affords no indication for the abandonment of breast nursing.

LACTAGOGUES

Drugs have no power to increase the flow of milk, although the prescription of some much-advertised lactagogue often has a strong moral effect upon the mother, who, fortified in her belief in the remedy, finds it more easy to persist with patience in the routine which is necessary to achieve success.

EXCRETION OF DRUGS IN THE MILK

Much has been written on the dangers which threaten the child if certain drugs—opium, belladonna, quinine, bromides, &c.—are given to the mother in medicinal doses. Practical experience has proved that these fears are groundless.

CONTRA-INDICATIONS TO NURSING AT THE BREAST

Active tuberculosis in the mother is an absolute bar to nursing. The infant should not only be removed from the breast, but so far as possible should be kept from all contact with the mother. Diabetes, advanced kidney disease, heart failure, Graves' disease, malignant disease, epilepsy, and other serious constitutional disorders are contra-indications. Acute infective disorders, on the other hand, have not proved to be incompatible with breast nursing. In measles, scarlet fever, erysipelas, and other fevers, if the condition of the mother permits, a new-born child may safely be placed at the breast. The feeding must, of course, be supervised by a nurse. A syphilitic mother should be urged to nurse her child. Menstruation affords no indication for weaning, because any resulting disturbance in the child is trivial and transitory.

DURATION OF LACTATION

The physiological duration of lactation is apparently almost unlimited. So long as the sucking stimulus is applied with regularity and in an efficient way, so long does the secretion continue; after a certain time, however, the quality of the milk rapidly deteriorates. As the infant's taste and appetite for other food develop there is less and less demand for mother's

milk, the sucking stimulus declines, and involution of the breast sets in.

Infants can be returned after a long interval to a breast which has become dry. I have frequently put infants back to the breast after an absence of three, four, or even eight weeks (*vide* p. 109).

Milk contains but little iron. The infant brings into the world an iron depot with him, which, it has been found, becomes exhausted about the ninth month (Bunge). For that reason the ninth month would seem to be indicated as the date at which weaning should take place. At the same time small amounts of vegetable and cereal foods which contain iron should be added to the cow's milk which has replaced breast milk.

CHAPTER VII

THE CRITERIA OF A SUITABLE DIET

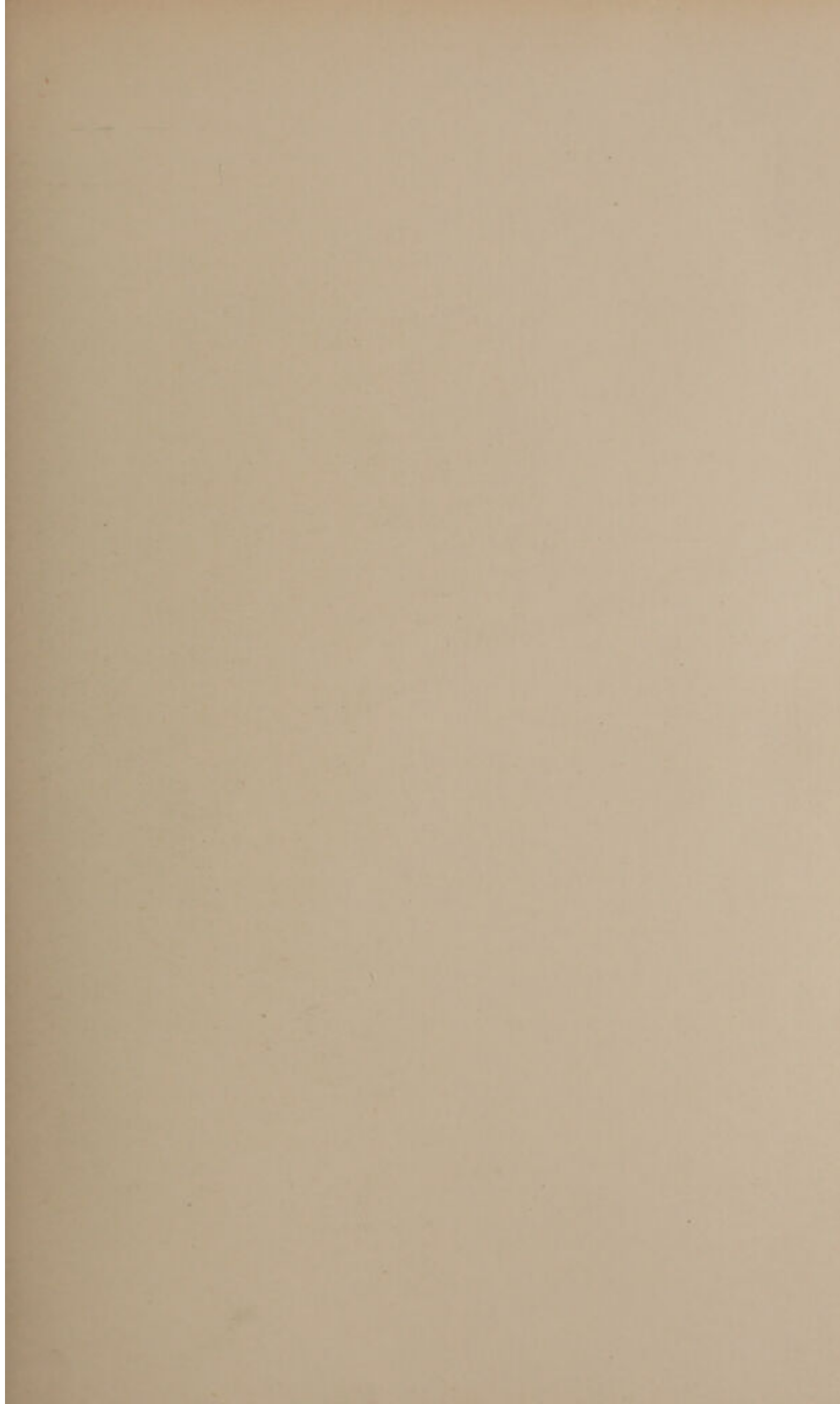
THAT diet alone is suitable upon which the physiological development of the infant proceeds with normal rapidity. Certain functions should be acquired by all infants in due order and at the proper time.

THE DEVELOPMENT OF FUNCTION IN THE CHILD

For some weeks after birth the limbs are incapable of effective voluntary movement. The action of the eye-muscles is not co-ordinated, the head rolls helplessly from side to side, and although the limbs are capable of free and even vigorous movement, their action is purely reflex and without purpose. When two months have passed much of this is altered. If the child is placed face downwards on a pillow, the head can be lifted so that the face is carried away from contact with it. In a darkened room the eyes will follow the movements of a bright light with some approach to precision. Voluntary movements of the limbs begin to appear and the same action will be repeated again and again. At the end of the sixth month the child can sit upright, can locate objects held before it, grasp them and hold them in his hands. By the tenth month he can stand upright, and between the twelfth and the fourteenth month he learns to walk with or even without support. The teeth should be cut easily and without undue delay.

If the child is not mentally defective, and if his progress has not been interrupted by grave illness, we may conclude that any serious delay in assuming these functions is evidence that the diet is at fault.

Further, at any one time we may determine that there is





The normal stool of the breast-fed infant.

disturbance of digestion and judge of the severity of the attack by attention to the following points :

THE EVIDENCE OF GOOD DIGESTION

(1) A child whose diet is not satisfactory and who is not thriving in consequence is restless and fretful. The sleep is broken and disturbed, the skin is pale, and the tone of the muscles diminished. Instead of the agile wriggling motions of the legs and arms there may be slow and feeble movements, and instead of an alert, placid, and observant expression the face may habitually show fretfulness or apathy.

(2) If the curve of the weight is plotted out, by weighing the child daily there should be a steady and uniform rise. The weight, seven or eight pounds at birth, should reach fourteen pounds at the end of six months and twenty pounds at the end of the year.

(3) The temperature curve should remain close to the normal line. An exaggeration of the normal morning and evening excursions, slight pyrexia, or a continued subnormal temperature are commonly met with in disturbed digestion of different types.

(4) The appetite should be good and the child should drink freely and with relish.

(5) The stools should be of normal colour, consistency, and smell, and should not be passed more than two or three times a day. The appearance of the stools varies considerably with the nature of the diet. It is not unusual for mothers and nurses used only to infants fed at the breast to look on a perfectly normal cow's-milk stool as something unnatural and disquieting. The stool of the breast-fed infant is yellow, faintly acid, odourless, and of the soft consistency of the yolk of an egg (*vide* Plate I). The stool of an infant fed on cow's milk is often pale or clay-coloured (*vide* Plates III and IV). It is alkaline in reaction with a musty odour. Often it is bulky, and it may be quite hard and formed so that it keeps its shape and can be readily separated from the napkin. When of a softer consistency, white curd-like masses of fat lie scattered throughout its substance. Such stools are often said to be "undigested," because of the fancied resemblance of these fat curds to the casein curds of the milk. The motion should

be passed quietly and without effort. In the infant in health the stool will often be found in the napkin, into which it has flowed quite unnoticed. In disturbed digestion it may only be passed with obvious effort, with much movement of the body and with the audible escape of gas. There should be no vomiting. Possetting, or the return of some milk immediately it has been swallowed, is usually a sign that the meal has been too large or too hastily taken.

(6) The extremities should be warm and pink, and the capillary reflux should be active. Cold feet may be a cause of diarrhœa; they are certainly the result of digestive disturbances. In chronic digestive disturbances vasomotor instability is often shown by the persistent red marks which are readily produced by slight pressure. There should be no urticaria, and no ulceration or erythema should be produced by contact of the stools with the skin of the buttocks and thighs.

Of all these indications, the first is that which is the most sensitive. To an experienced nurse or mother it is often obvious that the infant is suffering from indigestion for some days before the discomfort culminates in an attack of diarrhœa and vomiting. Where such little points as an infant's increasing fretfulness and want of sound sleep are apt to be overlooked, as in a busy hospital ward, there is much greater need for the plotting out of a chart which will show graphically the weight, the temperature, and the amount of milk taken. By so doing, timely warning of an approaching disturbance may often be secured. For infants whose digestion is continuously unstable such safeguards become essential.

In the next chapter it will be shown how important such a chart is in making an accurate diagnosis of the type of disorder.

CHAPTER VIII

THE CLASSIFICATION OF THE COMMON DISORDERS OF NUTRITION

To find a good classification of the various disorders of infant nutrition has proved a task of extreme difficulty. In turn attempts have been made and abandoned to base such a classification on morbid anatomy, bacteriology, the chemical composition of the diet, and the appearance of the stools. The study of morbid anatomy has been especially fruitless. In cases marked throughout by a great severity of all symptoms, the post-mortem appearances are often entirely negative. In the nomenclature such expressions as gastro-enteritis and enterocolitis are often more definite than our knowledge justifies.

The closing years of last century were marked by the discovery of the part played by bacteria in the ætiology of disease, and since the year 1880 there have been incessant attempts to find by bacteriological research the cause of the large infantile mortality from diarrhœal diseases.

The demonstration of the high degree of contamination which prevailed in the milk-supply of all cities encouraged the hope that boiling the milk would control this huge death-rate. Later experience has modified these hopes and expectations. The arguments for the necessity of attaining a pure milk-supply are not based upon a belief that the ordinary bacteria which multiply in milk have the power to cause a specific infection of the bowel. A low bacterial count is insisted upon only because a high-grade milk is less likely to contain the germs of specific infections, occasionally and accidentally introduced—as, for instance, the bacilli of diphtheria, typhoid fever, or tuberculosis—and because it will not already, before ingestion, have undergone fermentative changes to any harmful extent or contain injurious products of bacterial activity.

To-day attention is directed away from a one-sided bacteriological standpoint and more and more importance is being attached to disturbances of infantile digestion and metabolism in the production of this group of disorders. The functions of the epithelial lining of the alimentary canal are extraordinarily complex. It secretes important digestive ferments and controls the synthesis of fat and of protein; it regulates the passage of water and of salts from the bowel to the blood-stream and from the blood to the bowel; it exercises control over the growth and multiplication of the bacteria which reside in the bowel. Alterations in the functions of this epithelium must play an important part in the production of disorders of nutrition.

In severe cases of infantile diarrhoea the symptoms are not all confined to the alimentary canal, nor all occasioned by excessive stimulation of the intestinal peristaltic movements. The rapid removal of the abnormal contents of the alimentary canal, by vomiting and by the frequent passage of watery stools, is a protective reaction in the interests of the child which, if successful, prevents any serious damage to the epithelial lining of the bowel. If, however, the action of the abnormal contents of the bowel is long continued, or if the offending substances are present in extreme concentration, the complex regulating functions of the epithelial cell are interfered with and grave disturbances in the metabolism of the child ensue. In the majority of fatal cases of so-called summer diarrhoea serious symptoms of this sort precede death, and their onset is often accompanied by a cessation both of diarrhoea and vomiting. The most fatal cases of food intoxication in infants are not infrequently admitted to hospital in a condition closely resembling that of meningitis (*vide* p. 92, Fig. 6). Sometimes the disordered and amplified respiratory movements recall the similar condition met with in diabetic or uræmic coma, or, in association with a high temperature, suggest a diagnosis of broncho-pneumonia. High temperature, rapid irregular pulse, accelerated and amplified respiration, glycosuria, acetonuria, albuminuria, clouding of the intelligence, and partial coma are striking symptoms of intoxication present in the majority of fatal cases of diarrhoea in infants.

Czerny, Keller, and their pupils have especially studied

these disturbances of metabolism and have found in them a basis for classification. They have directed attention to the various factors which may lower the vitality of the alimentary epithelium and so evoke abnormal reactions to food.

(a) In the first place, disturbances may be occasioned by abnormality in the digestive process even when the food given is free from contamination and is of suitable composition. The question as to which of the many products of digestion is to be looked upon as the dangerous factor was answered long ago on the grounds both of experimental research and clinical experience. In the vast majority of cases of diarrhoea and vomiting in children the acidity of the contents of the alimentary canal is greatly increased.

The fatty acids which arise from the fermentation of sugars and of fats—for example, lactic acid, butyric acid, valerianic acid—have the property of stimulating the intestinal movements and of increasing the intestinal secretion, while in great concentration they so damage the epithelial cells as to interfere with their manifold functions.

Feeding at intervals too frequent to allow the stomach to be emptied and to permit of the proper secretion of hydrochloric acid, and over-feeding, sometimes with a mixture of suitable composition, more commonly with a mixture which contains excess of sugar, are frequent causes of excessive acid fermentation and consequent disturbance.

(b) In other cases the fermentative changes are already far advanced in the food before it is given to the child. In milk which has already undergone decomposition and which contains a large number of micro-organisms the danger, as a rule, lies not so much in the possibility of infection of the bowel-wall by these organisms as in the likelihood that further fermentative changes will be initiated within the bowel by the bacteria which are already present in the milk.

(c) If, however, virulent organisms of disease should actually be present in the milk—as, for example, the germs of typhoid fever, diphtheria, tuberculosis, or dysentery—the bowel-wall can be directly infected by the organisms, and not merely damaged by the products of their activity.

(d) Further, all infective processes from which a child may suffer, no matter where the seat of infection may be, are liable to exert a prejudicial effect upon the bowel epithelium.

A similar change is apparent in other epithelial cells of the body under the same circumstances. The kidney epithelium, for example, is often unable to prevent the passage of albumen into the urine during infective disorders. In this transitory interference with the complex functions of epithelium of all sorts we have the explanation of the usual appearance of symptoms of disturbed digestion in infants during pyrexial disorders.

(e) Lastly, a further cause of damage to the epithelial lining of the bowel is found in long-continued starvation. In hypertrophic pyloric stenosis, for example, the tolerance for food is markedly diminished and the difficulties of successful treatment are commonly enormously increased by the readiness with which dyspeptic symptoms are added to those of pyloric obstruction and inanition (Meyer).

An appreciation of these various factors, all of which tend to the production of diarrhoeal disorders, is of the first importance. For example, there is too great a tendency to embrace the simple belief that in the summer diarrhoea of infants we have to deal with a specific infective disorder, communicable from child to child and occasioned by some unknown organism conveyed in contaminated food. The subject will be further discussed when the effect of heat upon the infant body is dealt with later (*vide* p. 115).

Nevertheless, it has to be conceded that a classification based upon these purely ætiological considerations is of but little value in practice. Whatever the cause, each gives rise to the same result. Each produces in the first place intestinal disturbance, and later, if long continued or of unusual severity, gives rise to a general intoxication. Further, whatever the original cause of any attack may have been, convalescence is always accompanied by a temporary lowering of the tolerance for food, so that a second attack is more readily induced by any one of the causes mentioned. A satisfactory classification must be based not upon points in the history of the disturbance, which are possibly so obscure that even the most careful cross-examination of the mother may fail to elicit the truth, but upon sharply cut and constant clinical features.

The following classification follows to a great extent that recommended by Finkelstein. It is based upon differences in the reactions of sick children to starvation and the with-

drawal of food upon the one hand, and to the intake of food upon the other.

(1) Dyspepsia or simple diarrhoea and vomiting.

Under this heading are included all cases in which diarrhoea and vomiting, together or separately, are prominent symptoms, but which show no signs of absorption of the harmful products of digestion into the general circulation. In infants suffering from dyspepsia the epithelial lining of the alimentary canal retains sufficient vitality to act as an efficient barrier, with the result that all the most striking symptoms are confined to the alimentary tract. A second line of defence is provided by the liver.

(2) Summer diarrhoea or Intoxication.

Under the name Intoxication are included cases in which the symptoms of diarrhoea and vomiting form only a part of the clinical picture and in which absorption of poisonous substances takes place through a bowel-wall which can no longer resist their passage. The symptoms of intoxication in such cases may be more striking than the symptoms of disturbance within the alimentary canal.

(3) Marasmus or Decomposition, in which, as a result of long-continued dyspepsia or severe intoxication, the tolerance for food is so lowered that it falls permanently below the limit necessary for growth and development.

(4) Inanition or starvation, in which the child receives less food than is necessary for growth and development. Such starvation may be due to ignorance or carelessness on the part of the parents or to inability or refusal on the part of the child to take the food.

This classification, although not exhaustive, contains all that is common and of everyday occurrence. It does not assume knowledge which we do not possess and it is based upon clinical variations which are strongly marked and easily identified. Moreover, it contains at least one distinction vital for prognosis. Few infants fail to recover from dyspepsia. If intoxication supervenes the mortality becomes enormous.

The classification depends upon the various reactions of the sick child to food. The following charts, representing the weight, temperature, and amount of food taken, are based upon those of Finkelstein and express diagrammatically the characteristic symptoms.

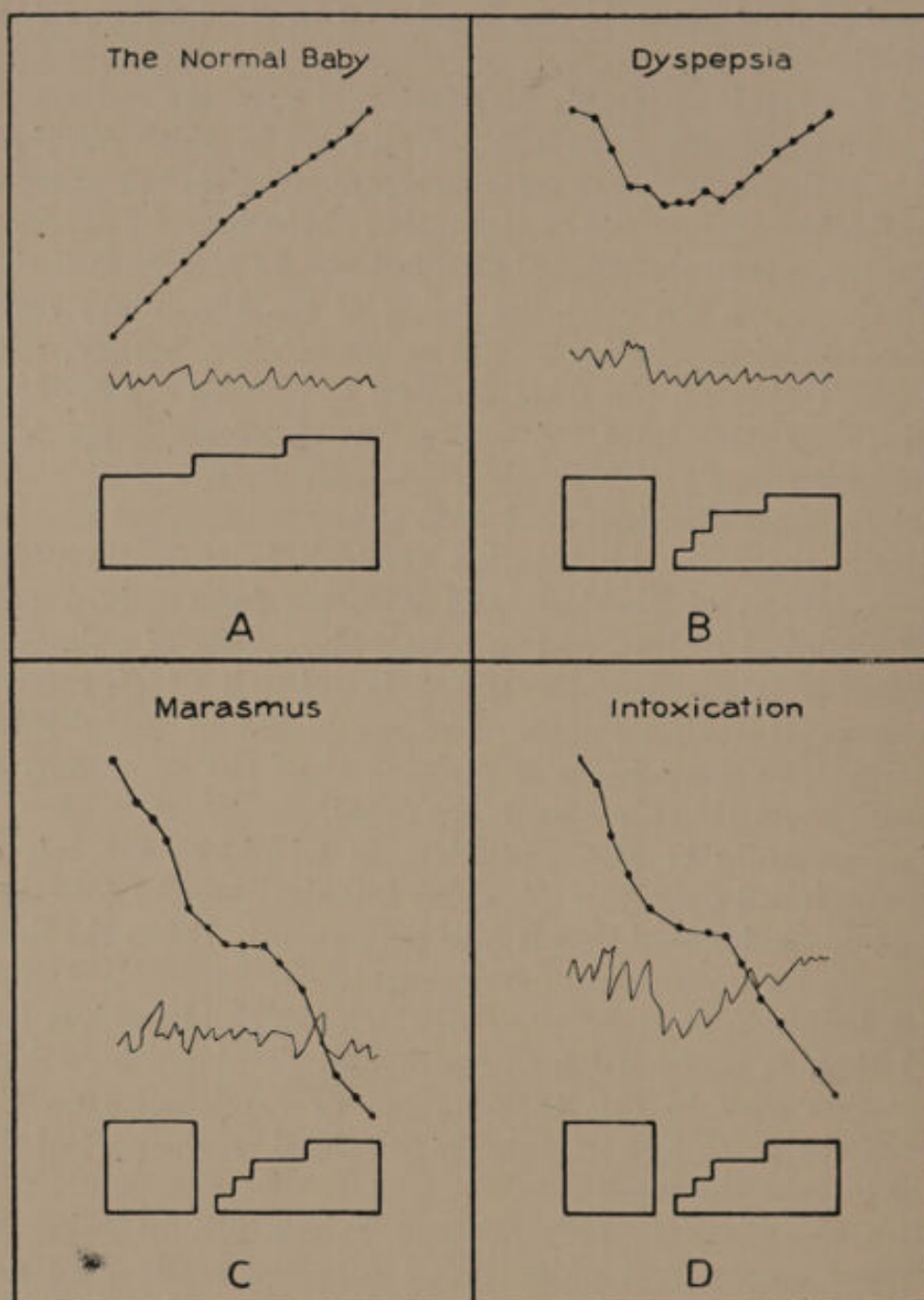


FIG. 1 shows diagrammatically the typical arrangement of the curves of weight and temperature, with the usual changes of diet, in the normal baby and during Dyspepsia, Marasmus, and Intoxication.

A. In the normal infant, with an increase in the amount of food, the temperature remains steady and the weight curve ascends regularly.

B. In Dyspepsia the weight falls and the temperature may be a little raised. After twenty-four hours' starvation, followed by a gradual return to full diet, the weight curve first flattens and then ascends, while the temperature curve falls to the normal line and adheres to it.

C. In Marasmus the decline in weight is steady and rapid, while the temperature is irregular without marked pyrexia. During starvation the fall in weight is less marked and the temperature curve is more steady.

D. In Intoxication the pyrexia is high and the decline in weight rapid, though improvement in both curves follows during starvation.

CHAPTER IX

THE NATURE AND SYMPTOMS OF DYSPEPSIA

THE NATURE OF DYSPEPSIA

ACUTE attacks of diarrhœa in infants are not always infective in origin. We are apt to forget how highly developed are the infant's powers of digestion, and how susceptible to disturbances apart altogether from the risk of infection of the bowel-wall. These disturbances are due to alterations occurring in the disintegration which takes place during digestion in the complex structure of the proteins, fats, and carbohydrates of the food. In digestion the food-stuffs are broken up into their simplest constituent elements, just as that which was once a house with an individuality of its own may be dissolved into a pile of bricks and a stack of wood. The work of digestion, however, is susceptible to pathological changes. Disintegration may proceed with unnatural rapidity or violence; interactions abnormal in nature may take place between the products of disintegration, or the bacterial contents of the bowel, in consequence of changes in their environment, may display an excessive or one-sided growth. We must endeavour to achieve a proper conception of the nature of dyspepsia in infancy.

(1) We must consider which of the constituents of the food—fats, proteins, and carbohydrates—most commonly give rise to disturbance.

(2) We must consider which of these disturbances is primary. For example, are we to regard the vomiting of the casein curds of milk as evidence of a primary disturbance of protein digestion, resulting from its abnormal disintegration, or as a secondary effect of a previously existing acid dyspepsia?

(3) We must consider the part played by the whey, the fluid in which the constituents of the food are suspended or

dissolved when presented to the epithelial cell of the alimentary canal.

(1) It is probable that the primary cause of most dyspepsia in infancy is an increase in the fermentative changes in stomach and intestine. These changes affect principally the sugars, and to a less extent the fats. Protein, which does not tend readily to undergo fermentative changes, takes no part in the process. By the disintegration of sugars, various fatty acids are formed which, when present in excess, impart a sour odour to the breath of the child and to the vomited matter. The secretion of hydrochloric acid is diminished and the emptying of the stomach is delayed, with the result that further fermentation of the food and further production of fatty acids are encouraged. The increased formation of fatty acids leads to increased stimulation of the bowel, with painful colic and diarrhoea. The accumulation of gas gives rise to meteorism, the stagnation within the stomach to vomiting. How violent a stimulus the too acid contents of the bowel may be is shown by the erythema and ulceration which are produced upon the skin when the stools are allowed to remain in contact with it. Diarrhoea and vomiting alike are protective reactions in the interest of the child, designed to remove the fermenting material from the bowel.

(2) It would, however, be wrong to consider the part played by any one class of food-stuff in the production of dyspepsia apart from its association with other constituents of the diet.

Experience has shown that not only does a high percentage of sugar of itself tend to cause fermentative dyspepsia, but that this danger is especially great when a high percentage of fat and a low percentage of protein are combined with a high percentage of sugar in an artificial diet.

It is for this reason that diluted milk mixtures which are enriched with both sugar and cream in an attempt to "humanize" cow's milk are sometimes dangerous. If a teaspoonful of cream and two teaspoonfuls of cane-sugar are added to three ounces of a diluted milk mixture, about 2 per cent. of fat and 5 per cent. of sugar are added to the mixture.

On the other hand, a high percentage of casein in a mixture tends to inhibit fermentative changes and to produce an alkaline reaction in the bowel and a soapy alkaline stool. Whole milk, which contains much casein, much fat, and little

sugar, tends to produce, in the normal infant, constipation rather than diarrhoea. Upon a diet of whole milk, save in the case of very young infants, there is comparatively less risk of such stormy attacks of diarrhoea and vomiting as are common enough in infants fed upon artificial diets which are rich in sugar or starch.

The disturbances of protein digestion are, generally speaking, secondary to fermentative dyspepsia. Although all that we know of the chemistry of infantile digestion and much accurate clinical observation point to this conclusion, it is still often authoritatively taught that the protein of cow's milk is the most frequent source of trouble, and that which most commonly causes vomiting and colic. Those who achieve good results with patent foods are apt to explain their success by reference to changes produced in the protein by its subjection to great heat in the process of condensation or desiccation. It would be better if it were frankly recognized that patent foods as a rule owe any success which they may achieve to the circumstance that they offer to us a variety of carbohydrate preparations in the most easily assimilable form. Their utility lies in their contrast to cow's milk, in their poverty in fat, so often deplored, and in their richness in starches and sugars. That the protein content is usually low and present in a form which does not coagulate or cause delay in the emptying of the stomach is a less important consideration.

The belief in the inherent indigestibility of casein seems to depend upon three observations :

(a) Much more casein is present in cow's milk than in human milk.

(b) In infants fed upon cow's milk, when dyspepsia occurs, the vomit is apt to take the form of a dense curd.

(c) In the stools of infants fed upon cow's milk it is generally possible to detect numerous whitish curds, which have much the appearance of undigested casein curds.

Although there can be no doubt that these observations have had considerable influence upon teaching in the past, the conclusion drawn from them cannot be accepted at the present time without criticism. It is true that the vomiting of undigested casein curd often results from giving cow's milk, even in considerable dilution, to an infant which is suffering from fermentative dyspepsia. We cannot, however,

see in this evidence of a primary disturbance of protein digestion. The act of vomiting is caused by the acidity and the exaggerated fermentation in the stomach. The character of the vomited matter is determined by the nature of the diet. In other words, if milk is put into the stomach of an infant with dyspepsia the vomited matter will consist of partially digested, curdled milk.

It is also true that in a dyspeptic infant a change from a food rich in carbohydrates to a diet of cow's milk will at first increase rather than diminish the symptom of vomiting. The whole process of the curdling of milk is a device to throw the burden of digestion especially upon the stomach. The fat and casein are retained in the stomach, while the whey and salts pass rapidly through the pylorus into the duodenum. For this reason a diet of cow's milk during dyspepsia is especially liable to encourage the symptom of vomiting. At the same time milk, and especially milk which contains a low content of fat, is of all foods at our disposal that which is least likely to add fuel to the excessive fermentation. All dyspepsia is to be treated by a short period of starvation to permit the stomach to be emptied and to encourage the secretion of hydrochloric acid. Thereafter a diet of whole milk with a low fat content is often especially indicated because of its property of controlling fermentation and producing a relatively alkaline reaction in the bowel.

To sum up, we may say that although cow's milk is extremely likely to give rise to curd-vomiting in a dyspeptic infant, the vomiting is not due to any primary disturbance of protein digestion, and that we know nothing of any abnormal disintegration of protein in the stomach. The refusal to retain the curd is due to the irritation of the stomach-wall and the delay in the emptying of the stomach which result from the abnormal digestion of fats and sugars and the formation of excess of irritating fatty acids. Without a coincident *acid* dyspepsia, curd-vomiting does not take place.

Evidence that diarrhoea and colic are caused by abnormal protein digestion is not forthcoming. In the stools of an infant fed upon cow's milk there are always present, in more or less abundance, white curd-like masses of soaps, formed by the combination of the fatty acids derived from the food with calcium and magnesium. These whitish curd-like masses

of soap have much the appearance of undigested casein curds of milk, and their presence accounts for the frequent description of the stools by mothers and nurses as "undigested" (*vide* Plate II, p. 59). In undisturbed digestion the stools of infants contain only that small amount of nitrogenous matter which is derived from the secretions of the bowel. In disturbed digestion, on the other hand, when the contents of the small intestine are hurried on into the lower bowel and expelled explosively from the anus by the violent peristaltic waves which are evoked by the powerful stimulus of the fatty acids derived from the increased fermentation of the carbohydrate part of the food, there are present in the stools fragments of undigested and unabsorbed protein which are derived from the food. Casein curds are, however, not the cause of diarrhoea, but a symptom. Their presence indicates such a heightened peristalsis that fragments of food residue, such as are normally present in the small intestine, are expelled from the anus. Casein curds, moreover, are comparatively rarely found even when there is active diarrhoea. The large white curds which are almost constantly found in dyspepsia are composed of soap and are derived from the unabsorbed fat of the food.

(3) Finally, we must bear in mind that the fluid, in which the various constituents of the food are dissolved and presented to the epithelial cell lining the alimentary canal, may itself influence the working of these cells. The alimentary epithelium achieves the optimum of activity in the medium for which it was designed, that of human milk.

The well-known experiments of L. F. Meyer illustrate the effect of the whey and saline constituents of the food. Meyer found that infants were free from digestive disturbances when they were fed upon the curd of cow's milk suspended in the whey of human milk, while disturbances were frequent when they received the whey of cow's milk and the curd of human milk.

All experimental evidence goes to show that the fermentative processes in the bowel are determined chiefly by the presence of carbohydrates, and that we must recognize both a normal and an abnormal fermentation. The degree of fermentation is dependent upon two other factors, the concentration of the whey of the cow's milk and the relative

proportion of the casein to the carbohydrates. Thus, for example, when cow's milk is enriched with considerable quantities of sugar it generally becomes necessary to dilute the milk, if dyspepsia is to be avoided. Again, observation has shown that a high percentage of casein tends to inhibit the fermentative processes in the bowel, even although the whey may be concentrated. The albumen-milk of Finkelstein, now generally used throughout Germany and largely in America, is constructed in an attempt to combine a high casein percentage with a dilute whey.

The present trend of opinion is to regard all dyspepsia as due in the first place to carbohydrate disturbances, aggravated in some cases by the abnormal digestion of fats and the ill effects of a whey which is too concentrated in salts, and to look upon the disturbances of protein digestion as secondary.

In entering upon the description of infantile dyspepsia, then, it is necessary to start with the faulty digestion of the carbohydrate part of the food. Excessive fermentation of carbohydrates results in the formation of various fatty acids. The increased acidity of the contents of the alimentary canal encourages the overgrowth of those organisms which flourish best in an acid medium, and which themselves add to the acidity by their own activity. These fatty acids provide the ordinary stimulus which excites peristalsis in the alimentary canal. When fermentation is slight, as often happens when the diet consists of cow's milk without addition of sugar, constipation frequently results; where the fermentative changes are excessive, peristalsis is active. Sometimes the peristaltic wave is so great as to become painful. During such an attack of colic the child stirs uneasily, the legs are drawn up over the hard contracted abdomen, and the face shows every sign of pain. The contents of the bowel may be so rapidly hurried along that the stools may contain curds of fat and undigested casein. The irritation of the bowel-wall by the acid contents may be so great that mucus and the watery secretions of the intestine make up a large part of the stool.

THE SYMPTOMS OF DYSPEPSIA

We may tabulate the symptoms of fermentative dyspepsia as follows :





The green, acid stool of Dyspepsia, with the typical whitish curds of soap scattered throughout its substance. Apart from the soap curds, the stool is so watery that it forms a mere stain on the napkin. A little greenish mucus is also present.

(1) The curve of the weight ceases to ascend, or descends irregularly.

(2) The temperature curve becomes irregular; there is an exaggeration of the normal small morning and evening variations. On the whole the temperature curve tends to be raised above the normal.

(3) The child becomes pale and fretful; sleep is usually broken and fitful.

(4) Vomiting is frequent. The vomited matter has a sour smell. The casein has coagulated and floats in particles of varying size in a grey liquid. The vomiting at first may take place soon after the meal; as the condition becomes developed the interval may lengthen.

(5) Diarrhœa is almost constant. In chronic and subacute cases the bowel-wall seems to grow accustomed to the abnormally strong stimulus, and periods of constipation alternate with periods of diarrhœa. The stools are generally acid to litmus, though here and there in the stool the alkaline reaction of the intestinal juices which are poured out in profusion may predominate. The colour is usually green. On spreading out the napkin a central green stain is seen, containing within it shreds of mucus and numerous white or greenish-white curds composed of fatty acids, soaps, or neutral fats. Over a wide area beyond the green stain the napkin may be soaked in the watery discharges of the bowel. (*Vide* Plate II.)

(6) In the infant in health the stools may be passed so quietly that the motion flows unnoticed from the anus into the napkin, where it is found when the child is undressed. In dyspepsia the whole body of the child is set into movement, while the stools are emitted with great force and with the audible escape of gas. That the act is painful is shown by the infant's cry.

(7) At times the abdominal wall is blown out by the accumulation of gas within the intestines, while loud gurgling sounds may be heard upon auscultation over the bowel. In chronic cases the intestinal peristaltic movements may be visible through the emaciated abdominal wall.

(8) The skin around the anus, over the buttocks, the backs of the thighs, and in severe cases of the leg as far as the ankle—the whole area which can be brought by any manipulation into contact with the anus—may become reddened, eczematous, and finally ulcerated from contact with the acid and irritating

stools. The spread of the dermatitis over this wide area is aided by the restless movements of the infant's limbs during the paroxysms of pain which accompany the attacks of colic.

In mild cases the symptoms of dyspepsia may be few. Restlessness and broken sleep, uneasy and violent defæcation and the frequent passage of wind, with slight diarrhœa, make up the clinical picture. But whether the symptoms are mild and transient or severe and long continued, all cases are alike in this, that all the striking manifestations are confined to the alimentary canal. In simple dyspepsia the epithelial lining of the bowel, whatever damage it may have sustained by contact with the acid and irritating contents of the bowel, at least still retains unimpaired its function of controlling the absorption of the end products of digestion. Nothing that is harmful is allowed to pass through the bowel-wall. As a result of this unimpaired action of the bowel-wall, the striking symptoms characteristic of alimentary intoxication are absent. Somnolence, coma, immobility of limbs, abnormal posture and expressionless face, albuminuria, glycosuria, high temperature, rapid and enormous fall in weight, great loss of fluid, irregular, deepened, and accelerated breathing—none of these symptoms are found in simple dyspepsia. When present they make up the clinical picture of intoxication—a condition which results when the abnormal acidity in the bowel no longer merely provokes attempts at elimination by inducing purging and vomiting, but has so depressed the activities of the epithelial cells as to permit of abnormal absorption and a general intoxication of the body.

We have now to ask ourselves, what are the causes of increased carbohydrate fermentation, and how may the condition be treated? For the sake of clearness it will be well to make the division into dyspepsia as it occurs, firstly in artificially fed children, and secondly in breast-fed children.

CHAPTER X

DYSPEPSIA IN THE ARTIFICIALLY FED INFANT

THE CLASSIFICATION OF DYSPEPSIA

THE majority of cases of dyspepsia in the artificially fed child may be grouped under the following classification. As elsewhere in medicine, it is bad practice to be content with treating a single symptom. The diagnosis of diarrhoea and vomiting alone is insufficient. In each case we must try to understand the underlying cause. The use of such a classification gives precision to our ideas, affords clearer indications for treatment, and enables us to make a more accurate prognosis by separating the cases into well-defined groups, each member of which may be compared with others in the same category.

I. *Dyspepsia ex alimentatione.*

- (a) Dyspepsia due to over-feeding or too frequent feeding with a mixture in itself suitable.
- (b) Dyspepsia due to over-feeding with a mixture in which some one constituent of the food, usually the carbohydrate or the fat, is in gross excess.
- (c) Dyspepsia due to feeding with stale and soured milk.

II. *Dyspepsia ex infectione.*

- (a) Infection of the bowel-wall (*enteral infection*).
- (b) Infection of other parts of the body remote from the bowel-wall (*parenteral infection*).

III. *Dyspepsia ex constitutione*, with signs of constitutional idiosyncrasy in the child.

- (a) With signs of the exudative diathesis.
- (b) With signs of neuropathy.

I. DYSPEPSIA EX ALIMENTATIONE

A. Dyspepsia due to Over-Feeding with a Mixture of Suitable Composition

It is difficult to restrain mothers and nurses from over-feeding infants. The fretfulness, pain, and crying which result from dyspepsia are too often regarded as evidences of hunger. It is true that a healthy and vigorous infant will resent any delay in the appearance of his meal and show his displeasure by loud crying. The symptoms of long-continued under-feeding and of inanition are, however, in many respects the reverse of those of dyspepsia. The mothers say of such babies that they are *good* babies; they are drowsy and apathetic, often constipated, with cool skin, retracted abdomen, and slow feeble movements of the limbs. Fretfulness, crying, restless and vigorous movements of the limbs, colic, painful or explosive defæcation, vomiting, and eructation of wind, are symptoms of dyspepsia, not of under-feeding.

While infants at the breast are not infrequently under-fed, it is very rare to find that an infant which is fed artificially is suffering from simple inanition provided that the composition of the diet is reasonable. It is true that we meet with babies whose food is of such a one-sided character, with such a marked deficiency in one or other constituent—fat, protein, or carbohydrate—that growth and development are retarded. Upon a suitable mixture sheer under-feeding is hardly ever met with.

Over-feeding, on the other hand, is much commoner and of a much more serious type in bottle-fed than in breast-fed infants. The reason for this greater frequency lies in the more powerful suction which is demanded of the breast-fed child. The labour of securing the breast milk is considerable, and the resistance against which the child must suck steadily increases until he desists from his efforts, tired out and recognizing that his suction has gradually become ineffective. As a rule, after efficient breast nursing the infant falls straightway asleep. The bottle, on the other hand, offers a minimum of resistance to suction, and the flow is constant from beginning to end. The pleasurable sensation of sucking and swallowing the milk suddenly comes to an end, and the infant is apt to resent the sudden cessation and show his disappointment by

fretfulness. The child has no knowledge of his exact needs. An excess will often be taken if an excess is offered. A mild dyspepsia and a standstill in weight are often made the occasion of a further increase, with disastrous results.

The amount of cow's milk taken daily should not greatly exceed the fraction of the child's weight previously mentioned—one-seventh of the weight at birth, one-eighth at three months, one-ninth at six months. The body-weight expressed in ounces should be divided by the appropriate number to give the number of ounces of milk. Increase in the amount should be gradual: when it is decided to increase the amount, the addition should not exceed 20 per cent. of the previous amount. For example, a child taking a pint of milk should not be advanced to a greater amount than twenty-four ounces. An increase of 40 or 50 per cent. may provoke disturbance.

Similarly, additions of sugar and cream should be gradual and tentative. An addition of 1 per cent. of either is sufficient at any one time. An additional teaspoonful of sugar for every three ounces of the mixture adds about 3 per cent. of sugar, an additional teaspoonful of cream adds 2 per cent. of fat.

The amount of sugar to be taken during the twenty-four hours should be measured, and divided into as many parts as there are meals, so that one part can be added to each bottle. An increase from a daily total of five to six teaspoonfuls of sugar is reasonable. An addition of a whole teaspoonful to each meal may well produce disturbance.

Too frequent feeding is also a cause of dyspepsia. The stomach of an infant may not be emptied until about three hours after a meal of cow's milk. Sodium citrate is probably effective in shortening this time. Five or six meals in the twenty-four hours are often sufficient after the first few weeks of life.

As a rule dyspepsia from over-feeding does not come on suddenly. The severe intestinal disturbance is preceded by a few days of loss of appetite and restlessness. The bottle is no longer emptied, the child sleeps badly and is bad-tempered and fretful. Wind and colic may be prominent symptoms. The weight ceases to ascend regularly, the regular temperature of the healthy, thriving child gives place to morning and evening irregularities of temperature. If over-feeding is persisted in, an acute attack of diarrhoea and vomiting follows.

Diagnosis. The diagnosis of dyspepsia from over-feeding depends upon the history of a recent increase in the amount of the food, which is of itself of unobjectionable composition, the gradual onset of the symptoms, and the absence of evidence of enteral or parenteral infection or constitutional anomaly.

Prognosis. The prognosis is good. Such dyspepsia is always readily amenable to treatment. The severity of the attack is estimated best by attention to the general condition of the child. If the baby remains active, smiling, and vigorous, in spite of violent vomiting and some diarrhœa, the attack is of little importance. If the child is prostrate and feeble, the condition is correspondingly more serious. Vomiting and diarrhœa are designed to remove the fermenting material from the stomach and bowel of the child; often that attack of dyspepsia is most serious and long sustained in which, while prostration is severe, the vomiting and diarrhœa are not marked.

Treatment. In a mild case it may be sufficient merely to diminish the amount of food and to give the meals at longer intervals. In more severe cases the following routine should be followed:

(a) **Starvation.** For twelve or twenty-four hours food should be withheld, in order to assist in the elimination of the fermented contents of the bowel.

During this time a plentiful supply of boiled water may be given, sweetened with saccharin, at the usual temperature of the food.

(b) **Washing the Stomach and Bowel.** At the end of twelve hours, if vomiting and diarrhœa continue unabated, the stomach and bowel should be washed out with a weak solution of sodium bicarbonate, one teaspoonful of the salt in a pint of water. To wash the stomach the infant is enveloped in a towel and held upright in the nurse's arms. A soft rubber catheter about the thickness of an ordinary lead-pencil, attached to a funnel, is passed into the œsophagus by the right hand, along the dorsum of the left forefinger, the tip of which lies in contact with the edge of the child's epiglottis. When the catheter is in the stomach, as shown by the crepitating sound, which can be heard over the funnel, the funnel is raised to a height of two feet and the solution

is poured in until the stomach is full. The contents are then siphoned off by lowering the funnel and allowing the fluid to run out. When the washings come out quite clear the tube may be withdrawn.

To wash the bowel, the child is held upon the nurse's knee, with the buttocks raised. A soft catheter attached to a funnel is introduced some inches beyond the anus, and under a pressure of two feet the fluid is allowed to run into the bowel. The nurse wears a mackintosh apron which conducts the returning fluid as it runs from the anus into a bath.

After washing out the stomach and bowel the infant may be laid in the cot and given one or two grains of chloral hydrate. After three or four hours' sleep, if food is given, it will seldom be followed by vomiting.

(c) **Warmth.** During the complete or partial withdrawal of food the child should be kept warm, and the temperature of his immediate environment should be kept constant. A thermometer may be pinned to his bed-gown and a sufficient number of hot bottles packed round to keep the temperature at about 80° . If two or three bottles are used, they should be changed alternately and not altogether.

(d) **The Return to Food.** The return to food should be gradual. When vomiting and diarrhoea have ceased, at first one-quarter, later one-half the usual quantity should be given, and the total amount of fluid made up by giving water, sweetened with saccharin, separately. It is wise, for some days, to allow the amount of food to remain a little below the level at which the disturbance originally took place.

(e) **The Use of Drugs.** Formerly many drugs were prescribed in infantile dyspepsia. We know now that the prescription of astringent or antiseptic drugs is useless without a temporary limitation of food, and superfluous with it. Opium may do harm by interfering with the evacuation of the bowel and stomach, which is necessary for recovery.

A little hydrochloric acid or an alkaline mixture may be helpful in combating the fermentative changes in the stomach.

Acidi. hydrochlor. dil.	.	.	℥ 1-2
Glycerini	.	.	℥ 6
Aq. destillat.	.	.	ad ʒ 1
S. Ft. Mist. T.D.S. a.c.			

or

Sod. bicarb.	.	.	gr. 1½
Spirit. ammon. aromat.	.	.	℥ 1½
Glycerin.	.	.	℥ 5
Aq. menth. pip.	.	.	ad ʒ 1
S. Ft. Mist. T.D.S. a.c.			

Purgation with a teaspoonful of castor-oil may be necessary if the diarrhœa is not marked and the general symptoms are severe.

B. Dyspepsia due to Over-Feeding with a Mixture in which some one Constituent of the Food, usually the Carbohydrate or the Fat, is in Gross Excess.

Dyspepsia in artificially fed children is especially liable to occur when a high percentage of sugar is given. The fat of the diet plays a secondary but important part. In certain children, and especially in the first few months of life, the high percentage of fat in cow's milk is of itself sufficient to give rise to vomiting and dyspepsia. In all children the presence of a high percentage simultaneously of fat and sugar is dangerous.

As a general rule it may be said that the ordinary proprietary foods and the sweetened condensed milks are especially liable to produce dyspepsia, while milk mixtures freely enriched with sugar and cream are also dangerous. Upon these diets infants may thrive for some time, and a rapid gain in weight may be achieved. The danger of a sudden disturbance, however, is always present, and in a few days the gain of many weeks may all be lost.

Treatment. If the previous diet has been at fault by reason of the high percentage of sugar, the immediate treatment when acute dyspepsia occurs does not differ from that pursued after dyspepsia from over-feeding with a mixture in itself suitable. When a careful return to food, however, is instituted, the character of the diet must be changed.

In many cases the child will do well if a diet of whole milk with sodium citrate is resorted to after the preliminary starvation, and persisted in for some time.

In other cases it will suffice to substitute a malt-sugar for the cane-sugar or lactose used before the disturbance. Malt-sugar much less easily undergoes excessive fermentative changes in the intestine, and can often be used when cane-sugar or lactose leads to a return of the symptoms.

In more severe cases, when the carbohydrate feeding has been long continued or very excessive, or when the infant

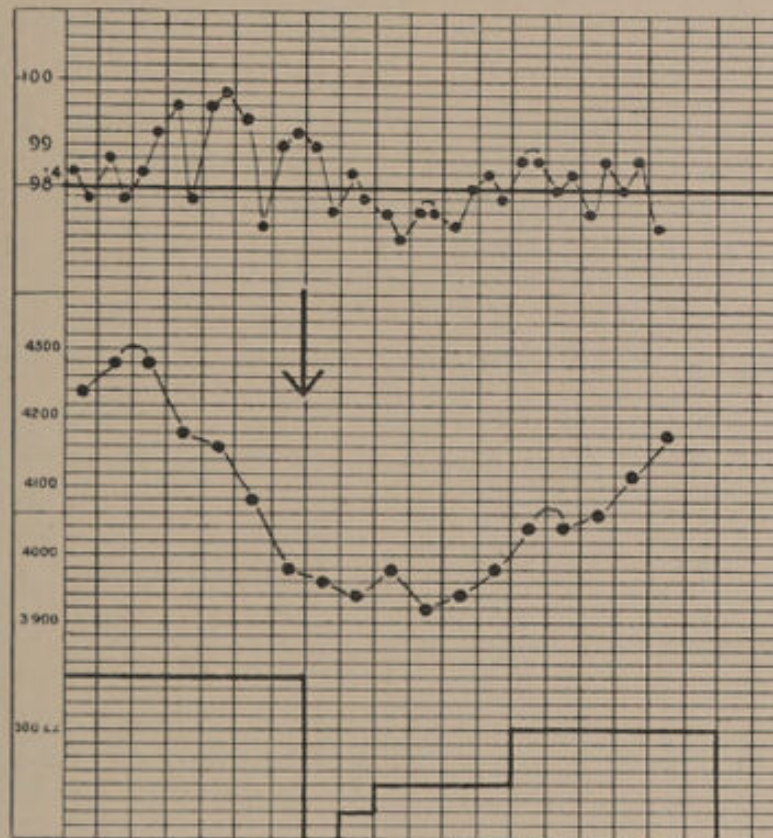


FIG. 2 shows a typical case of slight Dyspepsia, occurring in convalescence from a more severe attack, during a season of hot weather. The fall in temperature and flattening of the weight curve, following on twenty-four hours' starvation and a drastic reduction in the amount of food, are shown. To the point marked by the arrow the diet consisted of cow's milk 2 parts, water 1 part, and malt-sugar. After the point marked by the arrow it consisted of whole milk with sodium citrate.

is very young, it may be necessary on the resumption of feeding to remove the fat from the milk as well as to discard all addition of sugar. In such a case skimmed milk may have to be given carefully for some days in gradually increasing amounts before it is safe gradually to discard the skimming process.

In all cases the return to food must be gradual, while the child is kept warm and a plentiful supply of water is given.

Diagnosis. The diagnosis can only be made by obtaining the history of a faulty composition of the diet and by the result of treatment.

Prognosis. In a later chapter the chronic disturbance of nutrition which results from continuous carbohydrate over-feeding will be described. In infants which are permanently fed upon a diet insufficient in fat, protein, and salts, but rich in carbohydrates, and which display the atrophy which results from this diet, fermentative dyspepsia is of common occurrence and of great severity. In such cases where an acute attack is grafted upon the chronic disturbance the prognosis is always grave ; where the dietetic change is recent and the resulting dyspepsia occurs in a child which has not yet developed symptoms of chronic carbohydrate over-feeding, the prognosis is good.

C. Dyspepsia due to Feeding with Stale or Soured Milk

There is no proof that the ordinary air-borne bacteria which multiply in milk after it has been drawn from the udder are directly pathogenic for the human infant. The arguments for the necessity of procuring a high-grade and certified milk are not based upon the belief that infection of the alimentary canal will commonly follow upon the consumption of ordinary market milk, but upon the probability that milk prepared under strict supervision will be free from pathogenic organisms, such as those of diphtheria, tubercle, dysentery, enteric fever, and so forth. Indeed, butter-milk, which invariably contains a large number of the usual non-pathogenic organisms, and milk which has been purposely inoculated with lactic-acid organisms have often been used with good effect in the feeding of infants. Butter-milk, with its low fat content and high acidity, is usefully employed to treat the constipation and abnormal alkalinity of the intestinal tract which are apt to occur when an exclusive diet of cow's milk is given.

It is nevertheless true that soured and stale milk, which has already before ingestion undergone fermentative changes, is capable of instituting an excessive fermentation in the stomach and intestine. The increased fermentation which may act beneficially in constipation may provoke diarrhoea and colic in susceptible infants. Although the bowel-wall is not directly infected by this group of organisms, so that we

cannot speak of an infective enteritis, peristalsis may be increased and diarrhœa and colic be induced by the products of their activity. Moreover, it is obvious that in stale and sour milk the danger is much increased that other organisms may be present which are undoubtedly pathogenic.

Treatment. A supply of fresh milk must be obtained or a change may be made to a dried milk. The immediate treatment is as described before.

II. DYSPEPSIA EX INFECTIONE

A. Enteral Infection

From time to time we meet with cases of acute infective diarrhœa, both in breast-fed and in artificially fed infants. In the former the infection is usually by way of the blood-stream; in the latter, in a certain proportion of cases, it is due to the ingestion of milk infected with pathogenic organisms.

Diagnosis. The proof that the dyspeptic symptoms are due to infective enteritis may be difficult. When an infant who has previously enjoyed good health suddenly sickens with very severe diarrhœa, high pyrexia, and great prostration, the probability of an infective origin, whether enteral or parenteral, is very strong. Often the enteritis is only part of a general infection, as is shown by the simultaneous presence of pneumonia, pyelitis, otitis, or meningitis, and the recovery of the same organism from the stools, the urine, or the cerebro-spinal fluid.

A primary infective enteritis is, however, much more frequent in children whose nutrition is impaired and who have long suffered from digestive disturbances than in children who have previously enjoyed good health. A lowering of immunity against all infections of the skin and of the mucous membranes of the alimentary and respiratory tract is a direct result of chronic nutritional disturbances. The differential diagnosis between infective and non-infective diarrhœa is all the more difficult because the infection is likely to occur in a child who has previously suffered severely from diarrhœa of an origin not infective. Moreover, diarrhœa, both of infective and non-infective origin, is more common in times of great and continuous heat than when the thermometer is at a low level.

Non-infective diarrhoea is more common because the need for food and the tolerance for food falls when the loss of heat from the infant's body by radiation is greatly diminished. Infective diarrhoea is more common because the danger of contamination of the milk-supply is greater and because the resistance against all infections is lowered by prolonged exposure to a moist, over-heated, and stagnant atmosphere.

In making the diagnosis of infective enteritis two considerations are of importance.

In the first place, not only is the temperature usually much higher than in simple dyspeptic diarrhoea, but the temperature

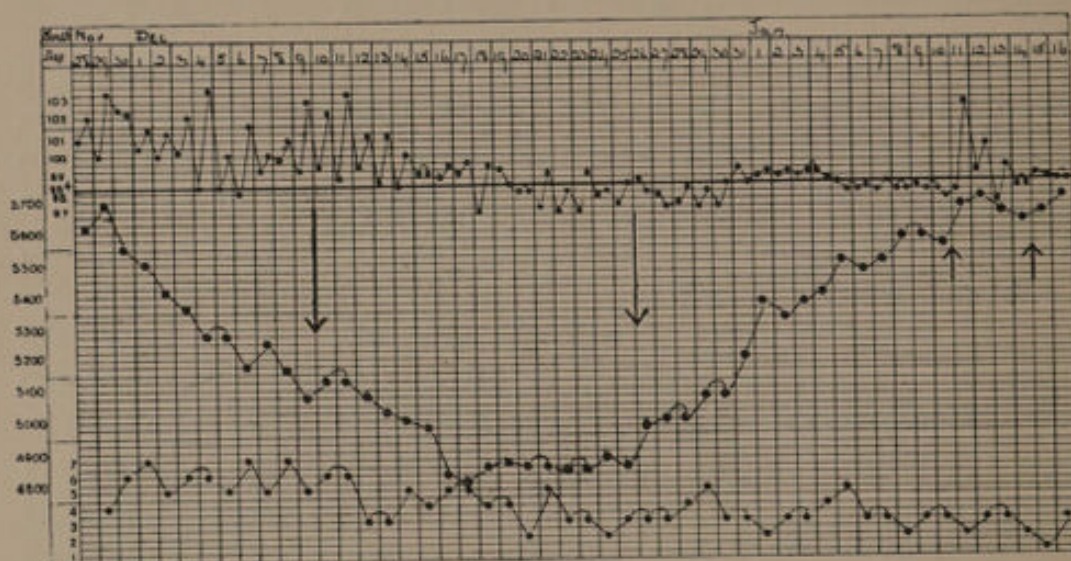


FIG. 3 shows the temperature (upper curve), weight (middle curve), and number of stools daily (lower curve) in an infant suffering from acute Infective Enteritis (*Dyspepsia ex infectione, Enterit*). It shows the following points:

- (1) The correspondence of the curves of weight and temperature. The weight curve falls steadily until the end of the pyrexial period, when without change of diet or treatment it gradually flattens and then ascends.
- (2) The diet throughout was citrated whole milk except between the longer arrows, when the milk was peptonized and not citrated. The improvement in the number of stools that follows the change to peptonized milk was immediate.
- (3) The shorter arrows towards the end of the chart enclose a period of slight nasal catarrh, with pyrexia and flattening of the weight curve.

is quite uninfluenced by the withdrawal of food. In dyspepsia the temperature usually falls to the normal or below the normal line under the influence of twenty-four hours' starvation. If the temperature curve is uninfluenced by starvation the diarrhoea is probably of infective origin, although it may still be uncertain whether it is due to an infective enteritis

(enteral) or is merely symptomatic of an infection elsewhere (parenteral).

Secondly, many cases of infective enteritis are marked by the passage of blood in the stools.

High pyrexia uninfluenced by twenty-four hours' starvation and the passage of blood-stained, watery stools make the existence of infective enteritis probable.

At times the blood may be present in such large amounts as to suggest a diagnosis of intussusception. The presence of a tumour, the absence of pyrexia—at any rate in the early stages—and the evidence of intestinal obstruction such that, after the first evacuation of the bowels, the matter expelled from the anus consists only of blood and mucus and contains no faecal material, will usually clearly indicate the presence of an intussusception.

Prognosis. The prognosis of acute enteritis in young infants is always grave if the pyrexia continues unabated for many days. Evidence of a generalized infection makes the outlook worse.

Treatment. The amount of food must be somewhat reduced. The symptoms are apt to continue unabated so long as the pyrexia continues. With the decline of the infective process and the return of the temperature to the normal line the diarrhoea ceases (*vide* p. 70, Fig. 3).

Changes of diet are usually without marked effect. In dyspepsia *ex alimentatione* the infant as a rule reacts to treatment with great promptitude, and the proper modification of the diet at once produces the desired change in the stools and in the curves of weight and of temperature. It is always suggestive that the dyspepsia is of infective origin when the diarrhoea proves refractory to treatment. As a rule a diet should be chosen which leaves as little residue as possible in the intestine. For this reason cow's milk, even in considerable dilution, is often unsatisfactory. In the case of young infants it is often wise to peptonize the milk. Fig. 3, while it shows how ineffective changes of diet are in controlling the pyrexia, shows also the improvement in the number of motions brought about by peptonizing the milk. In older infants much of the milk may be replaced by a cereal food, by a malted milk, by vegetable soups, fruit jelly, meat-juice, &c. During all pyrexial conditions a plentiful supply of water should be given :

the symptoms are aggravated if the child, rendered thirsty by pyrexia, is allowed to quench the thirst by drinking a milk mixture freely. Brandy freely diluted with water is the best stimulant in case of collapse.

B. Parenteral Infection

Even in adults any infection remote from the alimentary tract may give rise at its onset to a gastric disturbance or to diarrhœa. In infants alimentary disturbance is much more frequent, although not invariable, and the dyspeptic symptoms may persist throughout the entire course of the infection, and may even so dominate the clinical picture as to leave the underlying cause unsuspected. Tonsillitis, catarrh of the respiratory passages, influenza, pneumonia, pyelitis, even anterior poliomyelitis, are apt to be obscured in this way so that they may be treated for a long time under the impression that the disturbance was purely alimentary. The common infective colds or influenzas which sometimes lay low a whole household are in the case of infants almost always gastric in type. Again and again it has happened that the infant has been brought for treatment suffering from severe diarrhœa or vomiting, while the mother or nurse, upon inquiry, will relate that she has suffered from a feverish cold, or will show the mark of the infection in a herpetic eruption upon her lip.

It is probable that a true infective enteritis exists in only a few of such cases. The prejudicial effect of pyrexia upon kidney epithelium is shown by the febrile albuminuria which tends to occur in such cases. A similar interference with the function of the alimentary epithelium is probably responsible for the intestinal disturbance.

Treatment. The diet indicated in parenteral infection does not differ from that described under the heading "Enteral Infection."

Prognosis. It is a matter of everyday experience how severely intestinal disturbance may aggravate all infective disorders in infancy. The younger the child, the greater the danger. The severity of the disturbance is also determined to some extent by the nature of the diet before the infection. Children who have been persistently over-fed, as shown by their prominent abdomens and by a history of chronic

dyspepsia, and infants who have been fed upon a diet in which the carbohydrate has been in excess, suffer severely.

III. DYSPEPSIA EX CONSTITUTIONE, WITH SIGNS OF CONSTITUTIONAL IDIOSYNCRASY IN THE CHILD

Dyspepsia under this heading will be described in the chapters which deal with the Exudative Diathesis and Neuropathy in infancy.

(a) **With Signs of the Exudative Diathesis.**

Vide p. 166.

(b) **With Neuropathy.** *Vide p. 185.*

Or with Pylorospasm. *Vide p. 161.*

CHAPTER XI

DYSPEPSIA IN THE BREAST-FED INFANT

THE causes of dyspepsia among infants fed at the breast are fewer than in artificial feeding :

- (a) Over-feeding, or too frequent feeding ;
- (b) Enteral or parenteral infection ;
- (c) Constitutional idiosyncrasy, *e.g.* the exudative diathesis, neuropathy, pyloric spasm and pyloric stenosis, mongolism, &c.

OVER-FEEDING AT THE BREAST

Serious symptoms due to over-feeding at the breast are not common. The amount of milk secreted adapts itself so accurately to the appetite and suction of the child that dyspepsia is usually transitory and of a mild type. A further safeguard lies in the readiness with which some infants regurgitate the excess of milk. "Possetting," as this regurgitation of food is called, is undoubtedly due to over-feeding. The milk is vomited, however, before fermentation has taken place to any marked extent, and there may be for long no other symptoms of dyspepsia. If, however, the warning is disregarded, and over-feeding or too frequent feeding is persisted in, other symptoms are shortly added. The vomiting takes place at a longer interval, the vomited milk becomes sour and curdled, the child shows signs of pain and gastric discomfort, and finally colic, diarrhœa, and the passage of dyspeptic stools may complete the picture.

If the mother is taking little exercise and an ample diet, if the baby is strong and vigorous, the practice of feeding at such short intervals as every two or two and a half hours may give rise to dyspepsia. As a rule the symptoms are comparatively mild and of gradual onset. Prostration and collapse, frequent enough in the dyspepsia of bottle-fed infants,

are not usually found. The baby continues to grow in spite of the dyspepsia. His sufferings make him not so much ill as ill-tempered. A sudden, severe, and prostrating attack of diarrhœa and vomiting in an infant, which up to that time has thriven well on the breast, is not commonly to be explained by simple over-feeding, but always suggests the probability of an infective origin. Formerly when an infant failed to thrive upon the breast from the first, the suggestion was commonly made that the fault lay in some anomaly of the mother's milk. To-day attention is directed rather to the constitutional idiosyncrasies of the infant. Persistent refusal to thrive upon the breast is commonly not to be accounted for by simple over-feeding, but is usually explained by the presence of signs of the exudative diathesis, of neuropathy, or pyloric spasm. If, as is recommended, we divide the nutritional disturbances of infancy into three great groups according to their causation—*ex alimentatione*, *ex infectione*, and *ex constitutione*—as a rule all the more severe and alarming cases will be found in the two last. Among the milder cases, however, those from sheer over-feeding are frequent enough—lusty, vigorous infants fretful by day and wakeful at night.

Treatment. Such infants do best with five meals in the day, and the adoption of this rule will often bring rest not only to the child but to the whole household. To feed at 6 A.M., 10 A.M., 2 P.M., 6 P.M., and 10 P.M. is a good routine. A further advantage is that the strain of nursing is greatly lessened for the mother.

In a marked case it is well to begin treatment by a single dose of castor-oil, and to withhold the breast thereafter for twelve or even twenty-four hours. For twenty-four hours further the breast may be allowed five times for a shorter time than usual, *e.g.* for five or ten minutes. Recovery should take place within forty-eight hours. During the time of removal from the breast, or when only a short time at the breast is allowed, the need for fluid must be met by giving plenty of boiled water, sweetened, if necessary, by saccharin. Care must be taken to keep the child warm.

ENTERAL OR PARENTERAL INFECTION

Most sudden attacks of diarrhoea and vomiting in breast-fed infants previously healthy are due to infection. A careful physical examination must decide the seat of infection, whether enteral or parenteral. As a rule the temperature is raised to a considerable extent and the pyrexia is uninfluenced by twenty-four hours' starvation. Pyrexia from primary digestive disorder is commonly promptly lowered by withdrawal of food. Blood-stained stools indicate enteritis. Otitis media, pyelitis, nasopharyngitis, and influenza are common explanations of infantile diarrhoea of obscure origin.

Treatment. The child should be placed regularly to the breast at the usual interval. As a rule, with prolonged pyrexia the appetite and suction of the child will be seriously impaired, and there will be a grave risk that the mother's breast will become dry. We should remember, however, that a diminution in the amount of milk is a protective reaction in the interest of the child, designed to prevent a severe secondary dyspepsia. The tolerance for food falls in all conditions of pyrexia. To give additional food from a bottle is to run a serious risk both of setting up an intractable dyspepsia, which may gravely complicate the disorder, and of bringing about the complete drying up of the breasts. Supplementary bottle-feeding will often make weaning necessary at the most unfortunate time possible, during the height of an intercurrent pyrexial disorder. It is well to use every effort to keep the milk in the breasts. After nursing, the breast-pump should be used, and, if need be, the milk drawn off may be given to the child by means of a spoon or pipette. We must endeavour by every means in our power to prevent stasis and the accumulation of residual milk in the breast. Patience is nearly always rewarded, until, with the decline of the pyrexia, the appetite returns, the milk flows freely from the breast, and the infant rapidly makes up for lost time. If, on the other hand, weaning has been undertaken and dyspepsia has in consequence been marked, convalescence may be long retarded by persistent digestive troubles.

During pyrexia water should be given freely. Brandy well diluted is the best stimulant.

When a breast-fed infant is admitted to hospital the mother should be encouraged to attend and nurse the baby as often as possible. Nursing twice daily will often serve to retain the milk in the breast. By this means a protracted convalescence may often be avoided.

If additional food becomes absolutely necessary, peptonized milk in small amount may be given to young infants. In older infants strained vegetable soups, meat-juice, chicken broth, or cereal foods made with water or with dilute milk may be useful.

Prognosis. The prognosis depends largely upon the ability to retain the breast-milk, by the systematic use of the breast-pump after nursing. The younger the child, the greater the chance of secondary dyspepsia or of inanition and the drying up of the breasts.

DYSPEPSIA WITH SIGNS OF CONSTITUTIONAL IDIOSYNCRASY

The Exudative Diathesis and Neuropathy will be considered in later chapters.

Of the former condition a few words may be said in this place. Czerny has taught us to recognize a type of infant which, although exclusively nursed at the breast, shows none of the signs which characterize the normal healthy breast-fed infant. The infant's aspect often recalls that of an artificially fed child suffering from chronic nutritional disturbance. It is further characteristic of the diathesis that the infants tend to show eczema, especially intertrigo of the flexures, and of the buttocks and genitals. The cheeks are often reddened; the skin in this situation is rough, dry, and infiltrated. Seborrhoea of the scalp is so common as to be almost constant. The mucous membranes show the same tendency to exudative and inflammatory affections. Nasal catarrh, pharyngitis, catarrh of the middle ear, and bronchitis are all common, resulting in secondary enlargement and hypertrophy of the tonsils, adenoid vegetations, and lymphatic glands of the neck and bronchi. A well-marked intolerance for fat is a common feature.

The treatment of this condition and its relation to the so-called status lymphaticus will be discussed in a later chapter.

It is mentioned here because infants who are the subjects of this diathesis are often dyspeptic and fail to thrive, even although nursed with all precautions upon their mother's breast.

Treatment. The difficulty of digestion apparently chiefly concerns the fats. Improvement often follows if the time of nursing is cut down to ten minutes or even less, both breasts being used. In this way the fat content of the milk is greatly lowered. Such infants thrive best if the diet is reduced to a minimum and over-feeding is made quite impossible. The institution of supplementary bottle-feeding with a carbohydrate food, or even actual weaning, at an earlier age than usual may ultimately be necessary. Even in severe cases, however, it is seldom wise to take these steps before the fourth or fifth month.

CHAPTER XII

CHRONIC DISTURBANCES OF NUTRITION FROM FAULTS IN THE DIET

ACCORDING to the nature of the diet two types of chronic malnutrition may be recognized :

- (a) Disturbances with carbohydrate over-feeding ;
- (b) Disturbances upon a diet of cow's milk :
 - (1) Atrophy.
 - (2) Anaphylaxis.

DISTURBANCES WITH CARBOHYDRATE OVER-FEEDING

Long-continued feeding upon a mixture which, while rich in carbohydrates, is extremely poor in fats, protein, and salts results in a well-defined group of symptoms (Rietschel).

In this country prolonged carbohydrate over-feeding is almost exclusively the result of feeding with various largely advertised proprietary foods consisting mostly of starch, or with sweetened condensed milk. Mothers and nurses, in complete ignorance of the nature and the composition of the advertised food, make use of it on the recommendation of a friend, or because of the promises held out by the proprietors. Sometimes when a proprietary food is ordered to supplement a diet of cow's milk the whole improvement which follows is attributed to the food, with the result that the amount of milk given is lessened and the amount of the starchy food increased until the diet becomes so one-sided as to produce impairment of development.

Symptoms. The one-sided feeding must have continued for a long time before permanent changes in the appearance of the child result. It is a fortunate accident if the excess of

starch or sugar results in an attack of dyspepsia which leads to medical advice being sought before permanent damage is done. If diarrhœa remains absent and the one-sided feeding continues unchecked, sooner or later trouble occurs. The damage is not wrought simply by the excess of carbohydrates ; indeed, if there is no dyspepsia we may conclude that the tolerance for carbohydrate, at any rate at the outset, was unusually good. The evil is done by the poverty of the diet in some other essential constituents—protein, fat, or salts. For a long time the child may continue to increase in weight, and the presumption that the diet has been well chosen is strengthened. Such children are often large and well grown, agile, and of good colour. In not a few, however, there soon comes a change. The weight ceases to rise, the appetite fails, and sooner or later, often enough too late, it becomes apparent that something is seriously wrong.

By the time that advice is sought there is generally a high degree of atrophy present. This atrophy, we are told, has appeared with astonishing rapidity, and in a few weeks the infant has lost all the appearance of plumpness and health. This sudden fall of weight is due to a loss not of fat, but of water. The effect of a sugar-rich diet is to retain a large amount of water in the tissues. The appearance of plumpness which persisted for so long was largely deceptive, and was due to this high water content of the tissues. When advice is sought there may actually be œdema of the extremities, an œdema not due to nephritis, and not accompanied by albuminuria. The dropsy is apt to increase or to appear after a sudden attack of diarrhœa which has temporarily depleted the tissues of water. It is therefore often noticed in such children in convalescence from diarrhœa when, with renewed appetite for food, the intake of salt again rises. It commonly appears upon the dorsum of the feet and hands and is often accompanied by a marked cyanosis of the extremities.

A severe case of atrophy from carbohydrate over-feeding has a characteristic appearance. The body is emaciated, while the face, in contrast, may remain plump and rounded ; the lips are bright red in contrast to the general pallor of the body. The skin appears too large, and hangs in folds on the limbs ; its texture is tough, dry, and harsh. There is often a scaly desquamation. The mouth is dry and devoid of secretion.

Thrush is frequent. The extremities are often cyanosed, sometimes œdematous. The temperature is usually sub-normal. The abdomen is often distended with gas, and hernia is frequent. The stools are not characteristic; constipation and diarrhœa often alternate. The urine is usually normal, or an alimentary glycosuria may be present from time to time. Complete want of appetite is a constant symptom. The tone of the muscles may be increased; the movements of the limbs are slow and feeble; the child is apathetic and fretful. The cry is often hoarse and aphonic, from the dryness of the larynx. Pronounced rachitic symptoms are not common.

Very often the true extent of the wasting is masked by the watery condition of the subcutaneous tissue. The retained water is, however, liable to be lost at any time within a few days, when the full severity of the condition displays itself even to the untrained eye. This sudden change is apt to take place for two reasons. In the first place, such infants are liable at any time to develop a severe attack of dyspepsia because of the excess of carbohydrate in the diet, and the resulting diarrhœa quickly depletes the tissues of water. In the second place, there is no condition in which the immunity to infections of all sorts is more profoundly lowered. Bronchitis, broncho-pneumonia, nasopharyngitis, furunculosis, empyema, are all common.

ILLUSTRATIVE CASE. C. J., aged 11 months, was admitted into Guy's Hospital with cyanosis and œdema of the extremities. She had been fed entirely on sweetened condensed milk to which more sugar had been added, and had had frequent attacks of diarrhœa. A trace of sugar was found in the urine. The skin around the anus was ulcerated and sore. Although prostrate and feeble, she did not appear emaciated. On the day after admission an eruption appeared, most marked over the buttocks and thighs, but spreading also on to the back and abdomen. The eruption consisted of papules which rapidly became pustular. A diagnosis of *Echthyma gangrenosum varicelliforme* was made. The appearance was so like that of chicken-pox that it had been proposed to remove the child from the ward. Later an empyema developed, and the child died on the tenth day. Before death the œdema had disappeared, the subcutaneous tissues had been emptied, and the true extent of the emaciation had become very apparent.

Treatment. The disturbance is not due to excess of carbohydrate, but to the low percentage of fat and protein in the food. All carbohydrate should not be suddenly withdrawn.

Even twenty-four hours' starvation may produce sudden collapse. The food given previously may be continued in smaller amounts, while an attempt is made gradually to

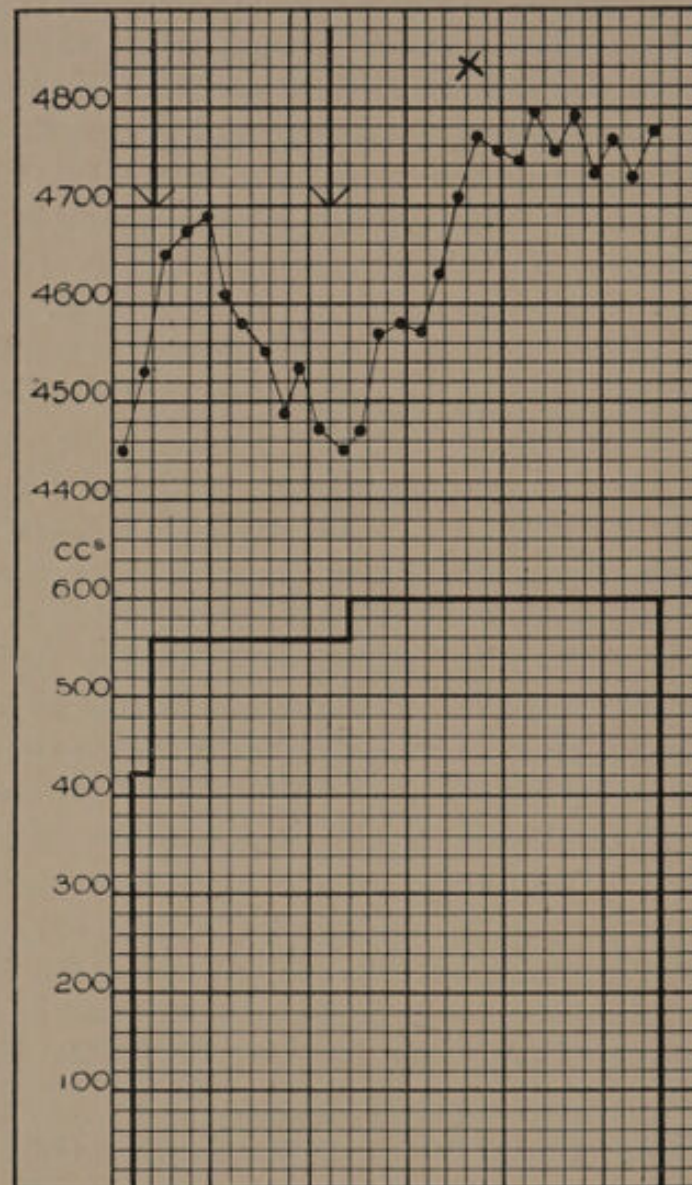


FIG. 4 shows the sudden increase in weight, between the points marked by arrows, due to the appearance of oedema in an infant suffering from chronic carbohydrate over-feeding. On the first day the child received water only. On the second day the amount of milk shown on the diagram was given, with 1.2 gramme sodium citrate (20 gr.) added. On the fourth day the citrate was omitted. The chart also shows the development upon the nineteenth day, marked X, of the condition next to be described, atrophy, with constipation, clay-coloured, formed stools, and a swinging irregular weight curve without steady rise.

substitute milk for some part of it. If the tolerance for fat is very low, as not infrequently happens, it may be necessary at first to skim the milk. With the free intake of cow's milk, especially if citrated, oedema may again appear for a time.

This need not disturb us, although it must be remembered that the resulting rise in weight is deceptive.

ILLUSTRATIVE CASE. J. D., aged 12 months, was admitted to Guy's Hospital for diarrhoea. She had been fed upon a patent food containing starch, with bread and tea. There was no oedema present on admission. The child was very emaciated, the mouth was dry, the lips bright red, the extremities cyanosed. She weighed only nine pounds and had the appearance of a child of four or five months. The change to a milk diet was unusually easily accomplished. Within two days the stools, which had been green and watery, became more formed. On the second day the extremities suddenly became oedematous, and the resulting gain in weight is shown on the chart. The oedema gradually disappeared again between the fifth and the thirteenth days, and the corresponding fall in weight is also shown. During all this time the child was improving in other respects, becoming more vigorous in movement and less apathetic. The chart shows the effect upon the weight curve of dropsy suddenly produced and gradually disappearing (*vide* Fig. 4, p. 82).

Diagnosis. The diagnosis depends upon the history of prolonged one-sided feeding with deficiency of fat and protein, upon the characteristic appearance of the child, and upon the presence of alimentary glycosuria or dropsy.

Prognosis. The prognosis is determined by the ease or difficulty with which the change to a milk diet is accomplished. In many cases even small amounts of milk produce violent diarrhoea and vomiting which may prove fatal, or the condition next described, cow-milk atrophy, may result. The younger the child, the more serious the prognosis.

Great atrophy, dryness of the skin and mucous membranes, dropsy, and persistent refusal of food are grave symptoms.

DISTURBANCES UPON A DIET OF COW'S MILK

I. ATROPHY

A very different group of symptoms results from over-feeding with cow's milk (Finkelstein). As a rule this type of disorder is seen in infants fed upon excessive amounts of cow's milk, although it is not altogether unknown even in breast-fed children, especially in those who exhibit the exudative diathesis of Czerny.

Symptoms. The disorder is characterized by a quite distinctive type of stool. The motion is formed, and can be readily separated from the napkin. It is grey in colour, of a

putty-like consistence, alkaline, poor in water, with a strong smell of putrefaction (*vide* Plate III). Analysis shows large amounts of calcium phosphate and of soaps, the combination of calcium with the fatty acids derived from the food. In the normal stools of the infant less than 20 per cent. of the fat appears as soap. In these abnormal stools as much as 50 per cent. may appear in this form. The amount of calcium in the stool may be very large, and in severe cases may even for a time exceed the amount ingested in the food. This depletion of the body of calcium accounts for the frequency with which rickets and convulsive disorders such as tetany, laryngo-spasm, and convulsions are developed upon the basis of this disorder. As a rule constipation is pronounced and persistent. Sometimes in severe cases the soapy stools become dry and pellety, like the droppings of sheep (*vide* Plate IV). The characteristic soapy stool is of great importance for the diagnosis of the condition.

A second characteristic symptom is furnished by the curve of the daily weighing. Not only does the weight curve refuse to show a steady ascent, but it has a characteristic zigzag appearance. A comparatively large increase on one day is apt to be followed by an equal loss on the next. For many weeks, and even months, the weight may swing to and fro in this way without permanent gain.

The *temperature* tends to be persistently subnormal. Fig. 5 (*vide* p. 86) shows well both the persistent subnormal temperature and the characteristic irregularities of the curve of the weight, with the sudden change in both when a suitable diet was given.

The *urine* decomposes readily, and is apt to have a strongly ammoniacal smell. The putrefactive changes in the stools are increased and indicanuria may be very marked. In cultures from the stools the bacillus coli communis appears as the predominant organism.

The infant is usually fretful and apparently hungry, even although large amounts of milk may be given. The voracious appetite usually leads to an increased amount of milk being given, with the inevitable result that the symptoms are made worse.

Rickets and spasmophilia are common complications. Both are probably dependent on the drain of calcium from the body.

PLATE III



The pale, homogeneous, salve-like stool often found in feeding with cow's milk. Note that it is readily indented by folds of the napkin. It is alkaline in reaction and consists largely of soaps.

To face p. 84





PLATE IV



A marked example of the formed, alkaline stools, consisting largely of soaps, sometimes found in feeding with cow's milk. They are associated with increased putrefaction but diminished fermentation in the intestinal canal. Such stools are often found in the chronic disorder described under the name "Atrophy upon a diet of cow's milk."

To face p. 85

ILLUSTRATIVE CASE. (*Vide* Fig. 5.) R. R. was admitted into Guy's Hospital on July 25, 1913, aged 4 months, weighing 7 lb. 4 oz. On September 7, when I saw her for the first time, the weight was still only 7 lb. 12 oz. The temperature had been irregular, but generally subnormal. The weight curve was typically zigzag and irregular. Constipation had been extreme, and the stools had often been clay-coloured and formed. The diet had consisted of 35 oz. of whole milk, with sodium citrate, divided into seven meals of 5 oz. each at three-hourly intervals. The only change made was to reduce the amount of milk to $22\frac{1}{2}$ oz. and to give a teaspoonful of extract of malt in each of three feeds daily. Three feeds of 5 oz. of undiluted milk were given daily, and three feeds each containing $2\frac{1}{2}$ oz. of milk, $2\frac{1}{2}$ oz. of water, and a teaspoonful of malt. The temperature soon rose to and adhered to the normal line, and the weight rose. The curve of the daily weighings became steady, as is usual when the proper diet is chosen, so that a line nearly straight could be drawn with a ruler through all the points indicating the weight on successive days from the first point to the last. On discharge, on October 3, the child's weight had reached 10 lb.

Treatment. The treatment consists in putting a stop to the over-feeding with milk and cutting down the amount to the appropriate figure, together with the addition of carbohydrate, preferably malt-sugar or a cereal food. A malt and milk mixture is very suitable (*vide* Appendix A, p. 202) as a temporary measure.

It is well to realize clearly that only a minority of infants fed upon cow's milk will suffer from the type of atrophy described. The symptoms are especially easily produced when the infant has already suffered from severe alimentary disturbances, acute fermentative dyspepsia, chronic carbo-parenteral or enteral infections, &c. Children with the exudative diathesis of Czerny are particularly prone to suffer in this way. Fig. 4, p. 82, shows the development of the disturbance in an infant convalescent from a disorder due to carbohydrate excess.

Prognosis. Unless treated the outlook is bad. Not only do rickets and spasmophilia develop, but secondary infections are frequent and fatal. The younger the child, the worse the prognosis. The longer the condition has persisted, the less readily does the child react to correction of the diet. When, as is not infrequent, it occurs in convalescence from chronic carbohydrate over-feeding, the outlook is unusually bad, inasmuch as the infant, with a return to a carbohydrate diet, is apt to react with symptoms of its former complaint.

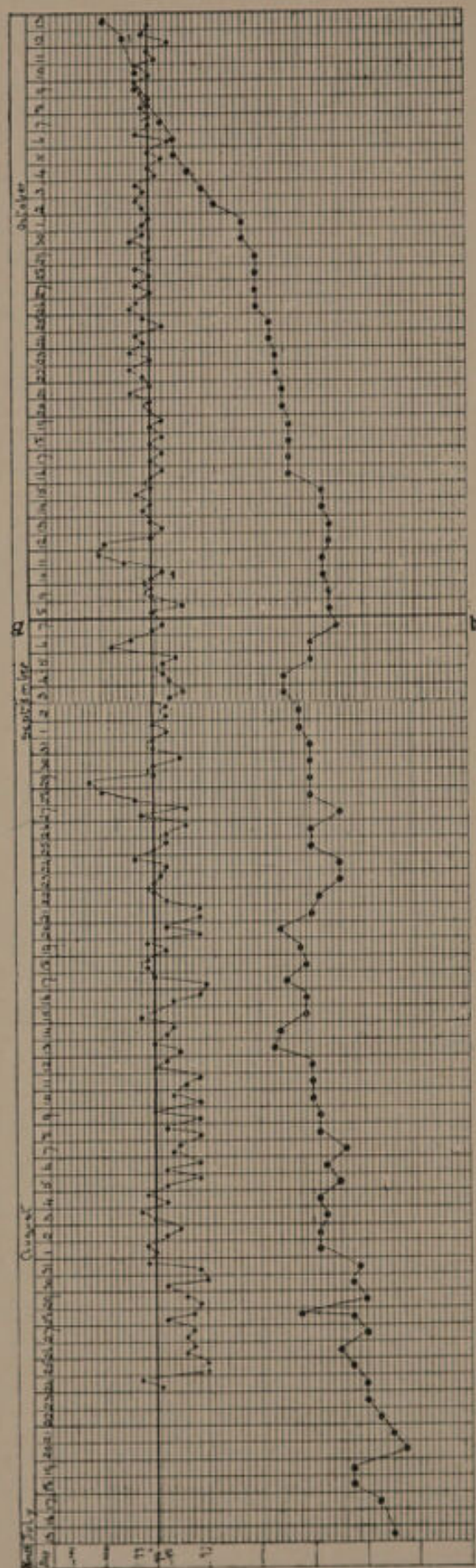


FIG. 5 shows the temperature curve (upper) and weight curve (lower) of an infant suffering from atrophy of severe degree. The subnormal temperature is well shown and the irregular weight curve without any steady rise. The diet consisted of 35 ounces of undiluted milk with sodium citrate. At the point marked *AB* the milk was reduced to 22½ ounces, and three teaspoonfuls of extract of malt were added. Thereafter the temperature rose to the normal line and adhered closely to it, and the weight curve showed a steady rise without irregularities. Note that all the points indicating the weight upon successive days lie in the immediate neighbourhood of a straight line drawn from the first point to the last. The marked irregularity in the early part of the curve, with alternate great rise and fall on successive days, is due to disturbance of the retention and excretion of salts and disappears after a suitable diet is chosen.

Diagnosis. The characteristic stool, weight curve, and temperature chart make up a picture which cannot be mistaken. For the diagnosis the absolute total of milk given in the day is less important. Symptoms may develop in certain susceptible infants on small amounts of milk (*vide* Fig. 4, p. 82).

2. ANAPHYLAXIS

In discussing the use of undiluted milk as a diet for infants and the part played in the result by the addition of small quantities of sodium citrate (*vide* p. 30) it has already been said that the excess of casein in cow's milk cannot, in the light of our present knowledge, be looked upon as the primary cause of the usual acid diarrhoea and vomiting of infants. Attention has comparatively recently been directed by Hamburger and others to a group of symptoms which are certainly the result of the ingestion of the protein in cow's milk. The entrance of a foreign protein into the circulation produces, as is well known, certain anaphylactic phenomena associated with precipitin formation. An infant which is fed upon protein derived from animal protein, which is specifically different from the proteins of the mother's milk, has more metabolic work thrown upon his digestion than the child fed at the breast. It is not only the amount of protein which counts, but also its specificity. The child by the force of digestion must remove all specific properties from the protein before absorption takes place. In undisturbed digestion this work is usually efficiently carried out, and the protein molecules of the cow's milk are very completely broken down. In disturbed digestion, on the other hand, the specific characters of the protein may not all be lost, and its absorption into the blood-stream may serve to provoke certain violent reactions. Chief among such anaphylactic phenomena are a variety of cutaneous rashes. Often these closely resemble the rash of scarlet fever, still more often that of measles. Indeed, such a diagnosis has more than once been made within my own experience. At other times the rash is more strictly urticarial in character, comparable to that which is apt to appear after the injection of antidiphtheritic or other serum. Sometimes there is marked oedema of the face and eyelids and of the extremities. As a rule the rash as well as the oedema is very transitory, so

that it sometimes fades away even while examination is in progress.

ILLUSTRATIVE CASE. A little girl, aged 10 months, had been fed at the breast since birth. The birth had been premature and she and her twin brother had been reared with great difficulty. At ten months the weight was only 12 lb. The day before the mother had given her cow's milk for the first time. A bright erythematous rash had appeared the same evening, and when seen was beginning to fade. An attempt was made to have the condition photographed, but before a negative could be taken the whole condition had faded away. A marked œdema of the eyelids was equally transitory.

ILLUSTRATIVE CASE. An infant, born in Guy's Hospital, was feeble and exhausted. The weight at birth was only 6 lb. Breast feeding was abandoned on the sixth day, in the belief that the mother was unable to nurse the child, and a cow's milk mixture substituted. Three days later a morbilliform rash appeared, so like measles that a diagnosis of measles was suggested. The temperature, however, was only 100° F. There were no bronchitis, no signs of catarrh, and no Koplik's spots. The rash appeared almost simultaneously over the whole body. The infant died from digestive disturbance a fortnight later. The immunity of the young infant against measles is so high that cases reported as occurring in the newly born must be scrutinized very carefully.

In severe cases the need for obtaining a temporary supply of breast-milk is very urgent. In milder cases a change to whey with added cream and sugar, to a dried milk, or to a malted dried milk may be tried. The condition is usually temporary and dependent upon the existence of some other digestive disturbance. Peptonizing the milk may be tried.

CHAPTER XIII

ALIMENTARY INTOXICATION

(SUMMER DIARRHŒA)

WE have seen that simple diarrhœa and vomiting or acid dyspepsia, which is due to a great excess of the fermentative processes in the bowel and which is marked by the passage of frequent, green, acid stools, is unaccompanied by evidence of the absorption of poisonous products from the bowel. Whatever damage the epithelium of the bowel-wall may have sustained by contact with the fermenting acid contents of the intestine or by the abnormal growth of micro-organisms which occurs in this altered medium, at least it has retained unaltered its function of control and selection in absorption. With the loss of this function, with the passage of various poisonous products of digestion through the bowel-wall into the general circulation, a very striking train of symptoms is produced and a condition of intoxication results. Intoxication is thus to be looked upon as a further and very fatal development of the same process which leads to fermentative dyspepsia of the ordinary type. The separation into two groups—those which show merely diarrhœa and vomiting without symptoms of intoxication, and those which show symptoms of intoxication as well—is necessary because of the extreme danger to life which is always present in the latter group. Such severe cases, although occurring sporadically at all times, are common during the hot months of the late summer, when they may reach the proportions of a veritable epidemic. For this reason in this country and in America they are commonly grouped under the name “summer diarrhœa.” That such cases should be relatively common in summer is easily understood. In times of great heat the decomposition of milk proceeds with great rapidity, so that there may be considerable change in milk which with an ordinary temperature would be

of good quality and perfectly suitable for consumption. In hot weather the tolerance of the infant for carbohydrate is diminished, so that dyspepsia becomes more frequent. Moreover acute attacks of dyspepsia are likely to be of great severity, while chronic disorders similarly undergo exacerbation. It is, on the whole, probable that a temporary lowering of tolerance for food, and especially for carbohydrate food, during times of great heat is, in part at least, responsible for the sudden outbreaks of summer diarrhoea. At any rate, it is certain that bacteriologists have not yet found any micro-organism which is so constantly present that we may be justified in looking upon it as the specific cause of the infection. In summer not only are severe fulminating cases with symptoms of intoxication much more common, but there also occur a much larger number of cases of simple dyspepsia without intoxication, while there are others which, after several days or even weeks of relatively mild dyspepsia, suddenly develop symptoms of the most violent intoxication, which rapidly lead to death. The effect of great heat in the production of diarrhoea will be considered at length in a later chapter (*vide* p. 115).

Symptoms. We may tabulate the striking symptoms of intoxication as follows :

- (1) Blurring of the intelligence, or partial coma.
- (2) High fever.
- (3) Collapse.
- (4) Rapid and enormous falls in weight, with marked loss of fluid.
- (5) An abnormal type of respiration from stimulation of the respiratory centre.
- (6) Albuminuria, glycosuria, acetonuria.

The character of the vomit and of the stools does not differ from that observed in simple dyspepsia. The vomited matter is intensely sour and smells strongly of fatty acids. The stools are watery, with shreds of mucus and fragments of fatty curd, usually green in colour and in places acid in reaction.

(1) The abnormal bearing and disturbed intelligence of the child are often the most striking symptoms. At times the appearance when at rest very closely resembles that seen in advanced tuberculous meningitis—a simulation which is rendered all the more striking by the exaggerated, irregular respiratory movements. The child lies in a drowsy condition,

paying no attention to what goes on around it, with eyes half-closed, or fixed upon the distance with a meaningless, unseeing gaze. Its posture is not that of a normal child. The limbs, instead of showing the quick, restless movements of pain or discomfort, are motionless, or are shifted with a curious slow and sluggish action. Sometimes on response to a slight stimulus the arms are slowly raised and flexed across the chest into a position that has been compared to that of a boxer's defence. Often the limbs can be gently bent into all sorts of unnatural positions, and the child will lie thus for minutes at a time. The most characteristic feature of all this partial unconsciousness is its transitory nature. If the child is roused by a sudden movement, it wakes as if from sleep, stirs itself, breaks into crying, and the whole picture fades. The face flushes a bright pink colour, intelligence returns to the look, the respiration proceeds naturally, the movements of the limbs grow more vigorous. If once more the infant is quieted, rocked in the arms or left to itself for a few minutes, the cry tails off unnaturally, the expression fades from the face, and in a few moments it has settled again into its unnatural somnolence (*vide* Fig. 6, p. 92).

(2) The *temperature* in summer diarrhoea is usually high at the onset; commonly it reaches to between 102° and 103° F. Later it sometimes falls and may be subnormal.

(3) In other cases the condition is one of severe collapse. The pulse can scarcely be felt, the fontanelle is greatly depressed. The corneal reflex may be absent. The extremities and point of the nose are cold.

(4) The *weight* falls with startling rapidity, so that in a single day ten or twelve ounces may be lost. The subcutaneous tissues are rapidly emptied of fluid, and the skin becomes inelastic and redundant, the fontanelle depressed, the eyes sunk deep into the head.

(5) The *breathing* is commonly deepened, rapid and irregular, or it may show the characters of Cheyne-Stokes' breathing. Sometimes apnœic pauses occur, during which the grey pallor of the face may be mixed with an increasing cyanosis until respiration begins again.

(6) In the *urine* we may find evidence of the serious disturbance of metabolism which has resulted. Albuminuria occurs frequently; alimentary glycosuria is sometimes found, but

occurs, of course, only when food is not withheld. Diacetic acid and acetone may be found in severe cases.

(7) Local or general *convulsions* are occasional symptoms.

Such are the more striking of the symptoms which accompany alimentary intoxication, and which serve to mark off the severe and intensely fatal cases of diarrhoea and vomiting which, although they occur occasionally at all times in the year, are especially common and of especial severity in periods



FIG. 6 shows in an infant of ten months the partial coma and immobility of limbs characteristic of intoxication. The child could be easily roused, when the stupor disappeared, giving place to fretfulness and restlessness. Death occurred on the next day.

of great heat and humidity among children living in crowded and insanitary homes.

Clinically the cases may be divided into three groups :

(a) A group to which the name "Cholera Infantum" has been given. The group is characterized by the persistence of the diarrhoea and vomiting throughout. The symptoms of intoxication are added to but do not replace the symptoms of the preceding and underlying alimentary dyspepsia.

(b) A group in which the cerebral symptoms of coma and somnolence are most marked. The resemblance to the symptoms of meningitis may be very close. In these cases the diarrhoea and vomiting may cease for some time before death. Convulsions and rigidity may be terminal symptoms.

(c). A group in which the disturbance of the respiratory centre is most marked. The symptoms are those of a general acid intoxication, comparable to the condition found in diabetic coma, with amplified, irregular breathing.

Prognosis. The first group is the most common. The prognosis is certainly less hopeless than in the other cases. Cases seen early, in which a short period of starvation serves to remove the more profound symptoms of intoxication, have relatively a good prognosis. Of cases in the second and third group few recover.

Diagnosis. The picture of intoxication is usually unmistakable. The most frequent confusion is with meningitis or broncho-pneumonia with secondary alimentary disturbance.

Of the nature of the poison nothing certain is known. It is not proved that the various fatty acids, derived from the disintegration of the sugars of the diet, undergo absorption. It is not even certain that a true acidosis exists at all, whether brought about by an acid absorption or by the excessive loss of alkali in the profuse secretion of the bowel. There is no evidence that the toxæmia is of uræmic origin.

Morbid Anatomy. In the majority of cases after death the liver is found to have undergone marked fatty degeneration. No other post-mortem changes are constant.

Treatment. In the treatment of the disorder we have to combat both the collapse and the intoxication.

The treatment of the collapse is rendered all the more difficult because it may be laid down as a rule that feeding in the ordinary sense of the word must not be begun until the symptoms of intoxication as described above have disappeared. To add to the fermenting contents of stomach and bowel a further amount of food is surely to prolong the intoxication until death ensues. An exception to this rule may usually be made in the case of protein, which cannot add to the fermentable material in the bowel.

For twenty-four hours, or even longer, if symptoms of intoxication persist, starvation must continue, save only for such meagre nutriment as is provided by albumen-water, Plasmon in a strength of one teaspoonful to five ounces of water, or raw meat-juice. All these may be sweetened with saccharin, but not with sugar. Water should be given *ad libitum*.

After twenty-four or forty-eight hours, with abatement of the diarrhœa and vomiting and disappearance of the symptoms of intoxication, a careful return to a milk diet may be begun.

The milk should be without any addition of sugar, and the fat should be removed. Whey will often be retained, but it lacks the power of the casein-rich skimmed milk to control the intestinal fermentation and to bring about an alkaline reaction within the bowel. The skimmed milk should be given undiluted in half-ounce doses six or eight times in the day, and with continued improvement in larger amounts. Only with the disappearance of the symptoms of toxæmia, solidification and diminished acidity of the stools, and cessation of diarrhœa and vomiting may sugar be added, the fat gradually restored, and a dilution suitable for the age of the child adopted.

If the infant is breast-fed—and attacks of summer diarrhœa do occur in infants reared solely on the breast—a temporary cessation of breast-feeding for twenty-four hours or longer is necessary, care being taken to prevent the drying up of the breast by regular use of the breast-pump. When feeding is begun again, nursing should only last for a few minutes at a time, because the milk secreted under such circumstances is much less rich in fat than the milk last drawn off. Sometimes it may be even well for a day or two to draw off the milk from the mother's breast, to remove the fat, and to give the infant the remainder.

In severe cases in bottle-fed infants the danger to life is extreme, and with marked symptoms of intoxication, especially when there is intense stupor or coma, a very large proportion will die; of these a number may be saved if temporary breast-feeding can be secured for the child.

In summer, where the quality of the milk is doubtful, or to prevent the possibility of relapse, it may be well to advise the use of dried milk for a time. During the season of great heat the food of all infants, and especially the added sugar, should be reduced in amount. It should be given in greater dilution, or, perhaps preferably, additional drinks of boiled water, sweetened with saccharin, should be offered to the child. The increased thirst of the infant adds very considerably to the risk of over-feeding if his only means of appeasing the thirst is by drinking larger quantities of a milk mixture

to which carbohydrate has been added. Malt-sugar, extract of malt, or such a mixture of maltose and soluble dextrins as Mellin's Food, is probably a safer addition to the milk than lactose or cane-sugar.

At the onset of an acute attack, during the time of starvation, gentle purgation should be adopted. Small, frequently repeated doses of calomel (gr. $\frac{1}{5}$ th to $\frac{1}{10}$ th), of grey powder (gr. i), or of the *Mistura Olei Ricini* (3 i) may be prescribed. With symptoms of intoxication opium is avoided lest the elimination of toxins from the bowel be prevented. Antiseptics or astringents given by the mouth have no effect during the acute stage.

At the earliest opportunity the stomach and bowel should be washed out with a weak alkaline solution, and this may be repeated once or twice daily until improvement sets in.

The rapid loss of water from the body is in direct proportion to the severity of the diarrhoea and vomiting. It is therefore usually impossible to make good this excessive loss simply by giving large amounts of water by the mouth or by irrigation of the rectum. As a rule we are forced to inject a solution of normal saline or Ringer's solution under the skin of the axilla, of the abdominal wall, or of the thighs. Each site may be used in turn and injection made twice or three times a day; three, four, or five ounces may be injected under a pressure of from 18 in. to 2 ft., using all possible care to prevent infection. To ensure that the fluid enters the subcutaneous tissues of the child approximately at a temperature of 105° F. is a matter of some difficulty. The use of an ordinary thermos flask, as adopted at the East London Hospital for Children, should help to obviate the difficulty and secure a fairly constant temperature.

During starvation it is of importance to keep the temperature of the air surrounding the child at a high and constant level. Again, the difficulties in the way of securing this in practice are very considerable. To depend upon a single hot bottle changed at long intervals is to defeat our own ends, for the temperature of the child will rise when the bottle is hot and will fall as the bottle cools. Four smaller bottles placed around the child outside a sheet and blanket, one of which is changed hourly, will serve to keep a remarkably constant temperature within the enclosed space in which the child lies if care is taken that air does not enter freely by the child's neck and shoulders.

A thermometer within this space should show a temperature of about 80° F. ; with gradual recovery the number of bottles should be diminished and the temperature slowly reduced.

The provision of a high and constant temperature of the surrounding air is especially necessary when there is great collapse, coldness of extremities, and a subnormal body temperature. In such cases a mustard bath should be given at the earliest possible moment. A hot mustard bath is not only an extremely useful measure for combating collapse, but it may also give us useful information as to prognosis. Infants in whom the skin readily becomes flushed and reddened by contact with the mustard and water are likely to do well ; those who show no such signs of reaction are in a serious condition. When the temperature of the room is high and the rectal temperature of the child above 101° F., care must be taken that the artificial heating is not carried to too great an extent. If the temperature rises above 101° the hot bottles should be removed, while the temperature is taken at short intervals to prevent undue cooling of the child. The child, if possible, should lie in the fresh air and in the shade, at least during the daytime, and in any case every care should be taken to secure the best possible ventilation.

In case of collapse, brandy (M v to x), well diluted with hot water, may be given at hourly or two-hourly intervals, or a subcutaneous injection containing one-half or one minim of the liquor strychnin. hydrochlor.

CHAPTER XIV

INANITION

IN the preceding chapters some of the disorders in which diarrhœa and vomiting are prominent symptoms have been dealt with. We must now consider others in which the chief and most striking symptom is wasting. Loss of weight is a feature of most disorders, both acute and chronic, occurring in infancy. For example, an infant whose weight was 8 lb. lost 14 oz. during an attack of pneumonia which lasted about ten days. Infants with any of the different forms of diarrhœa and vomiting which have been described tend to lose weight, though in varying degree and with varying rapidity. I wish now to speak, however, of infants in whom the loss of weight is the most striking symptom of all, who are not suffering from any infective disorder or from any constitutional disease, and who do not necessarily show either diarrhœa or vomiting.

Such cases fall readily into two groups: first, those in which the wasting is due to *inanition* or starvation, which respond more or less readily to an increased diet by increased growth and development; and secondly, those which are due to *marasmus*, a condition which is accompanied by a lack of tolerance for food, so that when any attempt is made to increase the food to the amount necessary to ensure growth symptoms of disturbance supervene, with diarrhœa and vomiting, and a still more rapid loss of weight.

Symptoms. By inanition, then, we mean the symptoms which are produced gradually by the partial starvation of the child.

The weight may remain stationary or gradually fall. Even in severe cases, in which the amount of food taken falls far short of that which is proper for the infant's age, the decline in weight, though steady, is gradual, and the steep fall characteristic of summer diarrhœa or severe marasmus is not seen.

In uncomplicated cases the fall in weight may proceed until an amount equal to about a third of the body-weight is lost. Thus an infant of average size in whom the inanition dates from birth is probably in some danger when the weight falls below 5 lb. The subcutaneous fat gradually disappears, and the infant's body acquires a slim and smooth appearance, due to the loss of all the folds and creases which the normal fatty covering of the infant produces. The extreme wrinkling and redundancy of the skin which is seen in true marasmus does not occur.

The skin is cool and the feet and hands are cold; the pulse is small, the fontanelle depressed, and the abdomen retracted. Constipation is usually marked, and the stools, instead of showing the normal appearance, which has been compared with that of the yolk of an egg, are smaller, drier, and coloured either a dark brown or sometimes greenish-black, almost like meconium. The loud crying and restlessness with which the normal infant resents any delay in feeding are not prominent symptoms. These infants are usually passive and somnolent, and are apt to sleep through the usual meal-times.

In breast-fed infants the behaviour of the child during nursing is characteristic. At first he may suck greedily, but in the action the sucking movements are more frequent than normal, and the swallowing movements less frequent. With the breast flowing freely, after every few sucking movements the infant audibly swallows the milk, often as he does so allowing some milk to escape from his mouth. With an empty breast there is much sucking, but little swallowing and no escape of milk. Often the infant suddenly ceases to suck as though recognizing its futility.

As the condition becomes developed syncopal attacks appear, each one of which is a grave danger. At other times attacks of cyanosis with marked dyspnoea occur, and these, too, constitute a warning of approaching death. These attacks are truly paroxysmal in character, and recovery from them may be apparently complete for the time being, so that there is some danger, when we see the infant on the morning after such an attack and find no trace of its presence, of minimizing the danger and of paying too little attention to the parent's description.

Somnolence, constipation, and attacks of syncope or cyanosis

are among the most striking symptoms which accompany the wasting of inanition, and it is to be noted that they are in marked contrast with the symptoms of dyspepsia and disturbed digestion generally.

Causes in Bottle-fed Children. Among the neglected children of the poor, brought up by hand, we meet from time to time with instances in which inanition is due to pure starvation—to a dilution of cow's milk, or of condensed milk far beyond all reasonable limits. More often the cause is to be looked for in the presence of some complication which may be very obvious or quite unsuspected. Cleft palate, pyloric stenosis, sublingual tumours, and facial paralysis are obvious, and need only be mentioned. In the prematurely born, too, the somnolence and the deficient sucking power make the provision of sufficient food a difficult matter. More apt to escape notice is the refusal to suck which results from stomatitis, especially from the ulcers which are known as Bednar's aphthæ. These ulcers occur at the posterior margin of the hard palate, one on either side of the middle line, at a point where the mucous membrane is tightly stretched over the bone beneath, and are probably to be explained by the constant friction of the rubber teat in bottle-fed babies, or by a rubber "comforter." A few infants will only suck when they are nursed in a reclining position in the nurse's arms. Common sense will suggest that it is well to examine the hole through the rubber teat. On one occasion I found that the milk only escaped with the utmost difficulty through the aperture.

Causes in Breast-fed Children. In artificially fed children, however, inanition is only rarely met with; in infants at the breast it is extremely common. As we have seen in discussing the causes of dyspepsia, it is not often that a healthy infant at the breast suffers from over-feeding severely or for any considerable length of time. The dyspepsia which results from a temporary surfeit is apt to bring about its own cure by the resulting diminution in appetite, force of suction, and amount of milk secreted. Not until recovery from all the symptoms has taken place does the flow become again established. On the other hand, a very considerable number of infants fed at the breast suffer from an insufficiency of milk during the first few weeks of life, and the complaint of

the mother is frequently heard that she has no milk or that her milk has left her.

A period of inanition, lasting for some days after birth, is normal and physiological, with the result that during the first few days the weight commonly declines. Some part of this loss of weight is, no doubt, to be explained by the evacuation of bladder and bowels which takes place after birth, but the greater part is due to a true inanition. In other words, the physiological needs of the child for food are not fully met until the secretion of milk is completely established.

It is not recognized with sufficient clearness that this first secretion of milk depends almost entirely upon the efficiency of the suction of the child. With vigorous suction and complete emptying of the breast, milk is rapidly produced; with feeble suction and accumulation of residual milk in the breast, the period of physiological inanition may be prolonged over many weeks. Women are too ready to attribute their failure readily to secrete a sufficiency of breast-milk to a want of robustness in their own health, when attention to the child will reveal an obvious cause for the deficient appetite and feeble suction which are the real source of the trouble. No doubt the suction power required of different infants to produce a similar result differs widely because of variations in the shape of breasts and nipples. With nipples which are seriously depressed even a vigorous child may fail to get sufficient food. If the nipples are reasonably well formed, the failure to secrete milk of sufficient quantity during the first month of life is almost invariably due to some fault in the child. Later in lactation, if the mother is not robust, if she is worried or over-worked or under-fed, the quality of the milk may decline. We should, however, have clearly in mind the distinction between the factors which make for failure in the proper establishment of the secretion in the first instance and those which tend to shorten the period of efficient lactation.

If, then, we are told by the mother of an infant a few weeks old that she has lost her milk or that she never had any milk, it is right that we should seek for some cause for the failure of appetite or suction in the child. I have grouped some of the more common causes under the following heads:

(1) Nipples which are so depressed that the child cannot grasp them. If this cannot be remedied, if the nipples cannot

be drawn out by manipulation, if a shield and artificial nipple cannot be satisfactorily adapted, weaning becomes necessary. It is only rarely that the breast secretion can be established and maintained for any length of time solely by artificial suction with the breast-pump without aid from the child. Persistently depressed nipples often make nursing at the breast impossible. The remaining causes of inanition are usually transitory and can be overcome.

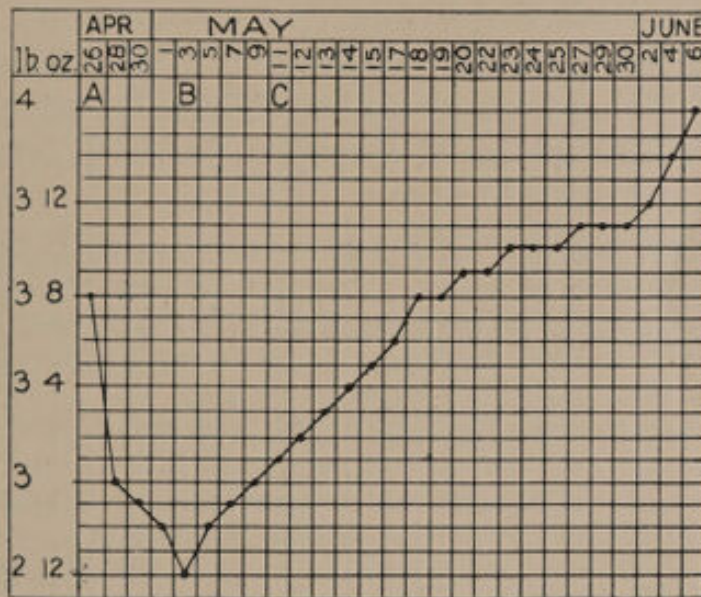


FIG. 7 shows the weight curve of a premature infant unable to draw the milk into the breast, although from the point A to the point B breast-nursing was steadily but unsuccessfully attempted. Between the points B and C the infant was nursed entirely on the breast of another woman, whose vigorous child was utilized for the work of sucking the milk into the empty breasts of the mother of the premature child. At C the premature child was returned to the breasts of its own mother, which after this treatment contained sufficient milk.

(2) Dyspnœa, whether due to adenoid vegetations, bronchitis, the "snuffles" of congenital syphilis, or a simple catarrh of the nose. I have seen cases of congenital heart disease so dyspnœic as to render suckling very difficult.

(3) Cleft palate, hare lip, Bednar's aphthæ.

(4) Prematurity. Children weighing less than 4 lb. at birth are often deficient in the necessary strength, although the sucking reflex may be well established.

ILLUSTRATIVE CASE. (*Vide* Fig. 7.) An infant born prematurely in Guy's Hospital weighed $3\frac{1}{2}$ lb. Although nursed at regular intervals by the mother, he steadily lost weight. The breast-pump was used to empty the breast completely after each nursing. On

May 1, 2, and 3 the milk so drawn off was given to him with a spoon. Nevertheless he continued to lose weight, and it became evident that he would die. I induced a woman in a neighbouring bed to come to the rescue. She consented to lend her healthy infant, which was then eight days old and weighed about 8 lb., for the work of suction, while she herself nursed the tiny premature child on her own easily running breasts. The result is shown in the chart on p. 101. At the end of eight days the mother and the healthy full-time child left the hospital, and the premature child was put back to his own mother's breasts. The chart shows how well the borrowed baby had done his work. The breasts were full of milk and the secretion, once established, did not again seriously diminish.

(5) Coincident pyrexial infections.* A very large number of infants suffering from severe but obscure infective disorders react, not with symptoms of dyspepsia, but with complete loss of appetite and refusal to suck.

ILLUSTRATIVE CASE. A female infant, five weeks old, suffered from a severe attack of pyelitis. The infant wasted rapidly and its weight declined from $7\frac{1}{2}$ lb. till it reached 5 lb. On the assumption that its mother's milk was insufficient for its needs, the mother was implored by numerous self-constituted advisers to wean the child. She continued, however, to nurse her baby at the breast, and by dint of extraordinary patience and self-control succeeded in avoiding the drying up of the breasts—a disaster which often seemed imminent. After eight weeks of illness the pyelitis suddenly subsided and the trouble was at an end. The appetite and need for food returned, the mother's breasts filled with milk, and the weight rapidly and steadily rose.

ILLUSTRATIVE CASE. An infant three weeks old was sent to me with the history that the mother's milk left her after ten days, that the child had refused to suck and had wasted rapidly, and that, although in a short time three different diets had been tried, no improvement had taken place; vomiting had been frequent. Throughout it had been assumed that the disorder was primarily one of digestion. Three days after I was consulted two subcutaneous abscesses formed, from which a pure growth of pneumococcus was obtained upon cultivation. The infant, unknown to everyone, had suffered and recovered from an acute general pneumococcal infection.

* The question arises, in this connexion, whether the so-called "inanition fever" is not invariably due to an obscure infection, which is at once the cause of the fever and of the failure of appetite. It is doubtful whether inanition can directly cause pyrexia, either by concentration of the tissue salts or in any other way. On the other hand, the toxæmias of the newly born may be difficult to recognize. In many cases there is no striking symptom, such as jaundice, hæmorrhage from stomach or bowel, convulsions or profuse diarrhœa to draw attention to the underlying cause. In many, pyrexia is the only prominent symptom accompanying the refusal to suck.

Bronchitis, broncho-pneumonia, pyelitis, otitis media, and umbilical sepsis should be borne in mind as infections, sometimes obscure, which may account for inanition and failure of appetite.

(6) It is possible that difficult labour with extreme exhaustion of the child may at times prolong the period of inanition of the child. In such cases there may be actual injury to the brain from cerebral congestion, or even from pressure by instruments used in delivery. In other cases prolonged and abnormal labours are associated with atelectasis pulmonum in the child or with the inhalation of amniotic fluid. In atelectasis there is always great drowsiness, and the respiration is irregular, feeble, and halting, except when the child is stimulated by the application of cold or by some other painful stimulus. Long apnœic periods are apt to occur and the infant is very liable to be found dead in bed, having ceased to breathe without a struggle. In all severe cases the sucking reflex is involved as well as the respiratory.

ILLUSTRATIVE CASE. An infant eighteen days old had been born after a very difficult instrumental labour. The right clavicle had been fractured and there was blood effused under the conjunctiva of the right eye and paralysis of the muscles of the other. Over the right parietal bone there was a deep depression. For several days respiration was only maintained by constant stimulation. The child was immersed in a warm bath, from which it was momentarily raised, and cold water dashed over its head and chest. So soon as a strong inspiration was taken it was again lowered into the hot bath. Immediately after this treatment the child was comparatively active, the limbs were moved freely, the respirations were deep and sufficient, and if it was given the bottle it sucked greedily and vigorously. Within half an hour the effect had usually passed off; the child subsided again into somnolence, the respiration became halting, and if the teat was placed in its mouth it made no effort at all to suck. The treatment was continued night and day for some days before improvement set in and recovery took place. Seen eighteen months later, the child was well. The ocular paralysis was still present.

(7) A very common cause for failure of breast-milk is found in the practice of giving additional artificial food during the first few days of life in cases where the flow of milk into the mother's breasts is slow, in the hope of tiding the child over the interval and diminishing the ill effects of the temporary under-feeding. It is not often that such a practice is justifiable, because by the very act of giving artificial food the want of

appetite and failure of suction, which are the cause of all the trouble, are increased. A child that is just holding his own and sucking a bare sufficiency from the breast, when once he has tasted an easily running bottle, is apt thereafter resolutely to refuse the breast. It is useless to place a torpid and satisfied infant on the breast. The flow will only be established by the vigorous sucking of a hungry child, and whatever amount is given from the bottle will be deducted from the amount secreted by the breast. Mixed feeding is often entirely successful later in lactation when all these initial difficulties have been overcome; when there is delay in the appearance of the secretion it is seldom successful in overcoming the trouble.

An early and injudicious resort to additional feeding often does even greater harm than by merely aggravating the want of milk which it is designed to overcome. As has been shown, the refusal of the child to suck and the consequent want of breast-milk are often the result of an obscure infective disorder in the child. In such cases the diminution in the milk-supply is a protective reaction, designed to prevent the complication of the disorder by a secondary dyspepsia. The common result of an attempt at mixed feeding is the production of such a dyspepsia. In other words, while the administration of additional food, or even the complete weaning of a vigorous and healthy infant, may be successfully accomplished, the results will be very different when we have to deal with children whose tolerance to food is already lowered by infective disorders.

(8) Lastly, the failure to supply an adequate amount of heat to the newly born is a cause of failure of the supply of milk. Modern custom has decreed—and, taking all circumstances into consideration, rightly decreed—that the infant as soon as born shall be separated from the mother and shall be deprived of the warmth of her body. Among all mammals the temperature of the young is somewhat unstable until the secretion of milk is well established. For that reason it is the task of the mother by close contact with her own body to regulate the temperature of the young by approximating it to her own. Deprived of the uniform heat of their mother's body, the temperature of young mammals falls, their movements become sluggish and torpid, and their appetite fails. Among the well-to-do the ill results of such enforced separation are minimized or overcome by the care which is exercised to keep

the temperature of the air surrounding the infant sufficiently high. Until the secretion of milk is well established the infant's cot is kept near the fire or sufficient heat is provided by means of hot-water bottles or in other ways. Among the poor, on the other hand, during the lying-in period, the infant lies in close contact with the mother. When, however, the time comes, after a week or ten days, for the mother to rise and resume her struggle for existence, the child is for the first time left to its own resources. "When I left my bed my milk left me" is a common complaint, and the explanation may lie in the torpor, subnormal temperature, and the want of suction power and appetite in a weakly infant suddenly exposed for the first time to a low temperature.

Treatment. The treatment consists—(a) in the prevention of excessive loss of heat, and (b) in the gradual increase in the amount of food taken.

(a) Because their surface area is very large in comparison with their bulk, infants lose much heat by radiation and conduction. In healthy babies the thick layer of fat which envelops their bodies is a means of preventing this loss of heat from becoming excessive; in wasted and premature infants there is no such protection. It is for this reason that it is well in all cases of inanition to avoid undue exposure of the body in washing the infant or in making an examination. In severe cases the whole body should be anointed with olive-oil and wrapped in a thick layer of cotton-wool. If there is a markedly subnormal temperature, or if there are signs of cyanosis or collapse, a warm bath at a temperature of 105° F. should be given before a warm fire; the child should be dried rapidly with a warm, soft towel, wrapped in wool, and put back to bed. It is essential to maintain a high uniform temperature of at least 80° F. in the air space around the child. The easiest way to arrange for this is to use an incubator, but should that be impossible, a very constant temperature can be obtained by the use of three or four small hot bottles, packed around the child and separated from it by a sheet and blanket, one bottle being changed at hourly intervals. To use a single bottle is to defeat our object, because the temperature within the space in which the child lies fluctuates with the temperature of the bottle. The danger of overheating is considerable, and to guard against this the rectal

temperature should be taken at intervals, and a thermometer should be pinned to the child's outer clothing and its readings frequently recorded. With improvement in the infant's condition, with increase of appetite and of vigour, the artificial warmth may be gradually lessened and finally omitted.

(b) The second indication is to increase the food taken to the proper amount.

In bottle-fed infants with complete lack of appetite nasal feeding may have to be resorted to. Nasal feeding is a proceeding which is quite unwarranted in all conditions of dyspepsia. No matter how badly the child sucks, if fermentation is excessive in stomach and intestines, as shown by the passage of sour, green stools and by the vomiting of acid stomach contents, it is unjustifiable to place food in the stomach by artificial means. In simple inanition the circumstances are very different, and nasal feeding may be of the greatest use. If nasal feeding is used it should, of course, supplement, and not supplant, feeding in the ordinary way. The amount taken by the mouth should be measured and deducted from the amount prescribed, and the difference given in one or two nasal feeds daily. If the refusal to suck is due to ulceration of the mouth, the ulcers should be touched with silver nitrate and smeared with glycerine and borax, and a soft teat of a different shape should be employed. If atelectasis is present stimulation by cold may be tried as described above. In all cases we should be content to aim at a gradual gain of weight, because inanition, if prolonged, is itself a cause of dyspepsia. In other words, after long starvation the tolerance for food is lowered, and dyspeptic symptoms are produced upon relatively low amounts of food. If dyspepsia complicates inanition the prognosis is made very much worse. The food prescribed should not be very dilute or of large bulk and should contain a relatively high carbohydrate percentage. Such foods as those mentioned under group 5 (p. 28) are very suitable. They contain dried milk with a considerable addition of malt-sugar, which is much less liable than cane-sugar or lactose to undergo fermentative changes and give rise to diarrhoea. Among the poor, dilute milk with extract of malt added, or even sweetened condensed milk, serves well as a temporary measure. The increase in the amount of food should not be sudden.

In breast-fed infants the successful treatment of inanition is often a matter of great difficulty. During the first month or two of life, when the condition is most commonly met with, an attempt at mixed feeding by the addition of two or three feeds from the bottle in the day is very apt to result in a still further diminution in the milk secretion, because, while the child sucks the easily flowing artificial food readily enough, it becomes increasingly disinclined to make prolonged and laborious attempts to obtain milk from the breast. Therefore, before the mother is advised to adopt mixed feeding we must carefully consider the probability that by so doing we shall bring about the complete cessation of breast-nursing. It requires great patience and great trust and confidence on the part of the mother to adopt what must seem to her a policy of almost complete inactivity—to obey the injunction to do nothing, to wait quietly, placing the infant regularly to the breast at three- or four-hourly intervals, until the quantity of milk becomes sufficient. Yet in the great majority of cases, within the space of one or two weeks, strict regularity in nursing, at intervals separated by a sufficient lapse of time, will prove entirely successful. *In all cases our treatment must be directed with one object only, to assist the infant to drain the breast completely dry at each meal.* When, after fifteen minutes' nursing, the infant will take no more, the breast should be drained by the use of a large pump, made on the principle of a Bier's suction apparatus. Even without a breast-pump, by raising the breast and exercising steady pressure with both hands many women can drain it dry. In the rare instances when an older infant has just been weaned, the older child may be put back to the breast for a few days, when his powerful suction rapidly produces the desired result. In all cases, too, the underlying cause, if detected, should receive appropriate treatment.

(1) Mercury should be given in the snuffles of congenital syphilis. For nasal catarrh a few drops of warm alkaline lotion from a pipette may be allowed to fall into the nostrils before nursing. In all cases of severe dyspnoea an artificial nipple may be helpful.

(2) In cleft palate and hare lip the question of an early operation must be considered. A specially large and soft teat provided with a flange, which is pressed against the

opening in the palate, is often helpful. Bednar's aphthæ should be painted with a 2 per cent. solution of silver nitrate.

(3) Atelectasis must be combated by baths and cold douchings. Certain cases of bronchitis benefit by similar treatment.

If after a fortnight or three weeks, during which this routine is steadily pursued, the weight is still stationary or declining, and if the symptoms of inanition persist or increase, so that artificial feeding becomes imperative, it is better to prescribe one or two artificial feeds of large size than to offer the bottle at frequent intervals. When mixed feeding is successful it ought to be possible to return after a few weeks to complete breast-feeding. The sudden and complete substitution of bottle-feeding for breast-feeding because of a few days' decline in weight in infants in the first few weeks of life is not justifiable because of the high mortality in artificially fed infants at that age, even under the best hygienic conditions. We should remember how well relative starvation is borne by infants so long as they are kept warm enough and are given sufficient fluid as water, and how transitory are many of the causes of inanition. Further, it must be borne in mind that the healthy infant, unless the mother's nipples are ill-formed, does not suffer from inanition. Inanition is commonly due to some underlying disorder in the child, and the risk of weaning is therefore especially great. If the child has suffered from inanition at the breast, the risk of dyspepsia from bottle-feeding is greater than usual.

Upon the other side, we must remember that severe and prolonged inanition in infants, just as in adults, causes a fall in the tolerance for food, and to wait for too long a time may mean the supervention of a severe attack of dyspepsia when food in generous amounts is at length given. No doubt danger lies in both directions, yet in actual practice it is rare indeed to see an infant starve to death at the breast, while injudicious and unnecessary weaning—whether intentional, under the belief that the mother is quite unable to suckle, or induced by the attempt to combine breast feeding with artificial feeding—is one of the main factors in infant mortality.

It goes without saying that in the treatment of inanition at the breast the habits of the mother as to rest, exercise, and

food must receive attention and any faults be corrected. She should take a sufficiency of fluid, at least three pints daily, and should endeavour to have a daily action of the bowels. Excitement of all sorts should be avoided. Lactagogues have no direct action. Their prescription will often, however, help us to persuade an anxious mother to persist in the necessary routine. The great majority of cases of inanition are due to causes which are transitory and will of themselves pass away if only the infant is not removed from the breast. So-called lactagogues often meet with success because their use implies that the infant is put to the breast. Without the regular emptying of the breast they are, of course, ineffective.

It is interesting to observe how long a time may elapse between the removal of the baby and the complete involution of the breast. Even after many weeks, in not a few cases, all that is necessary is to replace the child on the breast at regular intervals and the milk will again appear.

ILLUSTRATIVE CASE. An infant seven months old was sent to me by Mr. C. H. Fagge, who had operated upon it in Guy's Hospital for intussusception seven weeks previously. The operation had been successful, but there had been considerable trouble subsequently with the diet. Until admission to the hospital the child had been nursed entirely upon the right breast. The mother had not used the left breast for any of the last three children, so that it had not been active for eight years. The infant was put back to the breasts, each being used alternately at three-hourly intervals. During the first week there was a loss of two ounces, which was regained during the following week. Thereafter the child's gain in weight was entirely satisfactory and milk flowed in abundance from both breasts, one of which had not been used for seven weeks and the other for eight years. The mother had not used a breast-pump or attempted in any way to preserve the milk-flow while the child was in hospital.

I do not believe that it is always, or even perhaps commonly, possible to achieve such success at so long an interval. When the time which has elapsed is shorter, and amounts to no more than ten days or a fortnight, energetic measures will usually succeed. If artificial suction with an efficient breast-pump is practised regularly during the absence of the child for any reason, the difficulties are much less. The importance of these observations for surgical work upon young infants is obvious. With a little care and foresight the infant can be returned to the mother's breast when discharged from hospital.

CHAPTER XV

MARASMUS

THE name "marasmus" has come into general use to denote any condition marked by great wasting, due either to a primary disturbance of nutrition or to congenital syphilis, tuberculosis, or other chronic infections.

In what follows the name will only be applied to a certain definite type of disorder of nutrition which will be found to present symptoms which separate it on the one hand from chronic dyspepsia and the disturbances which tend to follow upon a gross excess in one or other constituent of the food, and on the other hand from inanition and under-feeding.

The Nature of Marasmus. To marasmus in this narrower sense Finkelstein has given the name "decomposition" in order to emphasize the permanent loss of tolerance to food which is the most characteristic symptom. We have seen that even a comparatively mild attack of dyspepsia may be followed by a temporary loss of tolerance for food, so that a repetition of the disturbance may be provoked upon a much smaller allowance of food than sufficed to produce the symptoms in the first instance. With repeated and severe dyspepsia, the tolerance may gradually sink so low that it falls permanently below the amount necessary for growth and development. When this serious condition has occurred we meet with the so-called paradoxical reaction to food (Finkelstein). Upon an insufficient diet the weight shows only the slow decline of partial starvation and inanition. When an attempt is made to cover the needs of the body for food, the infant reacts with symptoms of great severity, rapid fall in weight, pyrexia, diarrhœa, vomiting, or symptoms of alimentary intoxication.

We are ignorant of the real cause of this paradoxical reaction to food. We know only that the condition is seldom, if ever,

primary. Sometimes it follows directly upon inanition of long standing, especially in very young infants. It is thus comparatively frequent in premature infants, and in infants who have suffered from the toxæmias of the newly born. Severe icterus neonatorum, pseudo-tetanic convulsions, the hæmorrhagic disease of the newly born, and septic diarrhœa occurring within a few days of birth, are apt, if recovery takes place, to be followed by the development of marasmus.

In older children who are artificially fed, repeated and neglected attacks of dyspepsia, alimentary intoxication, or severe enteral or parenteral infection are the common predisposing causes. Not a few infants, who have suffered from diarrhœa and vomiting in the summer and yet have survived, may die of marasmus some months later.

Symptoms. The weight curve is characteristic. When food is given, it falls steadily and rapidly. When food is withheld, it becomes flatter, although it still declines.

The loss of weight towards the close of life may be very rapid, so that as much as four or five ounces may be lost daily. The emaciation proceeds until the child seems to consist only of skin and bone. The skin hangs in redundant folds and wrinkles. The mouth, which appears like a huge cavern framed by a little, wrinkled face, is usually open, and the lips and cheeks are constantly set into sucking movements. In contrast to the general emaciation, the sucking pad of fat may stand out prominently. The abdomen may be retracted or distended.

The child is restless, cries for hours together, and rocks himself to and fro unceasingly. The power to suck and the appetite, in contrast to the rule in severe dyspepsia, may remain for long unimpaired, although the fall in weight continues. The appearance of the stools is variable, depending on the nature of the diet. They may be watery and slimy, or bulky and fatty. Not infrequently they are of quite normal appearance. Towards the close the pulse may become very slow and the respiration irregular or even of the Cheyne-Stokes' type. The temperature fluctuates irregularly. Broncho-pneumonia is a common complication, and is usually the direct cause of death.

Diagnosis. The picture of alimentary marasmus is sharply opposed to that of alimentary intoxication: irritability with

clear mind, slow pulse, slight pyrexia or a subnormal temperature, and a normal urine contrasting with drowsiness or coma, rapid pulse, pyrexia often of considerable degree, albuminuria, acetonuria, or glycosuria.

If a few days' partial starvation suffices to restore the tolerance for food, the disorder is dyspepsia and not marasmus. If the wasted infant responds to an increase in the amount of diet by a rise in weight, the condition is one merely of inanition.

Prognosis and Treatment. It is obvious from the definition of the disorder that the treatment of marasmus in the majority of cases can be of no avail. No doubt in some instances the loss of tolerance does not affect all classes of food-stuffs in equal degree. It is more common and more marked in the case of fats (Finkelstein), and it is well to make an attempt to save the child by a diet in which the fat content is very low. If the loss of tolerance affects sugars as well, we must prescribe a diet which is especially rich in protein. Very striking results have been achieved in marasmus by the use of the albumen-milk of Finkelstein and Meyer.

If the tolerance for carbohydrates remains unimpaired, as is not infrequent, the prognosis is by no means so hopeless. The claims of certain patent foods, showing photographs of marasmic infants restored to plumpness and vigour, are sometimes made legitimately enough. When we are confronted by a case of marasmus it is our duty to estimate, by careful weighing of the child and intelligent manipulation of the diet, whether or not the intolerance for food extends to carbohydrates, and to make our prescriptions accordingly.

In marasmus, as in inanition, care must be taken to prevent undue loss of heat by radiation from the body, and to combat collapse and syncope.

Lastly, a proportion of marasmic infants can be saved if a suitable wet-nurse can be found, or if a supply of human milk expressed from the breast of a nursing mother is available. Infants in whom a marked intolerance for all forms of artificial diet has been shown, and in whom a condition of marasmus was far advanced, may improve from the very hour on which they are put to the breast.

The following case illustrates how even the most severe case of marasmus may sometimes recover upon a carbohydrate-rich diet if only the tolerance for sugar remains unimpaired.

It shows also the ill effect of fat in marasmus. The continuous pyrexia may be due, in part, to the high sugar content, and is to be contrasted with the subnormal temperature in Fig. 5 (*vide* p. 86), where the diet was whole milk.

ILLUSTRATIVE CASE. W. C., aged four months (*vide* Fig. 8 below), was admitted to Guy's Hospital under my care for severe

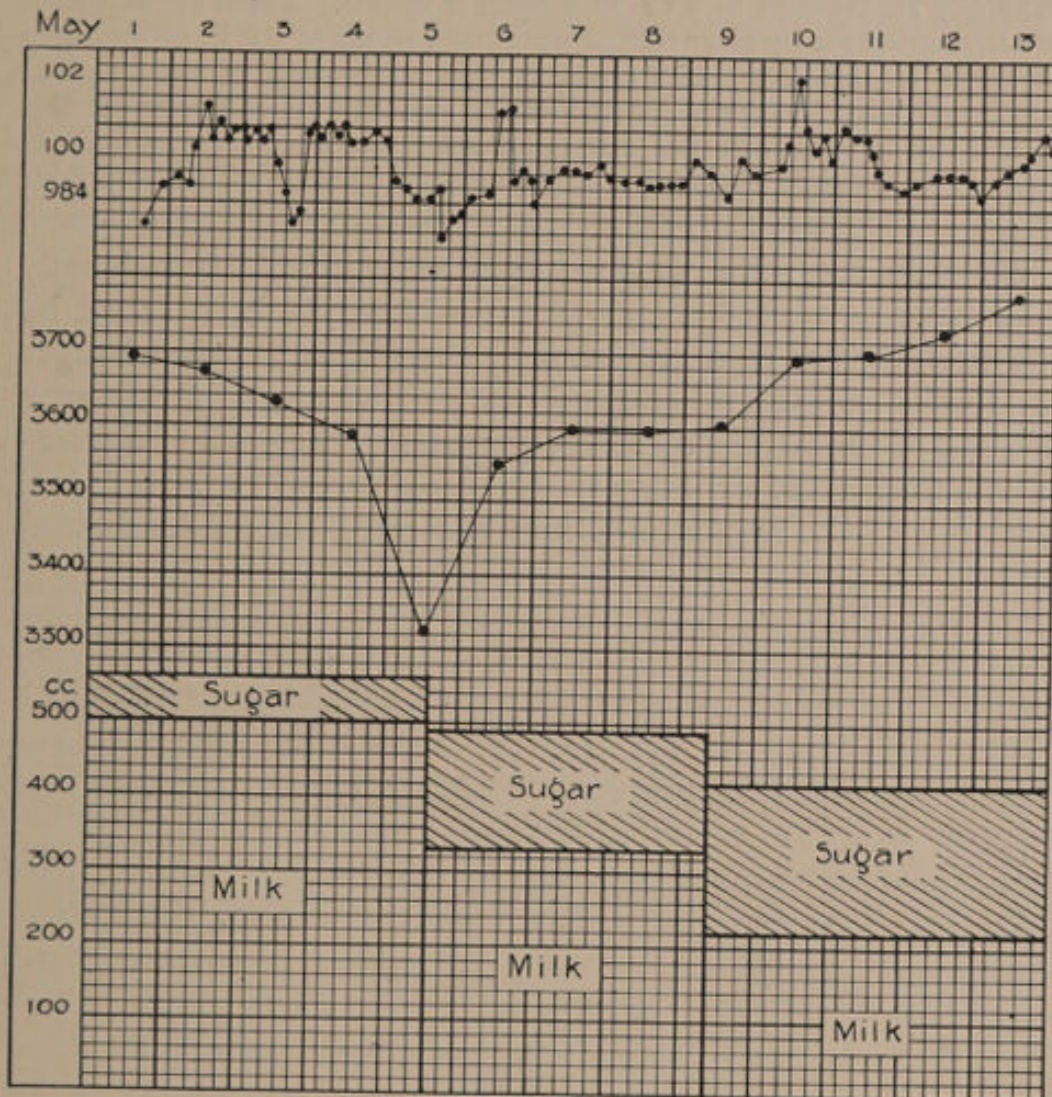


FIG. 8 shows the temperature curve, weight curve, and diet of an infant with severe Marasmus. It shows the improvement which followed upon an increase in the amount of malt-sugar, and a diminution in the amount of cow's milk. The continued slight pyrexia is not unusual when large quantities of sugar are given. In the present case, however, pyoderma was present. In the three periods respectively 40, 80, and 100 grammes of malt-sugar were given *per diem*.

wasting. The child had been artificially fed from the first. When ten weeks old he suffered from diarrhoea and was admitted to a children's hospital weighing 11 lb. 4 oz. When discharged four weeks later the weight was 9 lb. 3 oz. During the next fortnight until admission to

Guy's Hospital a further loss of 1 lb. had taken place. The weight was then 8 lb. 4 oz. On a diet of equal parts of milk and water (500 c.c. milk + 40 grammes malt-sugar) the weight fell to 7 lb. 6 oz.—a loss of 14 oz. in five days. Several small suppurating points developed on the fingers. On the fifth day the milk was reduced to 320 c.c. *per diem* and the malt-sugar increased to 80 grammes. On the day after the change of diet an increase in weight of $8\frac{1}{2}$ oz. was recorded. On the ninth day the malt-sugar was increased to 100 grammes *per diem*, and on the next day an increase of 3 oz. in weight is shown. These sudden rises are accounted for by retention of water as a result of the large quantity of sugar in the diet. The chart is also interesting as showing the continued slight pyrexia for the same reason. In the case of this infant the temperature did not fall until later, when the amount of malt-sugar was lessened and a larger amount of milk with baked flour given. The temperature then at once became normal and remained so.

Much in the same way we meet with infants occasionally who have developed marasmus and have yet been saved by the prescription of a patent food consisting largely of sugar or starch. On the other hand, the risk which the infant runs because of the sugary diet is very great. An attack of fermentative dyspepsia, or alimentary intoxication, or a terminal infection of the respiratory tract, too often causes death.

CHAPTER XVI

SUMMER HEAT AND DIARRHŒA. PROPHYLACTIC MEASURES

THE RELATION OF THE THERMOMETER TO INFANTILE DIARRHŒA

IN the study of the disorders of infancy it is impossible not to be struck by the close relation which exists between the height of the thermometer and the prevalence of infantile diarrhœa. To explain this close relationship it has been very generally assumed that the cause of the increase is to be found in the augmented bacterial growth occurring in milk during hot weather. It has, further, recently been suggested that the sudden rise in the numbers of infants with symptoms of diarrhœa, which sets in during the later summer months, is directly dependent upon the infection of the milk by organisms which are conveyed to it by flies. Before we can be in a position to discuss the prophylaxis of diarrhœa in hot weather, it is a matter of the first importance to decide how far we may consider that faults in the milk-supply are answerable for the heavy mortality, and whether there are not other causes which would still occasion an enormous increase in diarrhœal disorders, even if we were able to secure a perfect or reasonably pure milk-supply.

In this endeavour we may tabulate the possible relations which may exist between the height of the thermometer and the amount of diarrhœa prevalent amongst infants, and attempt to assess the part played by each.

(1) Heat may exert an indirect effect by favouring the growth and multiplication of organisms outside the body, by encouraging the decomposition of milk and other foods, or by promoting an easy means for the transport of organisms by the multiplication of flies and the spread of dust.

(2) The increase of diarrhoea may be due to the direct effect of heat upon the body of the young child in whom the mechanism by which heat-loss and heat-formation are controlled is not well developed or stable.

(3) The increase of diarrhoea may be due to the indirect effect of heat in lowering the tolerance for food, and in increasing the danger of over-feeding in an infant rendered thirsty by the loss of fluid which diarrhoea, vomiting, and excessive perspiration entail.

(4) Heat may exert an indirect effect by lowering the immunity of the child to infections of all sorts, both of the alimentary tract and elsewhere.

There can be no doubt that during hot weather the risk which a child runs of receiving milk which has developed a considerable degree of acidity is greatly increased. Such a statement, however, is quite compatible with the belief that so-called summer diarrhoea does not constitute a specific infective disorder, due to infection with some unknown micro-organism, and propagated by direct infection from one individual to another. For this latter view, although it would seem to have been widely adopted, it is difficult to discover any convincing evidence. Bacteriological research has failed to find any uniform causal connexion between any one organism and epidemic diarrhoea. The disease in its most fatal form is notoriously prevalent among infants fed on condensed milks, and patent foods which are relatively free from contamination, while breast-fed babies enjoy no immunity. The high hopes based upon the discovery of the enormous bacterial contamination of the ordinary market milk, and the expectation that by boiling or pasteurizing the milk the danger would be removed, have been doomed to disappointment. It is probable that Czerny and others are right in contending that the origin of the majority of alimentary disturbances in infants is to be found in a bacterial fermentation of the food, both within and without the intestinal canal, by which not the bacteria, but the fermentative products of the food constitute the dangerous factor.

Moreover, the closeness of the correspondence between the temperature curve and the curve of the deaths from diarrhoea is itself an argument in favour of the view that the effect of heat is exerted directly on the child and not indirectly

by providing a suitable environment for the development of an epidemic disorder. If each case arose by infection and was propagated by contagion, an epidemic, when once fairly established, might be expected to outstrip the limits set by the temperature chart and to persist for some time after the heat had departed. Such a true epidemic is not witnessed; the two curves keep pace alike in rise and fall, preserving throughout a constant relation to each other.

Little support is afforded to the view, that in summer diarrhœa we have to deal with an acute epidemic disorder, by a study of the disorder at the bedside. In times of great heat during the late summer there is not only a rise in the frequency of severe and fatal diarrhœa, with symptoms of intoxication, but there is an enormous increase in the number of cases of slight dyspepsia, and between the two extremes it is possible to find cases of all intermediate degrees. Moreover, the development of a fatal intoxication can be watched arising directly from a long-continued or neglected dyspepsia. Of those cases which present the most severe symptoms of poisoning, partial coma, hyperpnœa, albuminuria, &c., the great majority occur in children who are already the subjects of chronic malnutrition.

It is, of course, difficult to prove or disprove the possibility of the spread of contagion from one child to another. Experience in the infants' wards in all hospitals shows that one of the great risks to the child of all profound or long-continued disorders of nutrition lies in the striking lowering of the resistance to infective disorders of all sorts which accompanies the disturbance (*vide* Fig. 9, p. 121).

ILLUSTRATIVE CASE. During the hot weather in 1911 three infants were admitted to a ward in Guy's Hospital within a few hours of each other, all suffering, so far as could be determined, from acute diarrhœa and from that alone. In all three under treatment the diarrhœa ceased without the development of serious symptoms of intoxication. Yet in the course of a fortnight one child developed an empyema, in a second multiple subcutaneous abscesses appeared, while the third died of an insidious broncho-pneumonia.

The so-called "hospitalizing" of infants, which no amount of care in the hygiene of the wards has sufficed altogether to prevent, is due in a great measure to this disastrous after-effect of alimentary disturbance in the very young. It would

appear that the danger to very young infants of close contact one with another is not so much that infective enteritis will be disseminated, but that each will fall a victim to mild infections, most commonly of the respiratory passages (Meyer). "Infants," says Pfaundler, "*sicken ex alimentatione*; they die *ex infectione*." And again, Archambault: "*A l'hôpital des Enfants, on meurt, non de la maladie qui vous y amène, mais de celle qu'on y contracte.*"

It is not to be doubted that, like most other infections, infective enteritis is more common in hot weather than in cold, and from time to time undoubted epidemics of true infective enteritis have been recorded. Of the large infantile mortality from diarrhœa, however, deaths from infective enteritis form only a small part.

There can be little doubt that the increase in diarrhœa is in part due to the direct effect of heat upon the sensitive organism of the child. Many records have shown that in times of great heat the temperature of even healthy infants tends to rise above the normal, while their average gain in weight is much reduced. Both of these symptoms occur with considerable constancy, even in cases which are still free from diarrhœa and vomiting, and they may be regarded as prodromal symptoms sometimes preceding and culminating in a severe attack of dyspepsia.

It is well known that the power of the infant, and especially of the weakly infant, to maintain a constant temperature is ill-developed. Although the necessity of preventing an excessive loss of heat is insisted upon by all writers upon infant-feeding, less stress is laid upon the importance of avoiding the over-heating of the child. Yet summer diarrhœa in its most severe forms is almost confined to those of very tender years. Among the occupants of crowded courts and tenements again and again only one member of the community is affected—the infant under one year of age. With the attainment of a higher degree of adaptation between heat-loss and heat-formation, the older children tend more and more to escape. In estimating the direct effect of heat upon the child, it is to be remembered that we have to take into account not the temperature of the outer air, but the temperature of the stifling room in which the infant lies under a covering of heavy, impervious clothing. Where rooms are small and ill-ventilated,

where from lack of windows or in back-to-back houses there is no through draught brought about by the difference of temperature between the back and front of the house owing to the position of the sun, where the percentage of moisture in the air is high from overcrowding, or from cooking, or from washing of clothes, observation shows that diarrhœa is unusually common.

Further, we must consider that in times of great heat and of great humidity, on the ordinary ratio of food, the production of heat may be so great that pathological effects are produced. In adults the consumption of food under such circumstances is instinctively lowered. While less is eaten, more is drunk to make good the loss of fluid from increased perspiration. In infants the difficulty is greater because the infant's food and drink are bound up in one and the same fluid. No doubt the infant fed at the breast attains the same object, though in a different way. As we have seen, the provisions against over-feeding in the breast-fed infant are very effective. When the child ails the diminished force of suction soon interferes with the free flow of milk, and it requires some days of vigorous convalescence before it is again established. Moreover, when the breast is insufficiently emptied the last milk is not obtained, so that the percentage of solids, and especially of fats, falls. No doubt, too, the alteration in the mother's diet, the greater intake of fluid, and the decrease in the amount of solid matter react to some extent upon the milk and produce a fluid of less concentration. In the bottle-fed none of these safeguards are present, and the thirsty child, if left to itself, is more apt to suck an excess from a bottle, which offers no fine adjustment of amount and composition from day to day, in accordance with the needs of the child.

Too often in hot weather no attempt is made to reduce the amount of food and to increase the supply of water. The infant's thirst is left to be assuaged by a further consumption of a sugar-rich or fat-rich food mixture, until the tolerance is overstepped and dyspepsia is produced.

PROPHYLACTIC MEASURES

From these considerations we may gain some knowledge of a reasonable prophylaxis against diarrhœa in hot weather.

(1) It becomes of especial importance during hot weather to secure a supply of fresh milk and to have efficient means of keeping it cool. If the milk is already sour, no amount of subsequent boiling will render it fit for use. If milk of undoubted freshness cannot be produced, as often happens in this country, it is well to substitute for a time a dried milk of a good brand. Precautions against the infection of the milk in the home must be redoubled.

(2) In hot weather an infant requires very much less food than when the temperature is low. An infant has a body surface two or three times larger per kilo of weight than an adult—a figure which serves to show how close must be the relationship in the infant between the external temperature and the humidity of the air on the one hand, and the demand of the body for food on the other. It follows that whenever the temperature is persistently high we should diminish the amount of food by at least one-third, and increase the amount of water taken. Sugars, which, as all experience shows, are especially liable to lead to diarrhoea and to intoxication, should be reduced to a low limit.

(3) Great attention should be paid to ventilation, and stagnation of the air must be prevented at all costs. Clothing should be light and porous, and the bed-clothes such that the circulation of air is not altogether prevented. Wherever possible the child should sleep during the day out of doors in the shade.

(4) All overcrowding of the room in which the infant lies should be avoided. Bathing the child in hot and steaming water, washing clothes, cooking, &c., should not be allowed to add to the moisture of the air. If possible, all these tasks should be performed in another room.

(5) Tepid bathing may be practised once or more daily. Pritchard has recently insisted upon the value of using cooler baths for infants. The mother should be given a bath-thermometer and instructed to lower the temperature of the bath one degree each day until a temperature of 80° or even 70° F. is reached. Where ice can be produced the temperature of the air surrounding the child can be lowered by many degrees.

(6) Especial care should be taken to prevent the possibility of the infant becoming infected by contact with adults or

other children suffering from nasal or bronchial catarrh. As has been said, this danger is especially great for infants who lie prostrate and motionless in convalescence from summer diarrhœa. Where several infants are collected in one room, every attempt should be made to secure as complete isolation as possible. The cots should be separated by screens, and the attendants should only approach the infants after disinfecting the hands. An overall should be kept by each cot, and should be put on by everyone who approaches the child to examine it or to attend to its comfort. Where there is but one child, such precautions are, of course, unnecessary, provided that the attendants are free from any suspicion of infectious catarrh.

(7) Strict precautions must be taken in any place where infants are congregated to avoid the possibility of the spread of any infective enteritis. Soiled napkins must be immediately removed from the neighbourhood of the children and immediately disinfected. A careful routine must exclude the possibility of infection of the food with organisms derived from the stools.

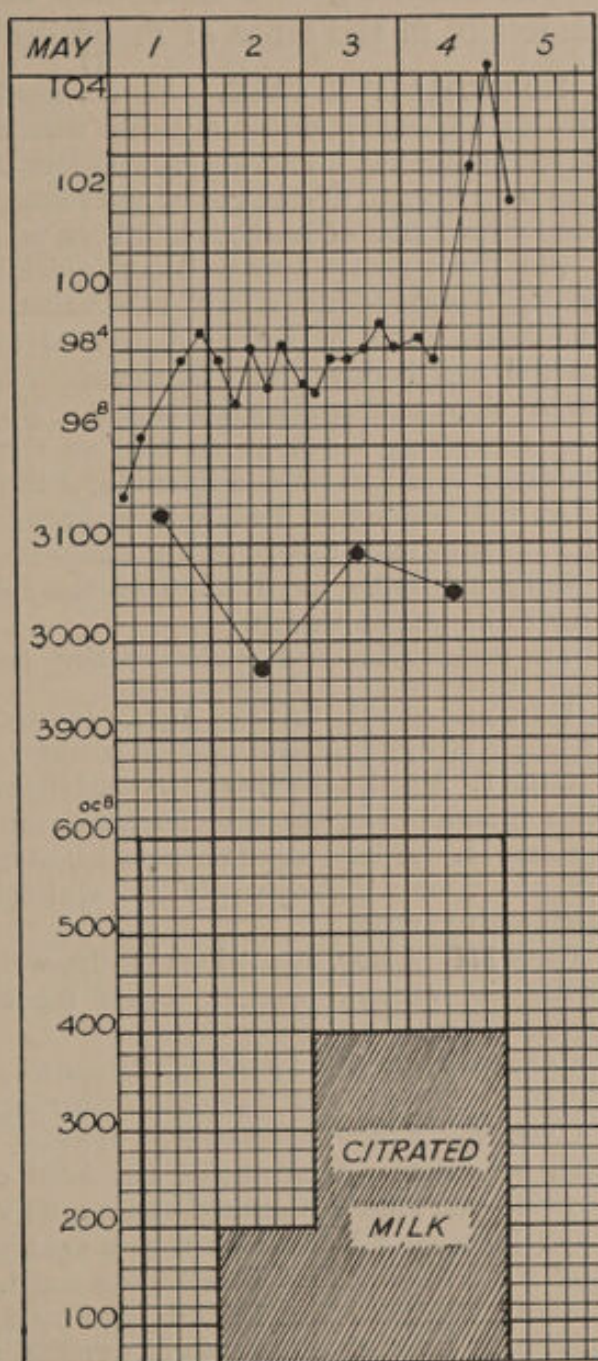


FIG. 9 shows the temperature curve and weight curve of an infant admitted with severe fermentative dyspepsia, which succumbed during convalescence to an acute pulmonary infection.

(8) Breast-feeding clearly offers the best prophylaxis against the risks of summer diarrhoea.

The following case illustrates well the risk of a terminal infection, in the sense of Pfaundler and Archambault.

ILLUSTRATIVE CASE. H. B., aged six months, was admitted to Guy's Hospital under my care with severe fermentative dyspepsia of long standing. The weight was less than seven pounds. The baby had been weaned at five weeks, and since then had been fed on sweetened condensed milk. Diarrhoea had been present intermittently ever since.

The chart shows how well and quickly the infant reacted to treatment. Twenty-four hours' starvation was followed by gradually increasing doses of milk. A formed alkaline motion was obtained on the fourth day. The temperature rose to the normal line. The infant slept well and ceased crying. No one doubted that the child was recovering when at 10 P.M. on the fourth day the temperature suddenly rose and sixteen hours later the baby was dead.

At the autopsy a little sticky mucus was found in the bronchi of the left lung, and the earliest possible broncho-pneumonia.

Cultivations by Dr. Eyre from the spleen and lung showed a pure growth of pneumococcus.

The infant admitted *ex alimentatione* had died *ex infectione*.

ILLUSTRATIVE CASE. Upon January 5 a small ward for infants at Guy's Hospital contained five inmates.

CASE I. A girl, aged two years and six months, weight 18 lb., admitted with spasmophilia, chronic diarrhoea, and pronounced indicanuria.

CASE II. A boy, aged six months, weight 9 lb. 2 oz., admitted with atrophy upon a diet of cow's milk which had reacted well to treatment with malted milk.

CASE III. A boy, aged nine months, weight 10 lb. 2 oz., admitted with dyspepsia, chronic eczema, otitis media, and bronchitis (exudative diathesis).

CASE IV. A girl, aged twelve months, weight 8 lb. 1 oz., a tiny, dwarfed child without digestive disturbance.

CASE V. A boy, aged twelve months, weight 8 lb. 6 oz., admitted with inanition. A neglected hand-fed child which had rapidly improved upon a diet of diluted cow's milk with added sugar.

On January 5 I caught a severe cold with a rise of temperature to 101° F., but continued to visit the ward. On January 6 Case II, on January 7 Cases I and IV, on January 8 Cases III and V, all became infected. In all there was slight pyrexia, and in Cases I, II, III, and V more or less marked loss of weight. Cases II and III, the younger infants, became seriously ill with marked diarrhoea. Case I lost much weight and became very prostrate. Before January 5 each had been convalescent and had been steadily gaining in weight for some time.

CHAPTER XVII

THE SPECIAL DIFFICULTIES OF ARTIFICIAL FEEDING IN THE FIRST MONTHS OF LIFE

DURING the first few weeks of life the difficulties of artificial feeding are especially great. An infant which has had the benefit of breast-feeding, even for a few months, acquires a stability of digestion which is often entirely wanting if artificial feeding has to be begun within a few days or weeks from birth. No doubt the majority of healthy infants can be reared upon the bottle with fair success. It is to be remembered, however, that a very large number of infants who are brought up by hand are weaned in the first instance not because the mother refuses to make the attempt to nurse her baby, nor because of her death or serious illness, but because the milk has been thought to be insufficient in amount, deficient in quality, or unsuitable in composition for the child. From what has been said in earlier chapters, it will be understood that it is only in the rarest instances that any one of these three assumptions has any real justification. In the later months of lactation the mother's milk, certainly, may be deficient both in quantity and in quality, and in that sense it may be said to be of unsuitable composition. In the early days of life, when there is delay in the establishment of secretion, or when the secretion, once established, again declines, the fault almost invariably lies in the impairment of the physiological stimulus to milk-formation, the sucking force of the child, so that the breast is not emptied regularly and efficiently. If the mother's nipples are well formed the failure of suction is nearly always due to some abnormality in the child. The disaster of being weaned seldom befalls a healthy baby. It is those already ailing who are threatened by the additional risks of removal from the breast. Infants who come into the world feeble and exhausted, with a want of vitality which is

apparently born with them ; infants suffering from the various forms of toxæmia of the newly born, with jaundice, for example, or melæna, or diarrhœa ; premature infants ; children with bronchitis and broncho-pneumonia, with pyelitis, tonsillitis, or umbilical sepsis ; children in whom difficult labour has resulted in some transitory cerebral lesion, or who suffer from atelectasis pulmonum or convulsions—all such run no small risk of being weaned and form ill subjects for attempts at artificial feeding. A second group is provided by children who have through faulty management developed dyspepsia and instability of digestion while still at the breast. If indigestion has resulted under these circumstances, the change to an artificial diet is more likely to aggravate than to alleviate the conditions. Infants who are mentally deficient, and that large group of infants whose neuropathic inheritance shows itself in continual screaming and fretfulness, are also apt to suffer weaning, often because mixed feeding has been instituted soon after birth in the attempt to assuage what has been regarded as an unusually vigorous appetite.

With such unsatisfactory material our attempts at artificial feeding have often to be conducted. Of inborn and inherited anomaly or weakness of digestion we know but little. One large group of cases in which there would appear to be a congenital weakness of digestion, and particularly an intolerance for fats, has been especially studied, under the name of the "Exudative Diathesis," by Czerny and others, so that in the last few years an enormous literature on the subject has grown up on the Continent and in America. Children who exhibit this diathesis are characterized by a faulty development even when fed on the breast or upon a suitable artificial diet, and by a tendency to suffer from acute exudative and inflammatory conditions of the skin—especially the scalp—and of the bronchial and intestinal mucous membranes. The exudative diathesis will be dealt with at greater length in a later chapter. It is mentioned here because it constitutes an attempt which has met with general acceptance to describe a constantly recurring and strongly marked type of inherited abnormality of digestion.

During the first few weeks of life, while many infants will thrive and give no ground for anxiety upon a diet of cow's milk, whether diluted or undiluted or modified so that its

percentage composition approaches that of human milk, not a few others will react with symptoms of alimentary disturbance. Much discussion has centred around the question as to which of the constituents of the milk constitutes the difficulty of digestion. At the present day the casein of the milk, which was for long regarded as the constituent at fault, is looked upon as the least harmful of all. On the other hand, a great deal of evidence has been accumulated to show that while infants at birth and for some weeks afterwards often have a high degree of tolerance for sugar, in many cases a comparatively low percentage of fat is sufficient to produce disturbance. The common experiences of everyday practice in this respect are, perhaps, explicable upon the assumption that the difficulty of digestion of milk is to be found in the density of the casein coagulum, but they are at least equally susceptible of the explanation that the main difficulty commonly lies in the presence of the fat. The vomiting which so often accompanies the use of cow's milk in very young infants is usually controlled by dilution with water, although to effect an improvement two or even three times as much water as milk may have to be used. In the second place, vomiting of milk is often controlled by a change from a fat-rich diet to one poor in fat but rich in sugar. The majority of proprietary foods owe their reputation to the circumstance, so often deplored, that they are commonly poor in fat, while their content of sugar is correspondingly high. No doubt their composition in this respect renders them quite unsuited to be the permanent diet of a child, yet it renders them peculiarly adapted to the temporary needs of a young infant in whom the digestion of fat is difficult. The malted milks, which are composed of a dried milk with a comparatively low fat content and a high percentage of added malt-sugar, are very often successful substitutes for cow's milk in this class of case. Among the poor the same may be said of the common brands of sweetened condensed milk. The mother who has, on her own responsibility and against all advice, substituted sweetened condensed milk for cow's milk, and triumphs in the result, has accidentally carried out just the therapeutic modification needed. It is, perhaps, interesting to note that the preparation of an unsweetened condensed milk has been commercially a failure, and that it seems impossible to foster any demand for it. No

doubt the comparative cheapness of the sweetened variety contributes powerfully to its popularity, but, even if there were no difference of price, I believe that the difficulty of fat digestion is so common that the fat-rich foods, such as the better brands of dried and condensed milks, will never earn the same reputation among the public, as foods for wasting or dyspeptic children, that is enjoyed at the present time by innumerable foods poor in fat and rich in sugar. In milk we have ready to hand a food rich in fat and casein. When milk disagrees, the substitution of a carbohydrate-rich food often allays the symptoms, but such success is due to the contrast and not, as the proprietors of patent foods claim, to any similarity in composition between the food and milk.

One further observation should be mentioned. Fat is relatively better borne in a protein-rich, sugar-poor mixture, such as cow's milk, than in one which contains a low percentage of protein and a high percentage of sugar, such as so-called "humanized milk."

In considering the difficulties of digestion of the very young infant, it is well to have in mind the possibility that the baby may thrive upon a diet of whole milk or that it may be best suited by a dilute milk with added sugar. The problem which again and again presents itself is so to manipulate the feeding that the change from the diet with insufficient fat to the diet with sufficient fat takes place as rapidly as is consistent with the development of the infant's power of digesting fat. For this task the use of so-called "humanized" milk offers peculiar disadvantages, because it combines a high content both of fat and sugar with a relatively low protein content. Such a mixture is not only peculiarly liable in itself to lead to dyspeptic disturbances, but it also adapts itself ill to the necessary adjustments in the fat content.

The diet chart on p. 127 may be used as a guide in the prescription of a diluted milk with added sugar for an infant from the day of birth.

The sugar added may be either cane-sugar or lactose or, perhaps preferably, such a mixture of maltose and dextrin as Mellin's Food, which contains about 50 per cent. of the former and 30 per cent. of the latter. Extract of malt may also be used.

As a diluent boiled water is usually best, but there are cases

	Number of feeds each day and size of each feed.	Total of milk <i>per diem</i> .	Total bulk of fluid <i>per diem</i> .	Dilution.	Total added sugar <i>per diem</i> .
Day 1 . .	Water only	—	—	—	—
„ 2 . .	6 × $\frac{1}{3}$ 3	$\frac{2}{3}$ $\frac{3}{4}$	$\frac{2}{3}$ $\frac{2}{4}$	M 1. W 2	$\frac{1}{12}$ oz.
„ 3 . .	6 × $\frac{1}{3}$ 6	$\frac{2}{3}$ $1\frac{1}{2}$	$\frac{2}{3}$ $4\frac{1}{2}$	M 1. W 2	$\frac{1}{12}$ „
„ 4 . .	6 × $\frac{1}{3}$ 1	$\frac{2}{3}$ 2	$\frac{2}{3}$ 6	M 1. W 2	$\frac{1}{6}$ „
„ 5 . .	6 × $\frac{1}{3}$ 2	$\frac{2}{3}$ 4	$\frac{2}{3}$ 12	M 1. W 2	$\frac{1}{3}$ „
„ 6 . .	6 × $\frac{1}{3}$ $2\frac{1}{2}$	$\frac{2}{3}$ 5	$\frac{2}{3}$ 15	M 1. W 2	$\frac{1}{3}$ „
„ 7 . .	6 × $\frac{1}{3}$ 3	$\frac{2}{3}$ 6	$\frac{2}{3}$ 18	M 1. W 2	$\frac{2}{3}$ „
Week 2 . .	6 × $\frac{1}{3}$ 4	$\frac{2}{3}$ 8	$\frac{2}{3}$ 24	M 1. W 2	1 „
„ 3 and 4 . .	6 × $\frac{1}{3}$ 4	$\frac{2}{3}$ 12	$\frac{2}{3}$ 24	M 1. W 1	1 „
Month 2 . .	6 × $\frac{1}{3}$ 5	$\frac{2}{3}$ 15	$\frac{2}{3}$ 30	M 1. W 1	1 „
„ 3 . .	6 × $\frac{1}{3}$ 5	$\frac{2}{3}$ 20	$\frac{2}{3}$ 30	M 2. W 1	1 „

in which thin barley water, freshly prepared twice daily, is preferable.

If undiluted milk without the addition of sugar or malt is used, one-third or one-quarter must be added to the amount of milk given. The figures indicate the quantity which as a rule may be given with safety.

Forsyth has rightly insisted that the amount of food should be adjusted by reference to the weight of the child rather than to the age. The following figures which he gives for cow's milk are generally lower than the amounts recommended above :

Weight of infant.	Amount of milk.	Fraction of body weight.
$6\frac{1}{2}$ lb.	$11\frac{1}{2}$ oz.	$1/9$
9 to 11 lb.	14 to $17\frac{1}{2}$ oz.	$1/10$
13 lb.	$19\frac{1}{2}$ oz.	$1/11$

The quantity of food, however, required by an infant depends upon so many varying factors, and not least upon the temperature of the atmosphere, that the amounts suggested can only be approximate. We should aim at supplying the smallest amount of food which achieves a satisfactory gain in weight.

On the appearance of the slightest sign of dyspepsia the amount should be substantially reduced, while the total intake of fluid is preserved at the same level by increasing correspondingly the amount of water drunk. In hot weather much less food is required than when the temperature is low. Babies with a thick layer of subcutaneous fat need less food than those which are thin and spare.

In the Table on p. 127 the amounts to be given during the first few days have been set out particularly and the total has been kept low. Recent work has emphasized the value of the colostrum-feeding of the first few days of life. The infant which is put to the breast during this time finds in the colostrum or first-formed milk a supply of immune substances which enables it to encounter without harm the bacteria with which it first comes into contact after birth. It is for this reason that if possible the child should be put to the breast during the first days of life, even if subsequent breast-nursing prove impracticable or inadvisable. In breast-feeding the amount of nourishment which the child receives and requires during the first days of life is very small. The especial importance of the colostrum milk is the part which it plays in the establishment of a normal bacterial growth within the intestine. At birth the infant's intestine is sterile. Within a few hours bacteria begin to appear, and within a few days the bacterial content is constant and definite. The bacteria are gram-positive, and consist predominantly of the *Bacillus lactis aerogenes*, the *Bacillus bifidus*, the *Bacillus acidophilus*, as well as the *Bacillus coli communis*, &c.—in all about nineteen sorts (Moro). If a diet of cow's milk, on the other hand, is given, the gram-negative bacteria predominate, owing to the free growth of the *Bacillus coli communis*. The implantation into the intestine of a normal bacterial growth is of the greatest importance to the child, and is of itself a great safeguard against an uncontrolled and one-sided development of any one group of organisms.

The septic infections of the newly born are often to be attributed to infection from the bowel by pathogenic organisms which have obtained a foothold in the intestinal tract, and later, having passed the barrier of the intestinal wall, give rise to a general infection (Czerny). Such deplorable accidents are not rare among breast-fed children, but they are more

common and their prognosis infinitely worse among those that are artificially fed. To diminish the risk of such an occurrence in artificial feeding, as in breast-feeding, the amount of nourishment given during the first week should be small and increase should be very gradual.

My own experience is not in favour of undiluted milk as a routine diet for infants under three months of age. I prefer to begin with such a dilute milk mixture as I have described. If all goes well in the third or fourth month, an attempt may be made to substitute one feed of whole milk for the diluted mixture and the result should be carefully watched. When the child is about four months old the change to whole milk can usually be successfully accomplished.

With milk which has been so modified that both the fat and sugar content have been raised to the comparatively high percentage found in human milk, I believe that the tendency to dyspepsia is unusually great. Every-day experience must convince us that no particular virtue lies in the mere closeness of the approximation of the percentages of protein, fat, and sugar to those of human milk, and that children may refuse to thrive except upon a mixture the chemical composition of which offers the most complete contrast to that of human milk. It is a very common thing to find that young infants in this country are given a mixture of diluted milk enriched both with cream and sugar. A common prescription for a young infant is as follows :

Milk	.	.	.	.	.	.	.	7 oz.
Water	.	.	.	.	.	.	.	14 "
Cream (20 per cent.)	.	.	.	.	.	.	.	2 "
Sugar	.	.	.	.	.	.	.	1 "

Such a mixture, while often digested with complete success, leads comparatively frequently to disturbances because of its high percentage of fat and sugar. It is especially dangerous when administered, as is frequently recommended, at intervals of two hours.

The chief safeguards in artificial feeding lie in the provision of long intervals between meal-times and in the use of a diet in the early weeks of life which has a comparatively low percentage of fat. If, however, a fat-rich diet is chosen, it should never be combined with a high percentage of sugar.

In keeping the fat content comparatively low in the first weeks of life there is no risk whatever that rickets will thereby be induced later in infancy.

If an infant fed upon a diluted milk with added sugar develops diarrhœa, the sugar must be omitted for the time being. Cane-sugar and lactose lead to diarrhœa more readily than malted sugar, and if the tolerance to the former is found to be small, extract of malt or a maltose preparation in similar amounts may be substituted. In other cases an early change to a whole-milk diet may prove entirely satisfactory.

If vomiting is troublesome even when a dilute mixture of cow's milk is given, treatment is sometimes more difficult. A milk with a lower fat content may be tried. The milk should be allowed to stand for six hours in a tall glass and the upper third rejected. A change to a diet consisting of a dried milk with added malted sugar in which the fat content is relatively low, or even to a sweetened condensed milk, is often successful. After a few weeks an attempt to prescribe cow's milk should be renewed and cow's milk restored in one after another of the feeds.

In all severe cases of vomiting twelve or twenty-four hours' starvation should precede the alterations in the diet, while at the same time care is taken that the need for fluid is fully met.

In the worst forms of intolerance for artificial food with profound prostration, loss of appetite, fall in weight, diarrhœa and vomiting, or syncope, the child's life may only be saved by breast-feeding.

CHAPTER XVIII

THE PREMATURE INFANT

IN the feeding of infants born before full time we are again often face to face with the difficulty that we have to deal with an infant that is already abnormal. Premature birth is always suggestive of congenital syphilis; often it is the expression of some toxæmia which has affected prejudicially both the mother and the child. In this way the cause of the prematurity profoundly affects the chances of life for the child. For example, while infants premature as the result of congenital syphilis show a high mortality, it is surprising how tenacious of life many infants are in whom the prematurity was the result of an accident, or when labour was purposely induced. For the same reason twin children born prematurely often do well.

It goes without saying that the chances of life are largely dependent on the extent to which the child is premature and upon the size of the infant at birth. Children under 3 lb. do not commonly survive, and under 4 lb. the mortality is very great. In infants over 5 lb. the mortality should be inconsiderable. The various manifestations of toxæmia neonatorum are more common in premature children than in those born at full time (*vide* chap. xxii).

For the premature child the value of breast-feeding is even greater than for the child born at full time. Unfortunately, it is just with these infants that satisfactory breast-nursing is most difficult to obtain. Not only have the mothers' breasts been called upon to fulfil their function at short notice, but in the majority of cases the premature infant lacks the power of efficient suction, upon which the successful establishment of the milk secretion depends. The premature child is commonly drowsy and torpid, and is content to lie passively throughout the whole day and night in an attitude curiously

reminiscent of that to which he became accustomed *in utero*. Under such circumstances the breast secretion is only too apt to fail. The small size and large surface area lead to a rapid loss of heat. The power of regulating the heat lost from the body is quite undeveloped, and unless special precautions are taken, the child may die as a direct result of exposure to cold.

To preserve the heat of the body the use of an incubator offers some advantages. The temperature of the air surrounding the infant can be controlled and recorded, and as the vitality increases it can be gradually and steadily lowered. On the other hand, the relative stagnation of the air in the incubator is prejudicial, and the risk of infection of the air passages is increased. The temperature, which may be 80° F. at first, should be gradually lowered.

A very constant temperature can be obtained by the use of three or four small hot bottles suitably disposed around the infant. These should be refilled one at a time at hourly intervals, so as to avoid any marked fluctuations in the temperature. The degree of heat provided must be that which suffices to maintain the rectal temperature of the child at the normal level, or a degree above it. Complicated garments, the adjustment of which involves the exposure of the child, should not be worn. A simple and effective plan is to envelop the child completely in cotton-wool. Bathing should be rapidly performed, and the child dried with a warmed towel. The skin of premature children is sometimes extremely sensitive, and in drying the child no friction of the skin with the towel should be used. All young infants, when being dried, should be enveloped in the towel, and any rubbing movement which takes place should be between the hand and the towel, and not between the towel and the body of the child. In infants under 5 lb. bathing is best omitted altogether for a week or two, and its place taken by a rapid sponging of the body, carried out without complete exposure. It is often recommended that the smallest infants should be smeared all over with olive-oil. It has been claimed that this serves a threefold purpose, preventing loss of heat, protecting the skin, and supplying small amounts of nourishment by direct absorption.

In consequence of the great loss of heat and the rapidity of

growth, the requirements of the premature child for food are very high. On the other hand, the suction of these tiny infants is so faulty that it is a matter of extreme difficulty to secure the proper and timely development of the secretion of milk in the mother's breasts. The breast-pump should always be used after the infant has sucked as much as possible, and the milk so obtained may afterwards be given to the child by means of a pipette. Even when the child is quite unable of itself to draw the milk from the breast and makes no attempt to lay hold of the nipple, the pump may for a time be sufficient to develop the secretion. The milk so drawn off is given to the child until the power of suction is developed. In a few cases it may be possible to put back to the breast for a few days an older child whose weaning is comparatively recent, overcoming any unwillingness on the part of the child by a few hours of starvation. Since prematurity of birth must always excite a suspicion of a syphilitic taint, the device of borrowing another older and more vigorous baby, though almost invariably successful, must only be resorted to after a careful examination. Unfortunately, it is a plan which in the nature of things can seldom be adopted outside a hospital. In cases otherwise hopeless the certainty that life may be saved by this means should avail to overcome a natural reluctance on the part of the mother. A case in which life was saved in this way is recorded on p. 101 (*vide* Fig. 7).

Premature children will not support inanition for many days, and where the breast proves refractory to the pump we may be forced to adopt mixed feeding, or even to wean entirely. The prognosis is thereby rendered considerably worse. Certainly in hospital practice the mortality among premature children who are fed artificially is very much greater than that which prevails among those nursed at the breast. Even where the hygienic conditions are faultless the mortality is higher. In these tiny infants the slightest symptoms of dyspepsia become of the most serious significance.

If artificial feeding is necessary, it does not appear that food of a character different from that suited to the needs of full-time infants is indicated. Success has been achieved upon all sorts of diet—upon foods rich in fat and poor in sugar and upon foods rich in sugar and poor in fat, with dilute milk, with whole milk, with peptonized milk, with dried milk, with

condensed milk, and with proprietary foods of all sorts. Although of more frequent occurrence and of greater severity, the difficulties encountered are the same as in infants born at full time.

A bottle with a nipple which runs more than usually easily should be chosen. When the child is unable to suck or to grasp the nipple at all, a pipette like the filler used for a fountain-pen must be used. Eight or ten meals should be given in the twenty-four hours.

Prolonged periods of apnœa usually usher in death. In premature children the medullary centres which control respiration and the act of sucking are apt to be insufficiently developed, and for some days neither may function adequately without constant stimulus. In such cases sclerema or scler-œdema of face and extremities is a frequent complication.

ILLUSTRATIVE CASE. An infant weighing $3\frac{1}{2}$ lb. was admitted to Guy's Hospital on the seventh day of life. The subcutaneous tissue of the legs and face was set hard as though frozen. No true œdema was present, and the limbs did not pit on pressure. A diagnosis of tetanus had been made because the jaw had become fixed, owing to the rigidity of the subcutaneous tissue of the cheeks. The mouth could hardly be opened. Respiration only proceeded when the child was held in the arms and stimulated by friction. If laid down, the breathing ceased and the child became cyanosed. During the unavoidable absence of the nurse for a few minutes, the child died in one of these periods of apnœa.

Such cases, even with constant care and watching, are in the nature of things almost always fatal. The child should be immersed in a hot bath and cold water dashed over him from time to time, while the thorax is rhythmically compressed. In this way the powerful stimulus to the respiration of the cold water is gained without any undue abstraction of heat from the body. Oxygen should be given freely.

The chief danger for premature children lies in the first few weeks of life. The ultimate prognosis is good. They show a greater tendency to develop rickets than children born at full time. As a rule all effects of prematurity will disappear in two or three years.

CHAPTER XIX

CONSTIPATION IN INFANTS

If by constipation is meant the lapse of twenty-four hours or more without the passage of a stool, then the symptom is comparatively frequent, especially among infants fed at the breast or upon a diet of undiluted cow's milk. If the bowels do not act regularly each day, mothers and nurses are apt to attribute to the omission a whole train of symptoms, such as restlessness and crying, painful defæcation and abdominal swelling. Constipated infants do not, as a rule, show these symptoms when they are under close observation in hospital practice, and the condition is compatible with undisturbed development.

Diagnosis. Before accepting the mother's statement that the child is constipated, and before prescribing purgative medicines, a few further inquiries should be made. Certain infants pass a large number of small stools at short intervals, others pass larger stools at intervals of twenty-four or even forty-eight hours. If the stool is of normal colour and consistency, or shows only the normal variations produced by different diets, and if the child is thriving in other respects, there need be, and should be, no interference. The breast-fed infant, when true constipation is present as a result of inanition, passes at infrequent intervals a stool which is drier and much more highly coloured than the "egg-yolk" normal stool. Sometimes it is not unlike the meconium which is passed in the earliest evacuations of the child, and it may be so pigmented that the mother describes it as "green." The baby fed upon a cow-milk mixture—especially one which is rich in casein, poor in sugar, and comparatively rich in fat—may pass hard, putty-like motions, which consist largely of earthy salts, as is apparent when the fatty matter is removed. Similar stools may sometimes be passed by constipated breast-fed infants

who show clear signs of the exudative diathesis and who fail to thrive even although the mother's breast is full of rich milk.

Further inquiry may show that although the complaint of constipation is made by the mother, the condition has been in reality one of mild dyspepsia. The motions of a healthy child should be passed so silently and with so little disturbance that the act commonly passes quite unnoticed by the mother or nurse. When dyspepsia is present, and there is excessive stimulation of the bowel-wall, during defæcation the child's body stiffens, the face flushes and becomes anxious, while the limbs may be thrown into a struggling movement of pain. This is often interpreted as straining at stool by the mother, and taken as evidence of constipation.

Causes and Treatment. If true constipation is present, the cause may be sought in any one of the following conditions :

(1) There may be constipation because the child is suffering from a real want of food. Such constipation from inanition is a marked symptom in cases of hypertrophic pyloric stenosis as well as in infants at the breast where there is deficient secretion. The stools are pigmented and often dry and crumbling. Sometimes they consist of little but pigmented mucus like meconium. Treatment can only be directed to overcoming the inanition.

(2) Constipation may be reflexly induced by anal fissure. Anal fissure is not infrequently met with in infants as a result of abrasion caused in cleansing the anus or, more frequently, in inserting the nozzle of an enema syringe. To detect such a fissure the child must be examined in a good light. He should be placed upon his back, with the legs fully flexed on the abdomen and the buttocks well separated. The wrinkled mucous membrane around the anus must then be unfolded on all sides in turn by pressure with the fingers, while each part so exposed is carefully wiped with cotton-wool. Treatment with orthoform or with a weak cocaine ointment is usually effective, but it is sometimes necessary to stretch the sphincter ani under full anæsthesia. During treatment an attempt should be made to ensure that only soft motions are passed. For this purpose the methods described in paragraph (5) may be employed.

(3) Constipation may be due to developmental malforma-

tions of the gut. In the majority of cases the constipation is then so profound that a condition of intestinal obstruction dating from birth proves rapidly fatal unless operative procedures are successfully undertaken. In a few cases a congenital narrowness of the anal orifice is said to cause constipation, and to be amenable to treatment by stretching. In later infancy Hirschprung's Disease or idiopathic dilatation of the colon may be already apparent.

(4) In mentally defective children, especially in cretins and Mongolian idiots, the rectal reflex is sluggish and constipation is often marked. In the former treatment with thyroid extract is alone effective.

(5) Many breast-fed infants who are receiving sufficient milk and thriving well are yet constipated. It is possible that the accurate adaptation of the food to the digestive capacity results in a deficient residue in the bowel. A teaspoonful of a paraffin emulsion flavoured with oil of peppermint, given two or three times daily, is often successful in producing a more frequent evacuation.

(6) Constipation in infants is most commonly due to defects in the composition of the diet. From what has been said in earlier chapters upon the ætiology of diarrhoea in infants, it will be readily understood that a diet in which there is a marked deficiency in sugar, and to a less extent a diet in which there is a marked deficiency in fat, lead especially to deficient stimulation of the bowel. The volatile fatty acids which are formed by bacterial activity from the sugars of the food are powerful stimulants both of the movements and of the secretions of the bowel. A teaspoonful of cane-sugar or a teaspoonful of olive-oil have long ago proved themselves efficient laxatives in infancy. A diet of undiluted milk, which tends to inhibit the activity of the acid-producing organisms and to determine an alkaline reaction in the bowel, is not infrequently accompanied by constipation. In feeding with cow's milk, constipation with the passage of soapy, putty-like stools is relatively common (*vide* p. 85, Plate IV). The use of barley-water as a diluent has the advantage that it helps to counteract the tendency to constipation. Similarly, although it has been stated that the effect of sodium citrate is to produce constipation, the pharmacological action of the drug would lead us to suppose that the exact opposite would be the case.

Sodium citrate has a mild action as a saline cathartic. Infants who have suffered from acute acid diarrhœa are apt to suffer during convalescence from obstinate constipation, perhaps because the bowel has become accustomed to the stronger stimulus of the acid contents, much in the same way as constipation is often seen to follow the use of purgatives. In many infants with chronic dyspepsia, constipation and diarrhœa may alternate in this way, and the resulting condition may be very difficult to treat satisfactorily.

Infants long accustomed to a diet in which carbohydrate predominates and infants with signs of the exudative diathesis, when a diet of cow's milk is prescribed, especially tend to become constipated and to pass soapy, putty-like, pale stools.

Constipation from faults in the diet may be controlled either by modifying the diet or by the use of tonic and mildly stimulating drugs. In no case should strong purgatives, such as the popular castor-oil, be permitted in the treatment of habitual constipation.

Whether the infant is fed upon breast milk or cow's milk, a single meal may be replaced by a few ounces of freshly prepared barley-water containing one or more teaspoonfuls of extract of malt. In older children one or more meals containing baked flour, or one of the numerous proprietary foods, which are composed for the most part of starch, may be given and the result watched. A few ounces of a strained vegetable soup, given daily, is often effective.

If drugs are used, the following prescriptions may be tried for an infant six months of age—given three times daily if necessary :

Tinct. aloes	.	.	.	.	℥ v
Sod. sulph.	.	.	.	.	grs. x
Tinct. belladon.	.	.	.	.	℥ i
Sennæ syrup	.	.	.	.	℥ xv
Aq. menth. pip. ad.	.	.	.	.	℥ i
S. Ft. Mist. t.d.s. p.c.					

or

Ext. casc. sagrad. liquid	.	.	.	℥ v
Ext. glycyrrhiz.	.	.	.	℥ v
Tr. nuc. vom.	.	.	.	℥ i
Tr. belladon.	.	.	.	℥ ij
Aq. destill.	.	.	.	ad ℥ i
S. Ft. Mist. t.d.s. p.c.				

As a rule it is wiser to regard habitual constipation, like vomiting and diarrhoea, as a delicate index of the suitability of the diet, to be corrected by making the necessary modifications in the food, and not to be masked by the use of powerful drugs. Enemas of soap and water, or of glycerine, should be given only with the utmost caution, because of the ease with which the delicate mucous membrane may be injured. A small cone of soap carefully inserted within the anus is often effective and much less likely than an enema to injure the mucous membrane. Massage of the abdomen in the direction of peristalsis along the line of the colon may help, or a warm compress applied to the abdomen regularly each day at the same hour. Habits of regularity should be encouraged early, and nurses are often successful in inducing a regular evacuation at an early age by holding the child in the position of defæcation at the same time every day. Not a few infants, however, resent the proceeding and respond to each attempt with struggling and crying, a result which has more than once in my experience been attributed by the mother to painful defæcation from constipation.

CHAPTER XX

RICKETS

OF the true nature and cause of rickets we are still very ignorant. All speculation must start from one clearly ascertained fact—that the bones of the rachitic child are greatly deficient in calcium salts. It is unlikely that this deficiency is primary and due to a deficient intake of calcium salts. In experiments with animals a diet poor in calcium does not produce rickets. It is more probable that the deficiency in the salt is secondary and due to defective absorption from the bowel. The suggestion that the fault lies in the inability of the cells to utilize calcium and to confine it in the bone is incapable of proof. We may discuss the predisposing causes under the following heads :

A. Diet and Dietetic Disturbances. There can be no doubt that faults in diet tend to produce rickets. Yet when we attempt to lay our finger upon the particular error which is most to blame we are immediately beset with difficulties.

In the first place, it is obvious that breast-fed children are relatively immune, and that the majority of cases of rickets occur either in bottle-fed infants or in children after partial or complete weaning from the breast. On the other hand, the majority of the more severe forms of alimentary disturbance show little tendency to produce rickets. Infants who exhibit the severer forms of atrophy, from a diet with gross excess of carbohydrates, for example, or from marasmus, do not as a rule show any marked sign of rickets. The atrophy which results from over-feeding with cow's milk (p. 83) is an exception to this rule, and infants with this type of atrophy show a tendency to develop rickets and spasmophilia. Both of these conditions are due to deficiency of calcium salts—in the one case of the bony, and in the other of the nervous

tissues. The characteristic stool, in which large amounts of calcium are excreted as phosphate or as soap, probably accounts for the depletion of the salt from the body. The view that rickets is commonly brought about by over-feeding with cow's milk, and especially by an early administration of undiluted cow's milk, is widely held upon the Continent at the present time. It would seem opposed to common experience in this country. Milk does not bulk largely in the diet of the rickety children of our large towns, and the opinion is commonly held that a deficiency of fat, perhaps also a deficiency in protein, is the most important ætiological factor in the production of rickets.

Most frequently, perhaps, rickets appears somewhat acutely in children of from nine months to a year, who have recently been removed from the breast and have suddenly been given a diet which hardly differs from that of their parents—a diet of tea, bread, biscuits, fish, vegetables, gravy, cake, and sweets. In some cases a few ounces of cow's milk may be given daily ; in others the breast continues to be offered freely though to little purpose, because the child, becoming accustomed to new and varied flavours, ceases to suck with the vigour and perseverance necessary to preserve a proper supply of milk.

For some time after weaning, cow's milk should form the staple diet. The sudden change from breast milk to a diet composed for the most part of starch and sugar is a common predisposing cause of rickets.

B. Faults of Hygiene. Rickets has been described as a "disorder of domestication." It is found in tame animals, not in those which have preserved their natural surroundings.

It is of infrequent occurrence and of milder degree among the children of the well-to-do, living in good hygienic surroundings ; while it is, of course, particularly rife in towns and among the poor wherever the housing conditions produce an unsatisfactory environment for a young child. High tenement dwellings, from which the rickety child finds egress almost impossible, are especially prejudicial. Findlay has shown in puppies the effects of lack of exercise and confinement in the production of rickets. Faulty hygiene in the widest sense—confinement to ill-lit and ill-ventilated rooms, over-

crowded with human beings, away from the sun and from exposure to the fresh and cold airs of the open country, clothing which is non-porous and excessive in amount, want of bathing, together with an irregular and unsuitable diet—these are the main factors at work. Under such unnatural conditions the metabolic processes of the child become depressed. As a result the bones grow soft, the muscles and ligaments flabby and relaxed. The loss of vasomotor tone is shown in the pallor and apparent anæmia, which yet readily at times gives place to a bright flush, and in the drenching sweats which are so characteristic. In such surroundings, too, the resistance to infections of all sorts is lowered, and rickety children, in consequence, are prone to suffer from a succession of catarrhs of the different mucous membranes of the body. Nasal catarrh, nasopharyngitis, bronchitis, and follicular enteritis are all of common occurrence.

C. Heredity. An hereditary tendency towards rickets has been asserted by numerous writers.

D. Premature Birth. Prematurity is a strong predisposing cause of rickets.

The tendency of the premature child to develop rickets may be explained by the fact that the calcification of bones proceeds most rapidly during the later months of intra-uterine life, and that the child, born before its time, comes into the world with a markedly deficient store of calcium. In practice the frequency with which premature children develop rickets later in life is very marked.

Symptoms. For a full description of the bony changes characteristic of advanced rickets—epiphysial enlargements, craniotabes and other deformities of skull, malformation of teeth, palate, jaws, spine, pelvis, and limbs, &c.—reference must be made to the text-books on diseases of children.

The musculature is badly developed, the ligaments of the joints are weakened and stretched and permit of abnormal mobility. The nervous system is often affected. The child is abnormally excitable, and the presence of a doctor or other strangers is resented with passionate crying. The restlessness and fretfulness often give the mother the erroneous impression that the bony deformities are painful. Formerly the symptoms described under the heading of spasmophilia, laryngismus, tetany, eclampsia, facial irritability, &c., were included in the

description of rickets. Although it is probably better to give separate consideration to each, nevertheless the combination of rickets and spasmophilia in the same child is extremely frequent. Bronchitis and enteritis are to be regarded as complications of rickets rather than as constituting part of the usual clinical picture.

Special attention should be paid to the prodromal symptoms which often precede the development of pronounced bony deformities. Among these the instability of the nervous system is prominent. Restlessness, fretfulness, broken sleep, are usual symptoms. Often the mother complains that there is something the matter with the child's head—that he bangs it restlessly to and fro or tries to bore it into the pillow. The vasomotor instability shows itself in the readiness with which the child flushes and breaks out into perspiration. A fit of crying may be followed by profuse sweating. Especially in sleep the child's head is apt to be covered with perspiration, so that the pillow may literally be soaked with moisture. Pressure upon the skin produces erythematous marks which persist for a long time. Sometimes a true dermatographism may be demonstrated. In children who have begun to stand or walk there is a notable decline in activity, and they lose the power and apparently the desire to perform movements in which they formerly took an obvious pleasure.

Dietetic Treatment. In different countries and in different grades of society an inquiry into the previous diet of rickety children will produce very different results. In some cases a diet which consists too largely of milk, to the exclusion of all forms of farinaceous food, may be found. We shall then do well to accustom the child gradually to the consumption of vegetable and cereal foods. For a child of a year old, a vegetable soup, made from carrots, potatoes, spinach, tomatoes, &c., and thickened with flour, may be given daily, or well-cooked vegetables may be mashed and beaten up into a paste with a little milk and a pinch of salt added.

Milk puddings—cornflour, sago, semolina, rice, &c.—should be given freely. Meat-juice and the juice of such fruit as grapes or oranges are useful, or part of a baked apple beaten into a froth, with a little added sugar.

In younger children of from six months to a year some part of the milk may be replaced by the addition of a cereal food.

Among the poor inquiry will usually show that the amount of milk is insufficient and not excessive. Breast-nursing prolonged after the child is nine or ten months of age and has begun to take other articles of food should be stopped, and a definite amount of cow's milk, usually about one and a half pints, given instead. Sweetened condensed milk should always give place to cow's milk.

Treatment by Drugs. Everyone is agreed as to the great value of cod-liver oil in rickets. It may be given in doses of a teaspoonful two or three times a day. Only a few children show a strong distaste for it. Numerous experiments have proved the increased calcium retention which results from its use.

Hygiene. If a temporary removal of the child to the seaside is impossible, every effort must be made to improve the hygiene of the child's surroundings. He should sleep in the open air during the day, and at night-time there should be a thorough ventilation of the sleeping-chamber. It should be the aim to keep the temperature of the room at about 60° F.

The bed-clothing should be light. A flannel nightdress should be worn, reaching well below the feet and fastened by buttons at the lower end. Rickety children often discard the bedclothes at every opportunity, and even draw up the nightdress to expose as much of the body as possible. The mattress should be hard and unyielding, and there should be no bolster.

The good effect of tepid bathing upon the unstable vasomotor system is often very marked. Bathing should be begun at a temperature of 80° F., and this should be gradually lowered one degree at a time to 70° or even lower. From the first the arms and legs may be douched with salt water at a temperature of 60° F. and afterwards rubbed into a glow with a warm towel.

Correction of Deformities. Until the bones have ossified into a faulty position much may be done to correct deformities by manipulation. Later, when ossification has taken place, osteotomy alone can avail. An X-ray photograph will be of considerable help in assisting us to decide whether or not there is likelihood of recovery by manipulation alone.

Fig. 10 shows the skiagram of an infant twelve months old with very severe deformity of the tibia and fibula. The area

of decalcified bone is very obvious. The photograph is also interesting as showing that all the bending takes place in the non-calcified area, and that the angle is much more acute

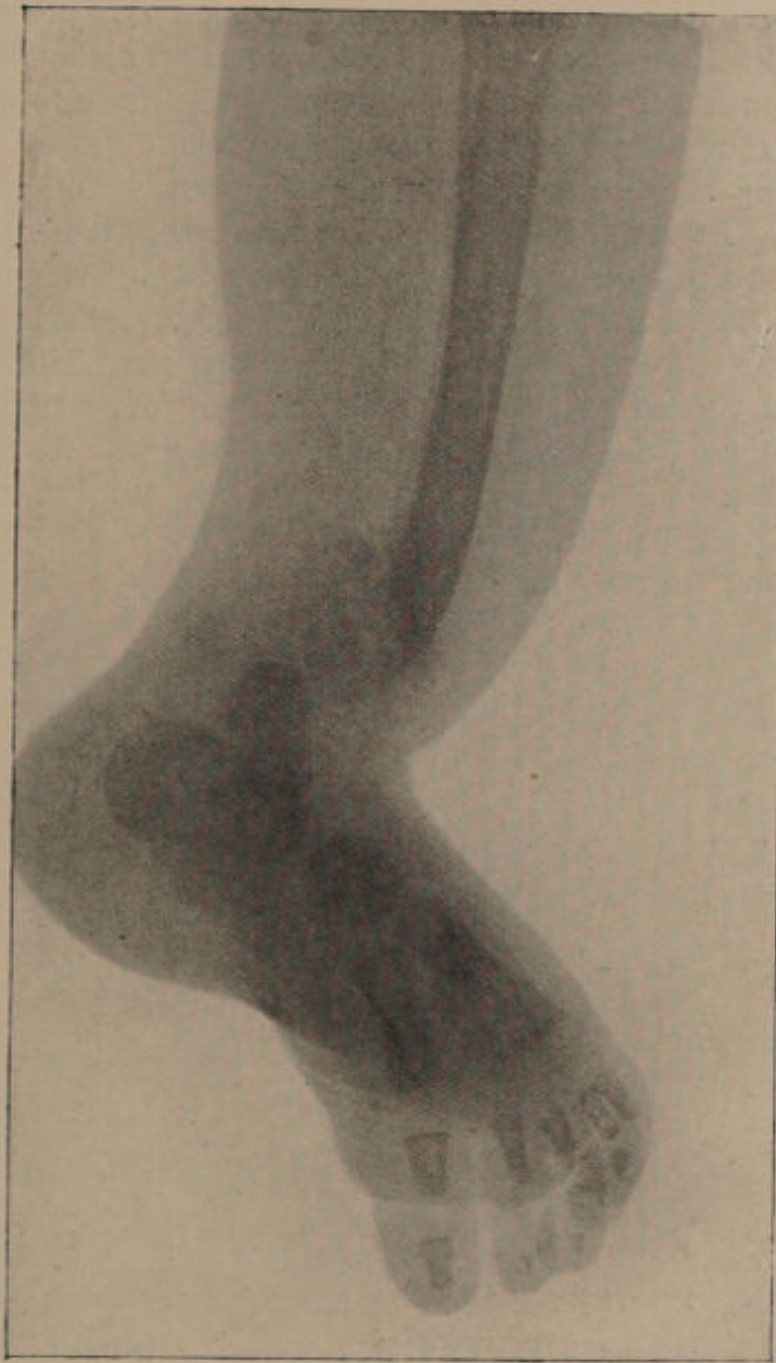


FIG. 10.

A radiogram of the lower part of the leg of a rachitic child, twelve months of age. The area of imperfect ossification at the lower end of the tibia is well shown. In this area the bone is expanded and its sharp outlines are obliterated. All the curving of the leg has taken place within this unossified area.

than would appear from inspection of the legs. In this child at the age of three all deformity had disappeared. The measures described above were carried out daily, and in addition the mother persevered in the attempt to correct the deformity by exercising steady pressure on the bone in the proper direction. No splints were worn, and although walks of any length were forbidden, no attempt was made to interfere with the movements of the child.

Splinting the limbs is as a rule unnecessary and not very effective. In very severe cases, if it is felt that it is necessary to prevent the child standing or walking, it is better to make a well-fitting plaster-bed upon which the child may be carried from room to room and out into the open air. The plaster-bed is curved so as to correct any rickety curvature of the spine which exists, while it leaves the limbs free for all movements.

CHAPTER XXI

SPASMOPHILIA

IN infancy and early childhood convulsions are relatively of such frequent occurrence that for a long time they were regarded as physiological, the result of a deficiency in cerebral control which disappeared with the lapse of time.

CLASSIFICATION OF CONVULSIONS IN INFANCY

In the light of our present knowledge we must regard all forms of infantile convulsions as pathological in nature. We may make the following classification :

I. *Eclampsia Neonatorum.*

(a) Of infective origin.

A general infection of the newly born, as a rule of intestinal origin (*vide* p. 157), is not uncommon ; other manifestations of a similar infection are icterus neonatorum, the hæmorrhagic disease of the new-born, and profuse septic diarrhœa and enteritis.

(b) Of traumatic origin, usually associated with difficult labour. Extravasation of blood under the pia mater is commonly found *post mortem*.

II. *Symptomatic Convulsions.*

Such convulsions are apt to occur at the onset of infective and pyrexial disorders, such as pneumonia, measles, &c. It is probable that symptomatic convulsions occur most readily in children with latent spasmophilia.

III. *Convulsions due to local disease of the brain, such as encephalitis or meningitis.*

IV. *Convulsions due to epilepsy.*

V. *Convulsions due to spasmophilia.*

From among the convulsive disorders in infancy the last group stands out sharply defined.

Spasmophilia is characterized by a definite and measurable increase of irritability in the peripheral nerves, an increase which is dependent upon faults in the dietary. The symptoms which are referable to this exalted excitability of the nervous system were formerly included in the description of rickets. They are perhaps better described under the separate heading of spasmophilia. Although spasmophilia and rickets frequently occur in the same subject, in many other cases one or other group of symptoms alone is prominent. The connexion between the two disorders is due to a common ætiology—a deficiency of calcium salts in the body. In rickets the loss falls upon the bones, in spasmophilia the symptoms are due to the depletion of the nervous tissues. It is known that calcium salts exercise a depressing effect upon the excitability of all nervous tissue, and analysis of the brain and spinal cord of infants with spasmophilia has shown a deficiency of the salt. A similar diminution in the calcium content of the brain occurs in animals after extirpation of the parathyroid glands. The part played by the parathyroid in the production of spasmophilia must at present remain doubtful. It is certain, however, that faults in the dietary and digestive disturbances are of great importance. The symptoms are unknown in breast-fed infants, and in the artificially fed they rapidly improve when the child is returned to the breast. Further, the more severe symptoms can usually be made to disappear by starvation for twenty-four or forty-eight hours.

Finkelstein has demonstrated that cow's milk, and particularly the whey of cow's milk, is capable of inducing the return of the symptoms in susceptible cases. The large excretion of calcium by the bowel in infants fed upon cow's milk—an excretion which may even exceed the amount ingested in the food—accounts for the deficiency of the salt, and the most successful line of treatment is found in the temporary exclusion of cow's milk from the diet.

Heredity plays a considerable part in the production of spasmophilia. For this reason Finkelstein speaks of a "spasmophilic diathesis." The recurrence of the disorder in several generations has been frequently recorded. A seasonal variation is marked: severe cases occur most commonly in the late winter and spring.

The condition is unknown in the first months of infancy.

It becomes frequent in the second six months of life, and is common throughout the second year of life. Cases persisting into the third and fourth year have been recorded—*spasmophilia tarda*.

THE SYMPTOMS OF SPASMOPHILIA

It is usual to divide the cases of spasmophilia into two groups—those in which the symptoms are said to be latent and those in which the symptoms are said to be manifest. Among infants fed entirely upon an artificial diet latent spasmophilia is extremely common. Further, in a case of latent spasmophilia comparatively trivial causes are sufficient to produce the symptoms of manifest spasmophilia—as, for instance, a transitory digestive disturbance, or a feverish cold.

The Symptoms of Latent Spasmophilia.

- (1) Erb's phenomenon.
- (2) Trousseau's phenomenon.
- (3) Chvostek's phenomenon.

(1) Erb's phenomenon is the most characteristic symptom of latent spasmophilia. Its presence is necessary to substantiate the diagnosis. All the other symptoms are variable; the increased excitability of the peripheral nerves to the electrical current is invariably present.

In normal infants the median nerve responds to stimulation as follows (Thiemich and Mann). The figures represent the minimal current necessary to produce contraction of the muscle:

K.C.C.	=	1.41	milliamperes
A.C.C.	=	2.24	"
A.O.C.	=	3.63	"
K.O.C.	=	8.22	"

A child with spasmophilia may show the following results:

K.C.C.	=	0.7	milliamperes
A.C.C.	=	1.5	"
A.O.C.	=	0.95	"
K.O.C.	=	2.23	"

A positive Erb's phenomenon consists of a K.O.C. less than 5 ma., while A.O.C. is less than A.C.C.

(2) Trousseau's phenomenon is much less constantly present. It consists in the production of tetany by encircling the arm above the elbow with a tight india-rubber tourniquet. The pressure must often be continued for some minutes, and be sufficient to cause cyanosis of the hand.

(3) Chvostek's sign of facial irritability is more frequently met with. It consists in the production of a visible contraction or twitch of the facial musculature when the facial nerve is stimulated by direct percussion with a suitable hammer. The face should be lightly struck over the canine fossa under the malar bone, while the corner of the mouth and the angle of the eye are watched for the resulting twitch. With a little practice the phenomenon can be elicited in a very large number of artificially fed infants.

Infants with latent spasmophilia are often violently excitable. Uncontrollable fits of crying and temper are common, during which there may be some spasm of the larynx. The children are said to hold their breath. Examination by the doctor is often furiously resisted.

The Symptoms of Manifest Spasmophilia.

- (1) Pyrexia.
- (2) Tetany.
- (3) Laryngo-spasm.
- (4) Eclampsia, or Infantile convulsions.

(1) In manifest spasmophilia there is often slight pyrexia. This pyrexia is not, of course, produced by the tetany, the laryngo-spasm, or the convulsions. It is due to some pyrexial disorder the presence of which has sufficed to convert the latent into the manifest form of the disorder.

(2) Tetany, or Carpopedal spasm.

The hands, and much less frequently the feet, are held stiffly in the form of a cone. In the hand the fingers are pointed and the thumb adducted—the so-called accoucheur's hand. The elbows and wrists are usually flexed, while the arms are held across the chest in the position like that of a dog begging. The spasm is intermittent. The condition apparently gives rise to pain of considerable severity. In severe and long-continued cases some œdema of the back of the hand or the foot is often seen.

(3) Laryngo-spasm.

Infants with spasmophilia are liable to severe attacks of laryngeal spasm. The breath is held and a long expiratory pause ensues. During this apnœic phase the face becomes congested and suffused. Slight twitching of the facial musculature may occur, or a generalized convulsion be induced. After a shorter or longer time the spasm suddenly ceases, and the air rushes into the chest with a curious whoop-like sound not unlike that of pertussis. The face then flushes pink and breaks out into profuse perspiration. Although it is only in rare instances that the attack is fatal, yet laryngo-spasm is by far the most common cause of sudden death, otherwise unexplained, in infants of from six months to a year. Death is frequently attributed erroneously to overlying, to suffocation from the pressure of pillows or bed-clothes, to fright, or even to pet animals which are thought to have lain on the child so as to have obstructed its breathing.

In other cases the spasm is persistent, and when the child is disturbed every inspiration is accompanied by a noisy stridor.

Laryngo-spasm is usually seen in children who are very fat and heavy, whereas eclampsia is more common in thin children.

The attacks are usually brought on by some stimulus such as a fit of crying, or by the taking of food.

(4) Eclampsia, or Infantile convulsions.

The most common of all the manifest symptoms of spasmophilia are convulsive seizures which do not differ in form from the epileptic seizures of later life.

A tonic stage precedes the clonic. In some cases they are preceded by an attack of laryngo-spasm which culminates in eclampsia. The attacks may be repeated at short intervals, so that a condition like that of status epilepticus results. A repetition of the seizure can often be provoked if the child is stimulated in any way, by undue handling or in the course of an examination.

Diagnosis. Chvostek's sign of facial irritability is nearly always present, and demonstrates the true nature of the convulsions. Spasmophilic convulsions are the common form of eclamptic seizure in infancy. With true epilepsy they have nothing whatever to do. True epilepsy is rare in infancy. Spasmophilia does not occur in the newly born or in breast-fed children.

PROGNOSIS

Save for the danger of a fatal laryngo-spasm, the prognosis is good as compared with that of convulsions which are due to trauma, toxæmia, or cerebral disease. If the condition is neglected or unsuitably treated, however, and the eclamptic seizures are frequent and of great severity, permanent damage may be done to the child's intelligence and intellectual powers. Very persistent cases which have been sent to me have often come with the suggestion that the child is mentally deficient or the subject of congenital or acquired cerebral defect. Neuroses, however, are more to be apprehended than sheer mental deterioration, and the mental exhaustion which ensues, if the fits are frequently repeated, tends to disappear quickly with their cessation.

As a rule all the manifest symptoms—tetany, laryngo-spasm, and eclampsia—are transitory, and disappear of themselves even without special treatment. Rarely the condition is severe and, unless radically treated, persists for many months, as in the following case :

ILLUSTRATIVE CASE. T. C., aged thirteen months, was sent to me on September 9, 1913, with the following letter from his medical attendant. He had been reared on cow's milk :

"T. C., seen on June 25, 1913, was then ten months old. At three months of age he was pitched out of a perambulator ; was quite well up to seven months old. On March 10 he had his first fit ; on March 24, seventeen fits ; on June 20, thirteen fits. In a fit his face is very much congested ; he has convulsive movements, afterwards twitching at the mouth, and then sleeps. I saw him on June 25 in two slight attacks. The second was ushered in by a bright redness of the face. The eyes turn concomitantly. He has suffered from vomiting all the time he has been ill. He has wasted a good deal lately. He is very constipated. Hands present flexion like that of tetany. His extremities get cold very easily."

The writer went on to say that he had seen a consultant three months before, who was of opinion that the child was suffering from cerebral maldevelopment, which would result in idiocy, and that there was no hope of improvement. A milk diet had been continued since, and fits had been of daily occurrence.

On examination the child was seen to be very emaciated. The hands were held permanently in the position of tetany. There was no paralysis, and the limbs were not rigid. The face was expressionless and immobile, and the child took no notice of his surroundings. Laryngo-spasm and general convulsions could be produced at will by any strong stimulus, such as pinching the skin. An attempt to feed the child

always resulted in a severe attack, during which vomiting took place, apparently from pharyngeal spasm. The temperature was subnormal; Chvostek's sign was marked and Erb's phenomenon present.

Chloral was given per rectum freely. For twenty-four hours the child received water and saline solution per rectum. For eight days no more milk was given, but a cereal food, extract of malt, and cod-liver oil made up the diet. After eight days one half-pint of milk was allowed daily. On the fourth day the fits, which had numbered about twenty a day, ceased, and expression began to return to the face. After seventeen days—on September 26—the child was sent home.

The same diet was continued with the addition of meat-juice and, later, of milk puddings.

On December 16 I saw him again in his home. He had had slight fits on November 8 and 14, when he had an attack of bronchitis, but was otherwise greatly improved.

His intelligence was rapidly improving, and he had begun to sit up. The tetany still persisted intermittently, with some oedema of the dorsum of the hand.

I have recorded this case at length because it shows well the symptoms and course of spasmophilia of great severity. Such serious cases are, of course, comparatively rare.

THE TREATMENT OF SPASMOPHILIA

Dietetic Treatment. The signs of spasmophilia, latent and manifest, rapidly disappear if the infant is placed on the breast.

Further, a period of twenty-four hours' starvation will usually cause the manifest symptoms to disappear.

Cow's milk should only be given in relatively small amounts—as a rule, not more than one half-pint a day. In severe and persistent cases of manifest tetany it must be altogether excluded for some days. Longer than eight days the infant must not go absolutely without milk.

The milk may permanently be replaced in part by a cereal diet—of dextrinized flour, for example—with the addition of vegetable soups, fruit-juice, meat-juice, rusks, extract of malt, and cod-liver oil. The last, as in rickets, is very useful and should always be given. Where the digestion of carbohydrates is at fault and fermentative diarrhoea is readily produced, the difficulty of steering a proper course is considerable. In such cases a larger amount of milk and less carbohydrate must be allowed, since the drawbacks and

dangers of spasmophilia are less than those of neglected dyspepsia.

Symptomatic Treatment. The sudden appearance of the symptoms of manifest spasmophilia is usually provoked by alimentary disturbance.

A purgative of constant action—castor-oil, for example, in doses of two or three teaspoonfuls—should always be given, and the bowels thoroughly emptied. In all cases of convulsions, laryngeal spasm and tetany, chloral and calcium bromide are the drugs most to be relied upon. They are usually best given in a 4 oz. rectal injection containing, for a child of a year old, about 4 grains of chloral and 4 grains of calcium bromide. The injection may be repeated in one or two hours, if necessary.

In all cases it should be the endeavour to avoid all unnecessary handling and movement of the child. Repeated examination should be avoided because they tend directly to provoke the spasmodic attacks. In persistent and repeated convulsions a hypodermic injection of morphia, $\frac{1}{60}$ th of a grain for a child a year old, is preferable to chloroform inhalations because the effect is less transitory and the necessary handling shorter and less irritating. Magnesium sulphate, 20 c.c. of an 8 per cent. solution, is recommended for hypodermic injection. Lumbar puncture is said to be sometimes effective in repeated attacks.

In laryngo-spasm, if the spasm is long continued, the parents or nurse must be taught to hold the jaw forward and to draw out the tongue. In the event of a serious cessation of respiration cold water should be dashed on the face and chest while artificial respiration is carried on unceasingly.

If a pyrexial attack has provoked the symptoms and the temperature remains constantly at a high level, tepid sponging should be employed and the bed-clothes raised on a cradle until the temperature falls.

CHAPTER XXII

THE TOXÆMIAS OF THE NEWLY BORN

THE SOURCE OF THE INFECTION

IN speaking of the artificial feeding of infants in the first week of life, mention was made of the risk which the newly born child runs of suffering from a generalized septic infection, the source of which is perhaps usually found in the absorption of organisms from the alimentary canal.

The infant nursed at his mother's breast enjoys in these early days a twofold protection which is lacking in the artificially fed child. In the first place, he derives from the colostrum a supply of immune bodies which are capable of conferring protection until the development of his own defensive powers; and in the second place, the bacterial growth in the intestine tends to establish itself in a constant and well-controlled manner, and the change from the sterility which obtains at birth to the fully developed bacterial picture is accomplished normally and without disturbance.

In the intestine of the artificially fed child matters may not proceed so smoothly, and in the absence of the antagonism of the normal bacterial content pathogenic organisms may gain a foothold and develop with dangerous speed.

Especially is this the case in premature infants, and it is common experience that the various manifestations of the toxæmias of the newly born—*icterus neonatorum*, *eclampsia* and *trismus neonatorum*, *melæna neonatorum*, and *septic diarrhœa*—are all more frequent in children born before full time. The explanation of this predisposition lies partly in the increased vulnerability of the intestinal wall, which acts as a less efficient barrier to bacteria and their toxins, as experiments by Czerny show, partly in the circumstance that a premature child is often saturated with the syphilitic or other toxin, and partly, perhaps, in the more frequent failure of

breast-nursing. At any rate, it is certain that prematurity is itself a strong predisposing cause of sepsis, and that syphilitic infants are especially liable to suffer severely.

Although the alimentary canal is probably the chief source of infection, it is not the only source. A generalized infection may take place from disease of the respiratory or urinary tracts or from lesions of the skin* or umbilicus. In many cases, however, it is probable that the infection of the umbilicus arises secondarily to the generalized infection and is not the primary source of the trouble.

It is more doubtful what part is played by infection of the mother and maternal sepsis in general. The care of the newly born should be marked by scrupulous cleanliness.

THE SYMPTOMS OF THE TOXÆMIAS OF THE NEWLY BORN

The symptoms are of very varied character. Although, for the sake of clearness, they will be described separately, in actual practice they frequently occur in various combinations. Bühl's disease and Winckel's disease, which to-day still find a place in the text-books of children's diseases, are now of historical interest only. They do not represent independent specific disorders, but particular combinations of toxic manifestations which were prominent in the cases and epidemics described.

ICTERUS NEONATORUM

The Symptoms. Icterus neonatorum in mild degree is so frequent that it has sometimes been claimed as a physiological rather than a pathological symptom. It commonly appears upon the second or third day of life, and in mild and uncomplicated cases—and these are an overwhelming majority—declines during the second week.

In rarer cases the icterus is combined with other and more grave symptoms—profuse and septic diarrhœa, eclampsia, or

* The vernix caseosa, which has protected the skin of the foetus from maceration in the amniotic fluid, should be removed with the utmost care. Friction is apt to separate the superficial layers of epithelium and thus to afford an inlet to micro-organisms. Pemphigus and erythrodermia desquamativa are probably produced in this way.

hæmorrhage. There is then profound toxæmia, often with high pyrexia and coma. It is probable, although not proved, that all icterus neonatorum, even when of little severity, is due to infection.

The Diagnosis. Icterus neonatorum is to be distinguished from the severe and progressive jaundice which accompanies congenital obliteration of the bile ducts, or syphilitic cholangitis. In the first case the absence of other manifestations of toxæmia neonatorum, combined with a very severe grade of jaundice, persisting from the first few days of life and giving rise to clay-coloured stools, is sufficient to suggest the true diagnosis. In syphilis other characteristic symptoms are likely to be present. When jaundice is due to infection from the umbilicus and extension by the umbilical veins to the liver, there is usually a marked local reaction at the umbilicus.

The Prognosis. Of all the forms of toxæmia of the newly born, that which is marked only by uncomplicated jaundice offers the best prognosis. The mortality in such cases is trivial.

The Treatment. In breast-fed infants no treatment is necessary in uncomplicated cases. In bottle-fed infants food should be sparingly administered for some days, while water flavoured with saccharin is given freely.

ECLAMPSIA NEONATORUM

The Symptoms. A less usual form of toxæmia is seen in cases in which the symptoms are confined to the nervous system.

Unrest, rigidity and spasticity of limbs, trismus, frequently repeated twitchings of the limbs and of the face and eye muscles, or actual convulsions, are prominent symptoms.

A light tap on the child's breast will often produce a general twitch of the whole body.

The rigidity of the facial musculature gives a fixed, expressionless appearance. Often the jaws are fixed as in true tetanus.

The Diagnosis. The condition has to be distinguished from convulsions of the newly born due to trauma. In these, paresis or paralysis of face or limb, the history of a difficult and prolonged labour, bruising and ecchymosis of the scalp or eyelids, or other injury, may suggest the correct diagnosis.

In convulsions due to toxæmia a degree of icterus is often present at the same time.

Premature children suffer often from toxæmia, seldom from trauma. Convulsions due to spasmophilia—that is to say, the usual convulsions of infancy associated with a faulty dietary and often with rickets—never occur at birth and hardly ever in breast-fed infants. Even when trismus is the prominent symptom, the condition is seldom due to true tetanus. In doubtful cases a smear from the umbilicus must be examined for the tetanus bacillus.

The Prognosis. The immediate prognosis, though less uniformly favourable than that of uncomplicated icterus, is still good.

Only in severe cases with persistent convulsions, high pyrexia, and unconsciousness need there be fear of death. Cases in which convulsions come on after an interval of some days are of better prognosis than those which begin soon after birth, presumably because the infection is less violent and more controlled.

The ultimate prognosis is perhaps more doubtful. It is certain that psychical disturbances and epilepsy develop with greater frequency in infants in whom there were convulsions at birth.

The Treatment. The infant should be kept under the influence of chloral for some days. Doses of one-half or one grain may be given every two or three hours by mouth, or double doses by the rectum. A hot pack is often soothing.

Meanwhile the child should be kept very warm and, if artificially fed, water, sweetened if necessary with saccharin, given freely, while food is only given in minimal amounts until the cessation of the convulsions. All unnecessary handling of the child should be avoided and he should lie quietly in a darkened, silent room.

MELÆNA NEONATORUM

OR THE HÆMORRHAGIC DISEASE OF THE NEWLY BORN

The Symptoms. Septic bleeding in the majority of cases takes place from the bowel only. With more profound toxæmia, hæmatemesis, purpura, vaginal bleeding, or oozing from the umbilical cicatrix and from other accidental wounds

of the body may all occur. Melæna is said to be found in about one case in every thousand infants. Infants with congenital syphilis show a well-marked tendency to suffer from this type of disorder.

ILLUSTRATIVE CASE. A premature infant born in the out-door practice of the Midwifery Department of Guy's Hospital was brought to the Out-patient Department on the ninth day of life. Melæna had begun three days before. Because of the comparatively long interval between the birth and the hæmorrhage a comparatively hopeful prognosis was given. The temperature was normal. There was no jaundice, convulsions had not occurred, and diarrhœa was absent. Three days later a profuse syphilitic eruption appeared, and the infant died a week later.

The Prognosis. The prognosis is always grave. Probably about 50 per cent. of cases in which melæna is the only symptom survive. With hæmorrhage from other sources as well, the condition is usually fatal. If syphilis is present the prognosis is well-nigh hopeless. Prematurity also greatly diminishes the chances of recovery. If an interval of some days intervenes between the birth and the hæmorrhage, the prognosis is better. High pyrexia, coma, convulsions, jaundice, and diarrhœa indicate a severe and probably fatal toxæmia.

The Diagnosis. True melæna must be distinguished from melæna spuria, in which blood is swallowed from a "cracked" nipple. Hæmophilia occurs in male infants, although the condition is one of great rarity. A family history of the condition is always obtained. A slight blood-stained discharge from the vagina is not uncommon in female infants and is without significance.

Intussusception does not occur in the newly born.

The Treatment. Five c.c. of fresh horse serum should be repeatedly injected subcutaneously, or 20 c.c. of Merck's gelatine. The site of injection should be painted with collodion to control oozing from the spot. Striking results are recorded from the transfusion of human blood into a vein. Bleeding from the umbilical stump should be dealt with by touching the cicatrix with the actual cautery, or it may be painted with strong adrenalin solution or with horse serum applied locally. In bleeding from the vagina, from the nose, or from wounds, tampons of gauze soaked in adrenalin solution or horse serum may be applied. Internal medication is without avail.

All food should be withheld for forty-eight hours, while water, sweetened if necessary with saccharin, is given by the mouth, or saline solution by the rectum.

SEPTIC DIARRHŒA

The cases in which acute diarrhœa is added to the other symptoms of intoxication described above are especially serious. When from the first days of life the evacuations of the bowel are watery and slimy and have a powerful putrefactive odour, the condition is always grave. When great restlessness, coma, convulsions, jaundice, hæmorrhage from the bowel, and rapid emaciation are present in addition, the result is usually fatal. If breast-milk cannot be obtained, recovery may be despaired of.

PYÆMIA

In other cases the infection may give rise to suppuration in different situations in the body. Subcutaneous abscesses, pleurisy, pulmonary abscesses, empyema, pyopericardium meningitis, suppurative arthritis, or peritonitis may develop before death. In such cases the prognosis is hopeless.

The following case illustrates well the association of symptoms commonly met with in toxæmia neonatorum:

ILLUSTRATIVE CASE. A. S., a female infant five days old, was admitted to Guy's Hospital suffering from convulsions and slight jaundice. The baby was premature and weighed 5 lb. The umbilical cord was healthy. The temperature was normal. The mother was thought to have had syphilis and had several scars, probably syphilitic, on the legs. Convulsions had begun on the third day of life and had recurred frequently. The breast had been refused, but the mother denied that feeding had been attempted in any other way. On the evening of the fifth day, soon after admission, the temperature rose to 104° and the child died in a fit. There had been no diarrhœa.

At the autopsy the stomach contained much altered blood and there were numerous petechial hæmorrhages under the pleura and in the substance of the lungs. The brain was soft and gelatinous and there was marked extravasation of blood under the pia mater covering the cerebellum and medulla. Over the base of the left lung was a single small patch of recent pleurisy.

A mixed growth of streptococcus brevis and bacillus coli communis was obtained from the contents of a loop of the small intestine. Cultivators from the spleen and lung gave a growth of bacillus coli communis only.

CHAPTER XXIII

PYLOROSPASM

(CONGENITAL HYPERTROPHIC PYLORIC STENOSIS)

THOSE who first described this condition (Beardsley, Williamson) were impressed by the frequency with which during life, or at a *post-mortem* examination, a considerable degree of hypertrophy of the pyloric musculature was present, amounting in the worst cases to a veritable pyloric tumour (Hirschprung). The name of congenital hypertrophic stenosis has thus come into general use. The condition, however, has not been found in the foetus or in the newly born, and in the majority of cases the clinical symptoms develop in the second or third week of life or even later. When the symptoms are relatively mild a pyloric tumour may not be felt, although visible peristalsis and projectile vomiting may warrant the diagnosis of pyloric obstruction.

The opinion most generally accepted at the present time is that the pylorospasm is the primary disturbance, and that the hypertrophy is secondary to, and occasioned by, spasm of long duration and great severity. The origin is, however, still disputed, and arguments of considerable weight can be adduced in favour of the view that the overgrowth of muscle is the primary disturbance. In many cases pylorospasm occurs in infants with other signs of neuropathy or in families with a pronounced psychopathic inheritance (Czerny).

SYMPTOMS. Vomiting. Persistent and explosive vomiting stands in the foreground of the clinical picture. At first regarded merely as "possetting," it soon becomes so violent that the parents are alarmed. In bad cases, after every attempt to feed, almost the whole contents of the stomach are discharged with such force as to be projected for a considerable distance. As a rule vomiting takes place within a few minutes; sometimes it is delayed for an hour or more.

Even if food is withheld, vomiting of a clear watery fluid which is always intensely acid may persist.

Visible Peristalsis. When obstructive vomiting of this sort has developed the remaining symptoms appear with great rapidity. If the abdomen is bared a few minutes after feeding, a rounded prominence will be seen to form itself in the epigastrium, while from time to time a ball-like mass passes along the epigastrium from left to right. The more emaciated the abdominal wall, the more striking is the visible movement. We are here observing the peristalsis of the hypertrophied wall of the stomach as it contracts against the pyloric constriction.

Pain. The crying and restless movements of the child indicate how painful the heightened peristalsis is.

Relief is only obtained after vomiting has taken place.

Pyloric Tumour. In the most severe cases the thickened ring of the pylorus can be felt as a hard, movable, deep-seated tumour between the umbilicus and the right costal margin. It is about as big as the terminal join of an adult's thumb.

In slighter cases this symptom may be absent.

Inanition. At the height of the disturbance the infant wastes rapidly. The abdomen and limbs become emaciated. The temperature is apt to be subnormal. Constipation, secondary to the inanition, is the rule, and the stool is accordingly dry, hard, crumbling, and high-coloured, or consists only of brown-stained mucus. It has been compared with meconium. The urine is scanty and deeply pigmented.

Secondary Infections and Complications. Broncho-pneumonia, bronchitis, naso-pharyngitis, or furunculosis develop in a proportion of the cases. In others a secondary dyspepsia, with frequent acid, green stools, or an alimentary intoxication may appear before death.

Prognosis. Although the condition is alarming and distressing, in breast-fed infants it is comparatively seldom fatal. The symptoms, which begin as a rule in the third week, usually attain a maximum about the tenth week. Then, when at their worst, improvement suddenly begins, and is generally steadily maintained.

Coincident infections are most to be feared during the height of the inanition, and may be the direct cause of death.

If the infant has been weaned before advice has been sought—

as, unhappily, frequently takes place—the prognosis is rendered much more serious, and with all the care in the world death is all too frequent.

The question of operative interference only arises when the child is artificially fed, and then only when it is clear that by no manipulation can the breasts be made to secrete. Many more babies would be saved by securing a supply of breast-milk, drawn from some nursing mother, than by the most skilful surgery. In artificially fed infants death takes place, as a rule, not from the intestinal obstruction, but from a secondary dyspepsia to which the child is rendered especially prone from the long-standing inanition. Often the dyspeptic symptoms develop at the very time at which the spasm is yielding, and the food begins to pass the obstruction in larger amounts (Meyer). In my own experience, in artificially fed children death has generally been preceded by marked dyspeptic symptoms, green acid stools, colic, and explosive defæcation. Often an alimentary intoxication has developed. Of five breast-fed infants under my care during the last two years, all have made a good recovery.

Diagnosis. The symptoms are so characteristic that no case should pass undiagnosed, if only the examination of infants is conducted after removal of all clothing.

Treatment in Breast-fed Infants. In hardly any infantile disorder is the necessity for securing breast-nursing so urgent. Every care must be taken to prevent the disappearance of the milk—if necessary, by careful use of the breast-pump to empty the breast after nursing. The danger that the milk may fail is especially great when the plan is adopted of feeding the infant at very short intervals—for example, every hour. If mixed feeding has been instituted, the baby must be put back exclusively to the breast.

The infant may be put regularly to the breast at the usual three- or four-hourly intervals, and we may rely entirely upon the general treatment, to be described immediately. Vomiting will occur, yet in many cases the obstruction is by no means complete and a considerable part of the meal is retained. If the greater part of the meal is persistently rejected, the stomach should be washed out each morning with a weak alkaline lotion and the attempt again made. If the vomiting is still so excessive that it is evident that little

is retained, the usual three-hourly or four-hourly intervals should be abandoned and nursing should be ordered at short intervals of sixty or ninety minutes. If vomiting is still uncontrolled, the mother's milk should be withdrawn by a pump and given at short intervals by mouth, preferably after it has been cooled by standing upon ice. If all is not taken, the remainder may be given in an enema per rectum. The withdrawal of the milk in this way has been, in my experience, the most successful device of all. There is some evidence that the pyloric spasm in these infants is directly produced by the act of suction (Ibrahim), and that without suction, when the milk is conveyed to the stomach passively, by the act of swallowing alone, or introduced directly by a tube, the spasm may not be provoked.

Many children who reject the first feed will retain the second if it is given immediately.

Treatment in Artificially Fed Infants. In artificially fed infants we must determine whether the milk has completely left the mother's breast, or whether it can be restored by the regular suction of the child assisted by the breast-pump.

If it is found impossible to restore breast-nursing, an attempt should be made to secure a supply of breast-milk withdrawn by the breast-pump from some nursing mother. The milk can then be placed on ice and used as described above.

If artificial feeding is necessary, the diet which is least likely to cause dyspepsia should be chosen, and for this reason whole milk with sodium citrate, given in small doses and at short intervals, may be chosen. This diet has the further advantage that it is concentrated and of small bulk. The fat, which leaves the stomach most slowly of all, should be kept at a low percentage, and if necessary the top cream should be removed by skimming. Good results have also been obtained with a whey and cream mixture.

General Treatment. Both in breast-fed and in artificially fed children the need for fluid must be met by giving water sweetened with saccharin freely by the mouth, or, if necessary, by saline infusion per rectum or subcutaneously.

The infant during all the period of inanition should be kept warm.

Opium, chloral, cocaine, and atropin or belladonna have all been advocated as useful either in relaxing the spasm or in

quieting the nervous disturbance upon which the condition develops. Warm applications to the abdomen should never be omitted, and are often of the greatest service.

Operative Interference. The question as to whether or not an operation should be undertaken only arises in artificially fed infants when breast-milk cannot be obtained. In such cases the mortality, when treated without operation, is probably as high as 70 per cent. It is claimed that surgical treatment is successful in about half the cases, but individual surgeons have occasionally met with greater success. Burghard records eleven successful cases out of sixteen, a mortality of 31 per cent. Scudden had only three deaths in seventeen cases. The operation of choice is probably that of posterior gastro-enterostomy. It should not be attempted by surgeons without experience in this special class of case. A decision should be made as early as possible, before the infant has suffered severely from inanition.

CHAPTER XXIV

INBORN ANOMALIES OF DIGESTION

IN much that is written upon the subject of the Feeding of Infants it is often assumed that all digestive disturbances proceed from faults in the composition of the diet, from gross excess, or from a want of cleanliness.

No doubt among the very poor the proportion of cases directly attributable to these causes is much higher than among those who are better situated, and there is a wide field for the instruction of poor mothers in the elementary rules of health and infant hygiene. Yet even among the poor there is abundant evidence that malnutrition and dyspepsia, on breast or on bottle, are not always to be attributed to gross ignorance or culpable carelessness on the part of the mother.

Dyspepsia is very frequently the expression of an underlying infection. The infant at birth has but one function highly developed—that of absorbing an amount of food which, relatively to that of the adult, is enormous. A function so highly developed is very readily disturbed, and infections of all sorts and in the most various situations present themselves in the guise of a primary digestive disturbance. Still more interesting is the large group of cases in which dyspepsia is dependent on peculiarities of infantile diathesis, and upon inherited, inborn abnormality of digestion. Among the infants of the well-to-do classes, where the composition and amounts of the diet are well controlled and subject to the most careful scrutiny, and where the hygienic conditions are faultless, digestive disturbances are rarely *ex alimentatione*—from gross assaults upon the digestive powers of the infant by an absolutely irrational diet—but arise commonly *ex infectione* or *ex constitutione*.

The suggestion that it is possible to recognize types of individuals whose aspect and whose liability to suffer from

a certain train of symptoms mark them off as belonging to a certain diathesis, is not new. Indeed, the conception of diathesis is almost as old as the study of medicine itself. For long it held a foremost place in all medical literature. Later, in the second half of the last century especially, there came a time when it fell into disrepute. These years were marked by great advances in the study of the local disorders of the different parts of the body as the use of the stethoscope grew general, and the methods of physical examination became highly developed. Bright, Addison, Wilks, Virchow, and many others taught the importance of morbid anatomy, and the necessity of interpreting all clinical phenomena in the light of the examination of viscera *post mortem*. Later still the science of bacteriology sprang into being and profoundly influenced our whole conception of the processes of disease. With more definite knowledge of these processes much of the old-time teaching upon diathesis was found to be no longer tenable, and the very name to a great extent fell into disuse. To-day it again stands in the forefront of interest, both in medicine as a whole, and especially in the study of the disorders of infancy. Although most of the types of diathesis formerly described have been discarded, it is still possible to recognize certain inborn and inherited constitutional anomalies marked by the constant association in the same individual of a wide variety of symptoms and local manifestations. The presence of one set of symptoms often enables us to predict the appearance of others at a later time.

Although we have no sufficient knowledge of the true nature of the constitutional anomaly, we believe that this anomaly accounts for the presence of the local disorder, and that treatment to be successful must be directed not only against any one local manifestation, but must combat the underlying cause—the diathesis itself.

EVIDENCE FOR THE EXISTENCE OF CERTAIN DIATHESES IN INFANCY

The evidence of these wide divergences of constitution is very marked in the study of the dietetic disorders of infants. It is universal experience that upon the same diet and under the same hygienic conditions we may meet with one child who

thrives and develops perfectly, whilst another becomes rachitic, a third grows anæmic, and a fourth shows a lowering of tolerance to all infective catarrhal processes. So frequently are such variations encountered that we are driven to the conclusion that infants are born with considerable differences in the chemical structure of their several organs and tissues—differences which exert their influence in greater or less degree, according to the character of the diet.

Formerly, when a breast-fed infant suffered from severe and persistent dyspepsia, the failure was commonly regarded as evidence of an idiosyncrasy on the part of the mother. It was thought that her milk was of unsuitable composition, or capable in some way of exercising directly a prejudicial effect upon a normal infant. To-day we know that the milk of every woman, not herself the subject of an infective disorder, such as tuberculosis or syphilis, is equally suitable for the normal infant, and that the composition as well as the amount of the milk is controlled to suit his needs by the varying stimulus of suction. If the milk of one woman causes digestive disturbances, the change to the milk of another is seldom of any avail. The same woman may suckle three or four infants, only one of whom is dyspeptic and fails to thrive. Although one infant may do very badly on the breast, the same breast may yet be safely used for other normal children. Of the three great groups into which infantile dyspepsia is divided, dyspepsia *ex alimentatione*, dyspepsia *ex infectione*, and dyspepsia *ex constitutione*, the last is not only of the greatest interest, it is perhaps also of the greatest frequency. No classification of infantile dyspepsia can be complete which ignores those fundamental distinctions between individual infants. That the same diet may produce a healthy infant in one case, and in another lead steadily to severe illness and even death, forces us to attempt the study of infantile diathesis.

It is right that we should have clearly in mind the results of under-feeding (*Inanition*), of over-feeding and a temporary loss of tolerance for all or some of the constituents of the food (*Dyspepsia*), of a similar but permanent loss of tolerance (*Marasmus*), and of the symptoms of the absorption into the blood-stream of certain disintegration products of abnormal digestion (*Intoxication*). At the same time we should endeavour to appreciate the usual result of imparting to the diet a one-

sided character, so that either fat or carbohydrate is present in gross excess, and we should be able to distinguish between a primary digestive disturbance and a disturbance secondary to infection, whether of the bowel wall (*enteral*) or in other parts of the body (*parenteral*). But we must also be prepared to recognize as a sufficient cause for disturbance the existence of certain constitutional abnormalities—the “exudative diathesis” of Czerny, for example, or extreme neuropathy. The study of the disorders of infancy must concede due prominence to the consideration of the child. The subject is not exhausted by an examination of a variety of diets, by enumerating rules for dilution and dosage, and by insisting on the necessity for cleanliness. If infants could always be fed by rule of thumb, if the whole matter could be dealt with in a few pages of general directions, infant feeding might be left, as at present, almost outside the medical curriculum, and be regarded as of greater interest to nurses than to medical men.

As knowledge increases it becomes more and more clearly recognized that dyspepsia in infancy is not always, or even usually, accounted for by gross excess in the amount of the diet or gross faults in its composition. It becomes more and more apparent that it is wrong to approach the study of the disorders of infantile digestion in the belief that the child is the constant and unvarying factor, and in the hope that we shall one day find a universal artificial diet applicable under all conditions and to all infants.

In spite of the confident statements of those who claim unvarying success with some particular method of feeding—whole milk, for example, or the so-called “humanized” milk—the digestive powers of individual infants are very various. We shall often find it our lot to study the abnormal reactions of particular children to food which may be said generally to be of suitable composition, and upon which in our own experience large numbers of infants of similar age have shown uniform and steady progress.

In the study of infantile disorders it is helpful to group together in our minds certain symptoms, certain peculiarities of aspect, certain tendencies and liabilities to particular disturbances, which experience teaches us are apt to occur in infants of a certain type and of a certain inheritance. The frequency with which these groups of symptoms occur in the same individual, either simultaneously or successively, at different times in the

course of growth and development encourages the belief that they are only various expressions of an underlying constitutional idiosyncrasy.

THE EXUDATIVE DIATHESIS

We owe to Czerny a clear statement of the clinical symptoms of a particular diathesis which is so common that its manifestations in greater or less degree are met with every day in practice and are familiar to all.

In the older medicine a group of symptoms, constantly recurring and of great frequency, was described under the name of "scrofula." Children who showed the scrofulous diathesis were characterized by a certain physical aspect—harsh, dry skin, with a pronounced tendency to certain scaly and lichenoid eruptions, fine silky hair, which grew irregularly beyond the true hairy scalp on to the forehead and over the zygomatic arch, long eyelashes, and a tendency to a further hairy growth on the back of the neck and between the scapulæ; chronic catarrhs in various situations were almost constant—nasal catarrh, with a profuse secretion which irritated and caused thickening of the upper lip, naso-pharyngeal catarrh, bronchial catarrh, phlyctenular conjunctivitis, leucorrhœa, and mucous diarrhœa. As a result of the chronic irritation of the mucous membranes a secondary glandular enlargement was the rule. Tonsillar overgrowth, adenoid vegetations, hypertrophy of the lymphatic glands and of the lymphoid tissue generally of the whole body were commonly found.

With the discovery of the true nature of the tuberculous infection it became recognized that a large number of scrofulous children were infected with tubercle. In many the enlarged glands became definitely caseous; in others the catarrhal and inflammatory symptoms were combined with diseases of bone clearly of a tuberculous nature or with tuberculides of the skin.

Nevertheless, after the separation of those individuals in whom a tuberculous infection had declared itself, there are still left a very large number of children who would unhesitatingly have been described in former times as of a scrofulous or strumous diathesis. Those children who show the catarrhal and lymphatic changes of the old-time scrofula without evidence of tubercle have been studied under many names. Virchow borrowed from

Thomas White* the name "inflammatory diathesis"; Heubner, Escherich, and others speak of "lymphatismus" and the "lymphatic constitution"; French authors write of "arthritismus" and "neuro-arthritis," the English authors of "mucous disease" and "status lymphaticus." Czerny, who has traced the diathesis backwards to earliest infancy, where it forms one of the commonest causes of digestive disturbance, impressed by the frequency with which exudative processes occur upon the skin and mucous membrane, has given it the name of the "exudative diathesis." He has emphasized especially that the increased vulnerability of skin and mucous membranes is primary, and that the lymphatic enlargement is secondary.

SYMPTOMS OF THE EXUDATIVE DIATHESIS IN LATER CHILDHOOD

The manifestations of the diathesis in infancy are those with which we are immediately concerned. The developments later in childhood, though not dissimilar in nature, are more varied in type and must first be described. The subjects of the diathesis are marked by a characteristic appearance (*vide* Figs. 11 and 13, pp. 176 and 179). The child's face is usually plump and rounded and marked by a high colour on the cheeks and on the front of the chin. In these situations a dry, scaly eczema is usual. Seborrhœa of the scalp is common. The hair is often sparse, but growing in wavy curls rather than straight. The eosinophil cells of the blood tend to be increased in number in all cases in which the symptoms are marked. The blood of the little girl, portraits of whom are shown in Figs. 11 and 13, showed 8 per cent. of eosinophil cells. The frequent catarrhs of nose and pharynx are accompanied by tonsillar and pharyngeal overgrowth and by enlargement of the cervical glands. Otitis media is common and the children are often in consequence deaf. The so-called "geographical tongue" is frequently seen. Bronchial catarrhs and asthma-like attacks are frequent. In some cases the symptoms in childhood persist and a permanent asthmatic tendency may be established. Many asthmatics will be found to have suffered in infancy and childhood from seborrhœa of face and scalp.

* "A Treatise on Scrofula, commonly called the King's Evil." By Thomas White, Surgeon to the London Dispensary; 1784.

In some cases the intestinal mucous membrane shares in the general tendency to catarrhal and exudative inflammation, with the production of chronic enteritis and secondary overgrowth of the intestinal lymphatic tissue. This condition is well described by English authors (Eustace Smith, Gee, Cheadle, &c.) under the name of "mucous disease" or "coeliac disease." In general, restlessness, irritability, and nervousness are marked symptoms, and a violent and passionate fit of crying will often make the examination of a young child difficult.

A further group of symptoms has a close association with the phenomena of anaphylaxis, urticaria, sometimes giant urticaria, transitory oedema or exudation into joints, as well as spasmodic asthma. In other cases difficulties in the digestion and metabolism of fat stand in the foreground. The "cyclical" vomiting of childhood is frequently accompanied by evidence which marks the child out as of this particular diathesis.

Perhaps the most characteristic of all the symptoms is seen in the profound constitutional disturbance which is apt to accompany those apparently slight catarrhs to which, at longer or shorter intervals, the child is usually liable. In some children hardly a week passes during which they do not sicken of an acute feverish attack. At nightfall the temperature may be 104° or 105° F., and the child may present all the appearance of serious disease; and yet the morning finds every symptom gone. If, on the other hand, the infection is more sustained, weeks of high fever may elapse, yet repeated and careful examination does not disclose any physical signs of disease. In the severer degrees of the condition numerous infections are fatal which would have caused but slight disturbance in a normal child. Pneumonia has a higher mortality; a trivial laryngitis may lead directly to death; in an acute attack of diarrhoea drowsiness may gradually deepen into coma, until death ensues; sometimes sudden heart failure, from fear or other emotion, the subcutaneous injection of antidiphtheritic serum, anæsthesia, or other trivial causes, may seem to be the direct cause of death. Acute infections may cause death with great rapidity and very early in the course of the disease, before the usual changes observed *post mortem* have had time to develop. The following case illustrates the rapidity with which infection may prove fatal:

ILLUSTRATIVE CASE. I was called upon to perform an autopsy upon a girl of seventeen years of age who had fallen down dead while

walking with a friend in one of the streets of the City. She had never been very strong, but had not lately complained of ill-health. The body was well grown and well nourished. Marked hyperplasia of the thyroid gland, the thymus, and of all the lymphatic glands of the body was at once apparent. Naked-eye examination discovered no other cause for death, yet careful histological examination by Dr. W. Johnson showed a very early miliary tuberculosis of the lung.

Lastly—as the French authors especially have insisted—arthritis, chorea, endocarditis, and other rheumatic manifestations are most commonly and most typically seen in children who exhibit marked signs of the diathesis.

The symptoms so described embrace a very large number of disorders not usually regarded as akin. The hypothesis that all are dependent upon an underlying diathesis is founded only upon the observation that groups of such symptoms tend to occur in the same individual. As a rule, in any one individual a particular group of symptoms recurs again and again. In other cases the type of the manifestations changes at different stages in the development of the child. In one child the tendency to pyrexial attacks, nasal or naso-pharyngeal catarrhs, otitis media, tonsillar and adenoid hypertrophy, and enlargement of the cervical glands is most marked. In another digestive disturbances and the antipathy to a diet rich in fat are prominent. In a third urticaria and bronchial catarrh, or true spasmodic asthma, predominate; in a fourth seborrhœa or eczema of skin and scalp. The diathesis is hereditary. Often it occurs in all members of a family, and it will then usually be found that one or other parent has suffered severely in youth in the same way.

ILLUSTRATIVE CASES. The diathesis so described is of such common occurrence that numerous cases might be quoted from among the patients seen upon a single day in the out-patient department of a large hospital. The following cases illustrate different types of symptoms:

CASE I. An infant, three months old, suffering from severe seborrhœa of the scalp, was brought to me on December 3, 1911. Although nursed on the breast, he had suffered severely from dyspepsia almost from the first. When five weeks old he had been weaned. He was always sick when cow's milk, even in considerable dilution, was given. He had had much less dyspepsia upon sweetened condensed milk. The seborrhœa had appeared at three weeks of age. The scalp when seen was completely covered with masses of secretion.

A fat-poor, carbohydrate-rich diet was ordered, and recovery followed in about six weeks' time. On April 20, 1914, he was again brought to me. I was told that he was well except for a tendency to suffer

from slight scaly eczema of the cheeks and chin, repeated nasal catarrhs, and severe spasmodic attacks of dyspnœa. Two maternal aunts suffered from asthma. He had some tonsillar enlargement and a mass of adenoid vegetations.

Dietetic rules were given. He had been taking large amounts of cow's milk, and a diet predominatingly vegetable and cereal was recommended. The adenoids may have to be removed later. The association between them and the asthma cannot, however, be regarded as cause and effect.

CASE II. A girl aged eight was brought to the hospital for growing pains. She had been weaned for failure to thrive at three months, although the mother had plenty of milk. She walked and cut her teeth somewhat late. In her third, fifth, and sixth years she was admitted to hospital for "broncho-pneumonia," but recovery was always rapid and pyrexia short-lived. The mother thought that the attacks did not differ from many others which the child had had, and which she had almost grown to neglect. They set in suddenly with burning heat, flush, and dyspnœa. At such times the glands in the neck always enlarged. (In another case with similar history the mother told me that a diagnosis of mumps had been made in the hospital surgery on four separate occasions, and on each she had attempted to obey instructions and carry out isolation of the child.) At two years old she had had eczema of the scalp. She had then been fat, but had got thin later. On examination she was seen to be a small child, with sparse, wavy, curly, reddish hair and long dark eyelashes. Fine downy hair grew low down on the forehead, beyond the true hairy scalp, and over the cheeks almost like a whisker. There were marked enlargement of tonsils and adenoid overgrowth. The nostrils were pinched and atrophied. The cervical glands were large and palpable, the axillary and inguinal glands smaller but easily palpable and visible under the thin skin. The face was reddened with rough, dry skin on the cheeks. The tongue showed the condition *lingua geographica*. The chest was narrow, with little subcutaneous fat. The skin was very white over the chest, and changed to a deeply pigmented colour over the distended abdomen. She complained of abdominal pain at intervals, and often had diarrhœa and blood-stained stools. There had been frequent prolapse of the rectum. At one time threadworms had been seen. Lately she had complained much of joint pains, and a diagnosis of acute rheumatism had been made.

CASE III. The portraits of C. E., aged five (*vide* pp. 176 and 179), are selected to show the sparse hair with indeterminate anterior margin, dry eczema of cheeks and scalp, adenoid overgrowth, and enlarged pigmented abdomen. She was brought to the hospital for repeated attacks of diarrhœa and abdominal pain. She had been weaned at three months, and had never thrived on the breast, although the attempt had been persisted in. The cervical, inguinal, and axillary glands were palpable. She was subject to repeated pyrexial attacks of short duration, during which she vomited, became drowsy and listless, and felt "burning hot."

SYMPTOMS OF THE EXUDATIVE DIATHESIS IN INFANCY

For our present purpose the chief interest lies in the extension by Czerny and others of the recognition of the diathesis back to the earliest days of life, and the emphasis more recently laid on the part which it plays in the production of digestive disturbances both on breast and on bottle.

In early infancy the most common way in which the inheritance shows itself is the complete or relative failure of breast-feeding. The children often show none of the strength, vigour, and firmness of the normal breast-fed baby. From the first they may be meagre, small, and complaining, and persistently dyspeptic. The mother's breasts may be well formed and full of milk, and yet for weeks and even months no improvement takes place. Dyspepsia, with the passage of green stools and vomiting, is frequent, and in a breast-fed child should always suggest the existence of this diathesis. In other cases, however, a different picture presents itself. The infant achieves a rapid rise in weight, yet the more rapid the growth the more marked do the other symptoms of the exudative diathesis become. Finkelstein especially has emphasized the tendency for infants who show the diathesis to belong to one or other of these two types—the thin and wasted type, or the fat, pasty, and eczematous type.

Cutaneous Symptoms. *Seborrhoea* of the scalp is extremely common in the form of a dirty greyish-brown fatty secretion appearing irregularly upon the hairy scalp, which resists all the mother's attempts to remove it.

A dry *eczema* of the cheeks and chin is common, especially in thin infants. The skin in these situations is reddened, dry, scaly, and rough. In the fat and pasty type an acute, irritating *eczema* is more frequent.

Urticaria papulata is often seen. The minute papules are scattered on the scalp, body, and extremities, less frequently on the face. They are often present on the soles of the feet. Each crop tends to last two or three days.

Intertrigo occurs readily, in spite of the greatest cleanliness, in the groin and axilla, in the genital folds, or behind the ear.

Symptoms in the Mucous Membranes. The same vulnerability which appeared in the skin shows itself in the mucous

membranes. Naso-pharyngeal catarrh, with accumulation of secretion in the posterior nares and pharyngeal wall, and slight enlargement of the cervical glands, is common. Because the infant lies



FIG. 11 shows the sparse hair with indeterminate anterior margin, dry eczema of cheeks, and adenoid overgrowth characteristic of children who are the subjects of the Exudative Diathesis. Portrait of C. E., aged five. See also Fig. 13.

constantly on his back the anterior nares often remain free from secretion, so that the appearance does not immediately suggest nasal catarrh. The interference with nasal breathing is so great

that suckling is rendered difficult. Often this obstruction is the direct cause of weaning, a course to which the mother is

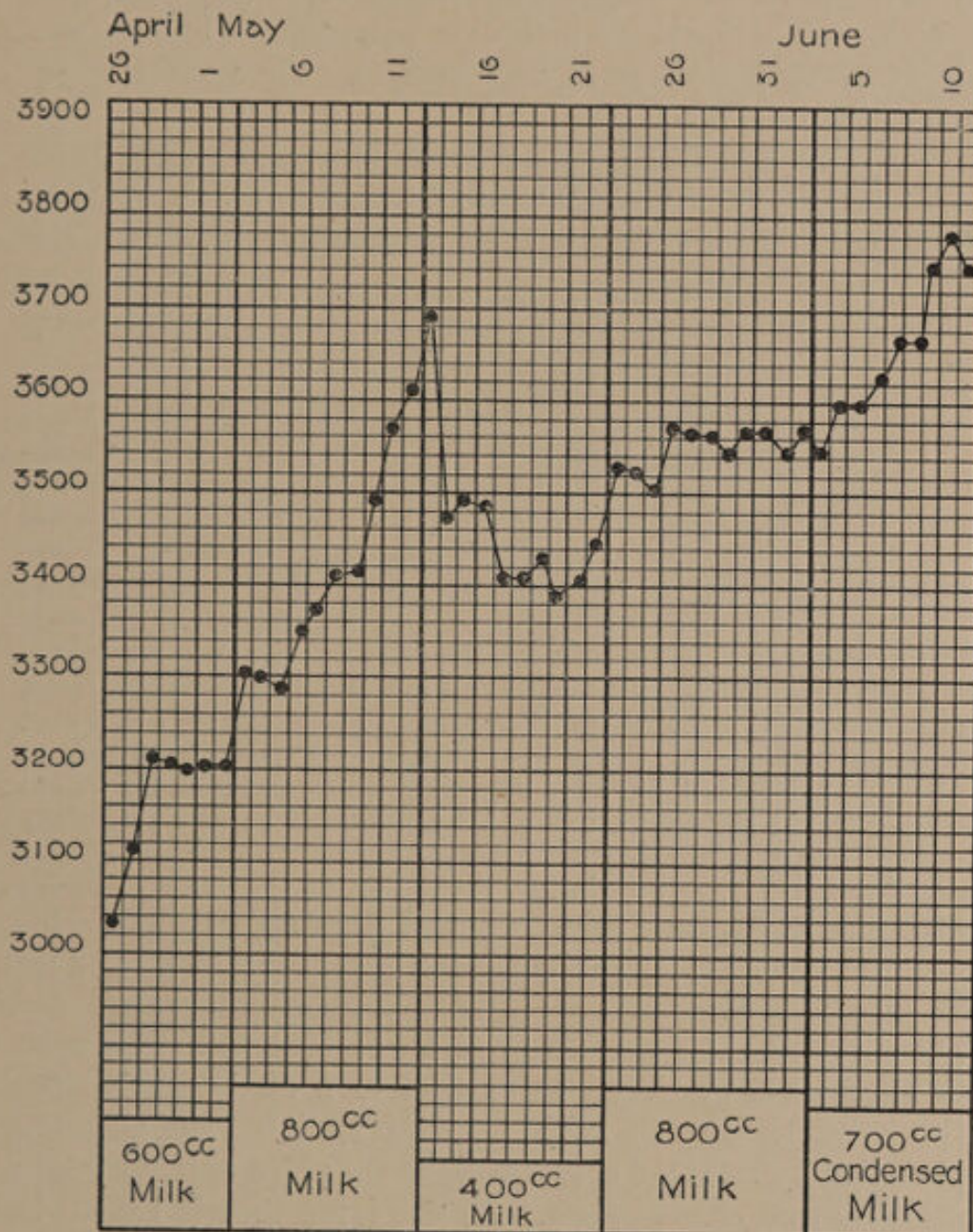


FIG. 12 shows the weight curve of an infant in whom acute eczema developed and continued upon a diet of citrated whole milk, given in amounts which varied from 400 to 800 c.c. *per diem*. The eczema continued unabated whether the weight rose or fell. Upon June 2 the diet was changed to sweetened condensed milk, and the condition rapidly improved at once. In ten days the skin was almost clear.

inclined because of the coincident dyspepsia. The catarrh often sets in with high fever, loss of appetite, diarrhoea and vomiting, and prostration; a diagnosis of broncho-pneumonia is often

wrongly made. Examination of the naso-pharynx and the cervical glands makes the diagnosis clear. Laryngitis, bronchitis, and otitis media are frequent complications. The lingua geographica, conjunctivitis, eczematous or phlyctenular, and circular caries of the teeth are seen in later infancy. The mucous membrane of the intestine is also affected. In earliest infancy constipation and dyspeptic green stools are common symptoms. Later follicular colitis, mucous diarrhoea, and threadworms are frequent.

Symptoms of Overgrowth of Lymphoid Tissue. The spleen, thymus, tonsils, lymphatic glands, and intestinal follicles all show a tendency to an enlargement, which is probably secondary to the chronic irritation in the areas which they drain.

ILLUSTRATIVE CASE. F. B., aged four months (*vide* Fig. 12), was admitted to Guy's Hospital under my care with a diagnosis of bronchopneumonia. In the surgery the temperature was 105° , and there was marked dyspnoea. Examination showed that the lungs were free from physical signs. The cervical glands were enlarged and the fauces and pharyngeal wall were reddened and inflamed. The temperature remained high for two days, when recovery took place rapidly. The child had suffered continuously since birth from dyspepsia, and the weight—7 lb.—was less than at birth. Weaning had taken place at six weeks, and the diet had since consisted of equal parts of cow's milk and water, with added cane-sugar. There was a slight roughness of the skin of the cheeks and forehead. Upon a diet of citrated whole milk the weight rose rapidly, but as the child grew fat the eczema became acute and spread actively over the cheeks. After five weeks the diet was changed to sweetened condensed milk, when the eczema immediately improved and the face became quite clear. On three occasions there were acute paroxysmal attacks of dyspnoea, without pyrexia, which suggest the presence of asthma.

There is no doubt some danger of laying too great stress upon such hypothetical conceptions as that of a diathesis, the true nature of which is still a subject for speculation, or of allowing explanation by assumed causes to take the place of inquiry into anatomical and clinical facts. At the same time it has to be admitted that Czerny and his school have done good service in calling attention to a group of cases which occur with great frequency and show a very definite association of symptoms.

THE TREATMENT OF THE EXUDATIVE DIATHESIS

According to Czerny the symptoms of the exudative diathesis must be attacked both locally, by measures to relieve the



FIG. 13 shows the plump, rounded limbs and prominent, pigmented abdomen often seen in children with the Exudative Diathesis. The remaining features as in Fig. 11. Portrait of C. E., aged five.

local manifestation, and generally, by endeavouring to combat the underlying predisposition.

Although heredity, diet, and a faulty hygiene all play a part

in the ætiology of the condition, we can hardly doubt that the last is that which is most susceptible to interference and which can be attacked with the greatest hope of success. In children who are the subjects of the diathesis the importance of fresh air, cleanliness, frequent bathing, and sufficient exercise is doubly great. Only by attention to the general hygiene of the child can the resistance to infections be raised and the vulnerability to the various catarrhs be lessened. Among the poor of our large towns, dirt, squalor, overcrowding, and a warm humid atmosphere work together in increasing the susceptibility of the child to infections and in stamping upon its features the marks of the diathesis.

Nevertheless, in certain cases the close dependence of the symptoms upon the nature of the diet is easily demonstrated (*vide* chart, p. 177), and the occurrence occasionally of well-marked examples of the condition under the most favourable hygienic surroundings forbids us to overlook the other ætiological factors. As a rule, with a well-chosen diet and with good hygiene the tendency to the exudative symptoms slumbers, to be awakened at once by faults in either.

Dietetic Treatment. In cases in which the constitutional abnormality is strongly marked, symptoms may develop in the first weeks of life while the infant is nursed at the breast. Sometimes the infant refuses to thrive and remains thin and even emaciated. Occasionally, perhaps, a green dyspeptic stool may be passed, and there may be some tendency to a little dry eczema of face or scalp, or to the outbreak of crops of urticaria papulata. The general aspect of the child, and especially the colour, is not satisfactory, so that his appearance is more suggestive of unsuccessful bottle-feeding than of nursing at a breast which is full of milk.

Such a condition is to be distinguished from one of true inanition, where for some reason the suction of the infant is interfered with and the total daily intake of milk is insufficient. In the cases which we are now considering, although the infant fails to thrive, the breasts may be full of milk and the symptoms are those of dyspepsia rather than of inanition.

The condition does not call for active interference. Even when the symptoms are comparatively severe, weaning or the institution of mixed feeding is not to be advised until the

child is at least three months old, when it may be gradually undertaken as recommended in the next paragraph. At an earlier age than three months any attempt at weaning usually aggravates the disturbance.

More frequently the breast-fed infants which are brought to us with signs of the exudative diathesis are fat and pasty, with a strong tendency to bronchitis or to acute eczema or intertrigo. Here an attempt may be made during the first three months of life to diminish the amount of milk taken during the day. Merely to decrease the number of meals is not usually effective. In a few days the infant drinks as much in four meals as it did formerly in five or six. It is better to curtail the amount of time spent at the breast to eight or ten minutes and to give one or two ounces of barley-water immediately before nursing.

When the child is about three months of age, if improvement has not taken place, an attempt at mixed feeding may be made. If five feeds are being given daily, the fifth may be replaced by an artificial feed. As a rule a mixture poor in fat and rich in sugar will be found most successful. Cow's milk diluted with twice its volume of barley-water and enriched with extract of malt or malt-sugar may be chosen. In other cases a malted milk may be used, or even a partially malted or dextrinized flour in a dilute milk. If no benefit follows or if dyspepsia results, the attempt should be abandoned and a return made to exclusive nursing at the breast. After an interval of some weeks the attempt may again be made and the result watched. If improvement follows, a second nursing at the breast may be replaced by an artificial feed, and later still a third, until weaning is complete when the child is about six months old.

If, as usually happens, the infant has been already weaned before advice is sought, our prescriptions must be guided by the same rules, to avoid scrupulously all over-feeding and especially to keep the fat content low. It is well to be satisfied with a comparatively slow gain in weight. Not infrequently, as in the case mentioned on p. 177 (*vide* Fig. 12), an ample diet produces a rapid growth, yet the fatter the child becomes the more rapidly do the symptoms of the exudative diathesis develop. In other cases the use of cow's milk in generous amounts is followed by the development of the condition described as atrophy due to cow's milk, with want of growth,

constipation, and the passage of hard, grey or white soapy stools. In both cases a diet relatively poor in fat and rich in sugar is generally best tolerated, while starchy and vegetable foods may be introduced with success into the dietary at an earlier age than usual.

In older children also a diet in which cow's milk bulks largely may be badly borne, and improvement may rapidly follow if vegetables and cereal foods are introduced more freely.

ILLUSTRATIVE CASE. B. F., aged three, the little daughter of a medical man, was sent to me for slight but intractable eczema of the face and scalp. The mother had suffered in the same way in childhood. Both mother and daughter had been reared by hand, after the attempt at breast-nursing had proved a complete failure. In the case of B. F. life had apparently been in danger for some weeks, although there had been a plentiful supply of milk in the mother's breasts. Finally, improvement had taken place upon a diet of whey, with added sugar and a small amount of cream. When seen she was having two pints of milk daily, an amount almost sufficient in itself to cover the needs of the child for food, and difficulty had been experienced in inducing her to take other food in addition. The milk was at once cut down to one-half pint daily and a diet largely vegetable and cereal was substituted. The eczema rapidly improved and after a few weeks had almost disappeared.

Local Treatment. Besides these general hygienic and dietetic regulations, the local treatment of the various manifestations as they occur in infancy must be described. Local and general treatment should go hand in hand.

Eczema of face and scalp may be treated by the following applications :

Zinc. oxid.	.	.	.	.	.	} aa. $\bar{3} \frac{1}{2}$
Gelatini	.	.	.	.	.
Glycerini	.	.	.	.	.	} aa. $\bar{5} 2$
Aq. destillat.	.	.	.	.	.

S. To be applied warm with a camel-hair brush. (Unna.)

or

Zinc. oxid.	.	.	.	.	.	$\bar{3} 1$
Glycerini	.	.	.	.	.	} aa. $\bar{3} \frac{1}{2}$
Amyli	.	.	.	.	.
Aq. destillat.	.	.	.	.	.	$\bar{3} 4$

Boil down to two-thirds.

S. To be applied with a camel-hair brush. (Unna.)

or

Glycerini plumbi subacetatis	.	.	.	.	$\bar{3} 1$
Glycerini	.	.	.	.	ad $\bar{5} 1$

Ft. Pigmentum.

S. To be applied with a camel-hair brush.

Bandages should be used as little as possible, but the child must be prevented from scratching. The arms should be kept extended by a light splint applied anteriorly. The hands can then be fastened to the sides of the bed. The finger-nails should be cut very short.

The **seborrhœa** of the scalp is best treated by ointments containing sulphur and salicylic acid, applied after removing as many crusts as possible by means of fomentations:

Sulphur. præcipitat.	. . . . .	gr. 10
Acidi salicylici	. . . . .	gr. 10
Vaselini	. . . . .	} aa. 3 4
Lanolini	

S. Ft. Unguentum.

Intertrigo. The acute dermatitis which is so readily induced in the flexures of the skin in susceptible infants, by contact with the urine and fæces, is often difficult to allay. So long as the skin is only reddened and does not weep or ulcerate, it is usually sufficient to wash the parts, not with water, but with olive-oil, and then to apply zinc ointment and the usual dusting powder. If the dermatitis becomes moist and ulceration occurs, after washing with oil and before applying the zinc ointment the parts should be lightly painted with a weak solution of silver nitrate:

Argenti nitratis	. . . . .	gr. 5
Aq. destillat.	. . . . .	ad 3 i

S. To be applied with a pencil brush.

The napkins used must be of soft towelling and should be frequently changed. Soda should not be used in washing them. A napkin should never be dried and replaced without thorough washing. It is quite unreasonable to accuse the mother of carelessness or to hold her responsible for the spread of the dermatitis.

Urticaria papulata. A lotion or ointment containing liquor carbonis detergens is usually effective:

Liquor carbonis deterg.	. . . . .	3 i
Aq.	. . . . .	ad O i

S. Ft. Lotio.

or an ointment:

Liquor carbonis deterg.	. . . . .	3 i
Vaselini	. . . . .	3 2

S. Ft. Unguentum.

Or a bath containing one drachm of the liquor carbonis detergens, or one drachm of potassium sulphate, or one and a half drachms of sodium carbonate, in a gallon of water.

Little can be done by treatment with drugs for the frequently recurring catarrhs of the naso-pharynx, bronchi, and bowel. Hot baths, hot packs, and small doses of salicylates or quinine may lower the fever. In severe bronchitis atropine in large and increasing doses is recommended. To a child of twelve months one or two minims of the liquor atropinæ sulphatis may be given every four hours. The taste is best disguised by five minims of the syrup of ginger for each minim of the solution. As much as twenty or thirty drops in the day is often well borne. Dilatation of the pupil and increased rapidity of the pulse indicate when the drug has been pushed too far.

CHAPTER XXV

NEUROSIS IN INFANCY

IN the classification of infantile dyspepsias adopted in an earlier chapter (*vide* p. 61) a part of these disturbances was attributed, not to unsuitable diet nor to coincident infection, but to constitutional abnormality; that is to say, their origin was neither *ex alimentatione* nor *ex infectione*, but *ex constitutione*.

Of these abnormal children neuropathic infants form a proportion. Such children are nearly always the offspring of parents who are themselves of an abnormal nervous constitution. The neuropathic inheritance often shows itself from the first day of life. When the normal child, after birth, has been washed and dressed he usually falls into a deep sleep for twelve or twenty-four hours, until, with unrest and crying, the first sensations of hunger declare themselves. Then, when hunger is appeased by the first meal, all is again quiet. The neuropathic child, on the contrary, is restless and fretful from the first. His cry is sure to be attributed to hunger, and yet is not appeased by the breast nor by artificial food, which is only too apt to be given in large amounts under the mistaken impression that the restlessness indicates a vigorous appetite. If artificial food is given, a premature weaning is often made inevitable. On the other hand, if the breast alone is proffered the infant usually remains restless and apparently unsatisfied. Such children are meagre and thin; the tone of the muscles is increased; the legs and arms are held a little stiff and rigid; the abdominal wall is strongly contracted so that the recti muscles stand out prominently. The intelligence of these infants develops early. They are observant and quick to notice, yet over-sensitive to all powerful stimuli, to bright lights or loud sounds. They sleep badly and with an extraordinary lightness. When the healthy baby sleeps he can

often be moved from his cot without awakening, and ordinary conversation carried on in the room in which he lies has no power to disturb him. The neuropathic infant sleeps only to wake at the slightest sound. If anyone approaches his cot, with a start he is at once wide awake and observant or fretful.

As the child grows older the abnormal irritability of the nervous system becomes more and more manifest. No doubt, when mother as well as child is of neurotic temperament, the condition in the child is aggravated by the atmosphere of his surroundings. His will and his temper suffer no opposition. If food is given to him on a single occasion to quiet his midnight cry, there is no rest for his mother for many subsequent nights.

More than other infants the neuropathic child needs rest and quiet, yet his fretfulness is such that, in the hope of coaxing him to quietness by arousing his interest, mother and nurse exhaust both themselves and him in devising new means to stimulate his sensations. The excessive psychical stimulus which results from this constant appeal to his senses aggravates the condition, until at last he can hardly be left alone for a moment, so accustomed has he become to the ministrations of mother and nurse. A little tyrant in the house, quiet only comes on his daily excursions abroad, when at last he may lie still with eyes fixed on the changing picture of trees and clouds.

As the time for weaning approaches a new difficulty manifests itself. Neuropathic infants will sometimes successfully resist all attempts at weaning. If the bottle or breast is withheld they will seemingly prefer to submit to actual starvation rather than betake themselves to other food.

Diagnosis. It is true that a certain degree of fretfulness and restlessness is a common result of infantile dyspepsia even in the normal child. In neuropathy the relationship is reversed. The unrest precedes the dyspepsia and is present in a degree which is out of all proportion excessive. In most cases there is clear evidence of family neurosis.

Treatment. For the most part our treatment can only be expectant. We have no power to change the nervous disposition of the child. We should explain the state of matters as clearly as possible to the parents and prepare them to encounter prolonged and continuous restlessness. While

regularity in feeding must be maintained, the number of meals may be increased to seven or eight in the day—although, of course, the total amount of food given remains the same. We must from the nature of the case be especially on our guard against over-feeding. Similarly we must set our face against the constant attempt to arouse and amuse the child and the excessive psychical stimulus which thereby results. Feeding should not be attempted immediately after play or when the child is excited. For some time before feeding he should lie by himself in his cot, and restlessness and crying should not avail to alter this routine. The meal should be taken as slowly as possible. If over-feeding and too great psychical stimulation are avoided, and if the nature of the case is clearly explained to the parents, a good deal can be achieved. Neuropathic children are usually thin and meagre, and we must be content with a slow and moderate gain in weight.

In the worst cases the hypersensitiveness seems to extend directly to the innervation of the alimentary canal. It is in these cases that pyloric spasm, with or without hypertrophy of the pylorus, is often developed. Hypertrophic pyloric stenosis has been dealt with in a previous chapter. If explosive and persistent vomiting is a marked feature of the neurosis treatment may be very difficult. Our attempts to soothe the over-excitability of the nervous system may have to proceed a step further. Before nursing or giving the bottle the child may be placed in a hot pack and half a grain or a grain of chloral given. Then when the baby begins to show signs of drowsiness the feeding may be attempted. If vomiting occurs at once so that the whole feed is ejected, a second meal given immediately is often retained. In some cases a warm compress applied to the stomach before feeding is all that is required.

Care must be taken early to accustom the neuropathic infant to take food from a spoon. At five or six months he may be taught daily to take a little fruit-juice in this way. If this is omitted and the child has never drunk from a spoon until nine months or a year, or even more, have passed when the attempt is made, we may encounter a much more formidable resistance because of the increased will-power which has developed. Prolonged refusal to leave the bottle or breast always indicates neuropathy. In some cases it may be

absolutely necessary to remove the child from the surroundings to which he has grown familiar and in which he has grown accustomed to have his own way. If the child is temporarily removed to new and strange surroundings with new attendants, his will-power, so formidable at home, rapidly disappears, and weaning is usually accomplished without any difficulty at all.

It is not possible to give any rule which shall be invariably applied for the diet of nervous children. Breast-feeding is more than usually desirable. If artificial feeding is necessary or has been already instituted, as is usually the case, small and concentrated feeds are sometimes best borne, and for that reason whole milk with added sodium citrate is often more successful than other diets.

CHAPTER XXVI

INFANTILE SCURVY

By infantile scurvy we mean a disorder, occurring in the latter part of infancy, characterized by severe anæmia, by oozing of blood in a variety of situations and especially by hæmorrhage under the periosteum and in the medullary tissue of the bones, by bleeding from the gums, and by hæmaturia. The first accurate descriptions we owe to Sir Thomas Barlow, and the disorder is also commonly known by the name of Barlow's Disease. Möller, Cheadle, and others who had previously recognized and described many of the symptoms had laid too great stress upon its relationship to or identity with rickets. Möller definitely regarded it as a form of acute rickets.

ÆTIOLOGY. Infantile scurvy belongs to that comparatively small group of disorders, which includes also scurvy of adult type, beri-beri, and possibly pellagra, in which the symptoms appear to be evoked by the absence or deficiency of some essential constituent of the diet, which is as yet not capable of being chemically isolated. To these important but intangible substances the name of vitamines has been given. Vitamines, although necessary for undisturbed growth and development, add nothing to the total supply of energy supplied by the food. It is easy to show that they are distinct from the other constituents of the diet, which can be identified by ordinary chemical analysis—fats, carbohydrates, proteins, mineral salts, and water. They are as a class very susceptible to heat, although the temperature destructive to each varies very much. For example, milk in the fresh state contains one substance inhibiting the production of the symptoms of beri-beri, and another which is anti-scorbutic, but the temperature at which each is destroyed is very different (Funk).

Infantile scurvy is most readily produced in infants who have been fed exclusively upon dried milks, condensed milks,

or carefully refined infant foods. It certainly appears to be more common among the children of the well-to-do classes than among the poor, perhaps because among the lower classes one diet is seldom rigidly adhered to throughout, and the child at an early age receives stray morsels from the food of the family. There is some evidence that infantile scurvy is especially common when the diet consists exclusively of one or other of the brands of dried malted milk on the market, and the high price of these confines their use to the well-to-do. Scurvy, however, is not unknown in infants fed upon boiled or pasteurized milk, and cases have even been recorded in which it is said that the child has had no food but breast-milk. It is certain that idiosyncrasy plays a prominent part, and amongst a great number of infants fed in the same way, one only will be affected. Nevertheless, the rapidity with which the symptoms disappear when fresh unboiled milk is given does not permit us to doubt the origin of the illness.

The age of the children to be affected is most commonly between six months and eighteen months, although isolated cases have been recorded both at an earlier and at a later age. Boys are said to be affected more frequently than girls.

SYMPTOMS. Anæmia. All cases are characterized by anæmia of greater or less degree. In many of the dietetic disorders of infancy—in chronic dyspepsia, for example, or in rickets—an unhealthy pallor of the skin is a marked symptom. In such cases, however, an examination of the blood often shows little change in the hæmoglobin percentage or in the number of corpuscles, and we are forced to regard the apparent anæmia as due to vasomotor changes in the skin, an explanation which accords with the readiness with which the child flushes and the ease with which erythematous marks may be produced on the skin by slight pressure. In infantile scurvy, however, the blood picture is often that of a severe secondary anæmia. The hæmoglobin may be reduced below 50 per cent., while the red cells may fall to 2,000,000, and there may be considerable poikilocytosis and anisocytosis. Abnormal cell forms are commonly absent.

Pain. Pain upon moving the limbs is generally the most striking symptom and that for which advice is sought. The legs are most frequently affected, the arms more rarely. The ribs also may be tender. The legs are usually held motion-

less, with the knees and hips flexed, and the thighs abducted. Any attempt to move them from this position—in bathing, for example, or in dressing or undressing the child—produces at once the unmistakable cry of pain. Moreover, it is obvious that the infant is apprehensive of this handling and will cry vigorously at the approach even of those who are accustomed to care for its comfort. Much less frequently tenderness may appear to be absent even when other unmistakable signs of infantile scurvy are present.

Enlargement of the Bones. Swollen areas are apt to appear in various situations, most usually near the epiphysis of the lower end of the femur or the upper end of the tibia. Frequently, too, the ribs at the junction with the corresponding cartilage show a tender enlargement so that a rosary, comparable to that of rickets, may rapidly develop. The swellings in the legs sometimes attain considerable size and the skin over them may become discoloured. Evidence of displacement of the epiphysis, with crepitation, is sometimes found. When separation takes place between the rib and its cartilage, a very characteristic deformity, seen under no other condition, is apt to appear. The sternum, with adjacent costal cartilages and a small portion of the contiguous ribs, appears as though it had been fractured by a blow from the front and had been forced backward. (Barlow.)

Hæmorrhages in other Parts. When teeth have been cut the gums are almost always affected. Where the gum encircles the protruding tooth it becomes softened, spongy, and of a blue or purple tint. At the least touch it bleeds freely. When no teeth have yet appeared this very characteristic symptom is absent.

In advanced cases subperiosteal extravasations of blood are apt to appear on the surface of the cranial bones, especially in the neighbourhood of the orbit. Hæmorrhagic extravasation into the eyelids or under the conjunctiva and exophthalmos may be produced in this way.

Hæmaturia is a frequent and often an early symptom. Subcutaneous hæmorrhage or hæmorrhage under the mucous membrane of the bowel-wall with the passage of blood per rectum is more rarely seen. Fever of mild degree is the rule.

Diagnosis. The diagnosis is usually made with ease in the presence of the characteristic swelling, immobility, and tender-

ness of the legs, accompanied by gingivitis, hæmaturia, and anæmia. Syphilitic periostitis, which produces a somewhat similar pseudoparalysis of the long bones, is rare after the first three months of life, while infantile scurvy seldom occurs before the sixth month. Rheumatism does not occur in infancy. Anterior poliomyelitis, although it produces tenderness, paresis, and immobility of the limbs, is unaccompanied by any swelling or hæmorrhage. Some of the more advanced cases in which a large swelling has appeared at the lower end of the femur have been confused with sarcoma. Rickets, however acute, is not accompanied by hæmorrhage and, in the absence of green-stick fractures, does not give rise to pain and tenderness on movement. In not a few cases the appearance of symptoms of infantile scurvy has led to charges of ill-treatment being preferred against the parents of the child. The crying of the child, the apprehension which it shows when approached, the subconjunctival hæmorrhage and the swollen epiphysis revealing crepitus upon examination, may well excite suspicion in the minds of those who have no experience of infantile scurvy.

Prognosis. In mild cases of short duration suitable treatment may bring about the disappearance of all symptoms within a few days. In a minority of severe cases of longer duration secondary infections may make recovery more doubtful. A case under my own observation died with evidence of pyæmia two days after admission to a children's hospital. Coincident bronchitis, bronchopneumonia, or enteritis renders the prognosis more serious.

Treatment. In the diet, raw, fresh cow's milk of undoubted purity should at once replace all prepared foods and all condensed, dried, boiled, or pasteurized milk. If breast-milk can be obtained, its use will be the most efficacious of all. Two or three teaspoonfuls of the juice of some fresh fruit—grapes, oranges, or currants—given daily, complete all that is necessary in the way of treatment. While the limbs remain tender the child must be handled with great care, and should be moved as little as possible in dressing, undressing, or washing. If the pain is severe, chloral may be used freely for a few days. The complete repair of advanced bony lesions, with separation of the epiphysis, may require several months.

CHAPTER XXVII

THE TREATMENT OF CERTAIN COMPLICATIONS OF DIGESTIVE DISTURBANCES

THE close relationship which exists in susceptible infants between the state of the skin and digestive disturbances has been already referred to. Not only acute dermatitis of the area covered by the napkin, but eczematous and erythematous eruptions widely spread over the whole body may accompany an attack of dyspepsia. The mucous membrane of the mouth is involved in this liability to catarrhal inflammation, and various forms of stomatitis are frequently found.

THRUSH. The *Oidium albicans*, the fungus which produces the so-called thrush, is found in the mouths of almost all infants, however well cared for. It is, however, only under conditions very favourable for its growth and development that the colonies of the fungus become macroscopically visible as white patches upon the tongue and inner aspects of the cheeks. An excessive dryness of the mucous membrane of the mouth appears to be especially favourable to its growth. The spreading of thrush in the mouth is therefore common in the wasting disorders of infants, and perhaps especially in those which are pyrexial.

Treatment. No attempt should be made to remove the fungus by direct friction. The patches form again with great rapidity and they cannot be rubbed off without risk of injury to the superficial layers of epithelium. A strong solution of boracic acid, or of sodium bicarbonate, or of the glycerinum acidi borici may be applied with a camel-hair brush at frequent intervals. A good plan is to fold a piece of clean gauze in such a way that it forms a pad of a size suitable for the child to suck, while it contains in its centre a little boracic acid powder and saccharin.

APHTHOUS STOMATITIS. In older children about the time of the eruption of the milk teeth another form of stomatitis is apt to occur, the so-called aphthous or fibrinous stomatitis. Upon the tongue, especially on its tip and sides, and on the inner aspect of the lips and cheeks small whitish patches appear, which are about the size of the vesicles of chicken-pox. The patches consist of small areas of necrotic epithelium. They do not show any ulceration, and vesicles or pustules are not found. The white coating cannot be separated from the underlying epithelium, and it is not composed of a definite membrane like that of diphtheria. The sockets of the teeth are not involved, and the teeth do not become loosened as is found in ulcerative stomatitis. Although salivation is profuse, the breath is not foetid. The child usually holds the mouth slightly open, and the saliva is apt to overflow, causing reddening and irritation of the lower lip and chin. The glands behind the angle of the jaw become enlarged and a little tender. It is easy to see that the condition of the mouth is a source of irritation, and the child persistently endeavours to rub the gums with any object within his grasp. Food, and especially hot food, may be refused altogether.

We do not know the cause of this form of stomatitis. It appears most commonly in children who are convalescent from an attack of enteritis which has been marked by irregular pyrexia and diarrhoea. It is rare among the children of the upper classes, but very common when little attention is paid to cleanliness. It is probable that the mucous membrane of the mouth takes part in the catarrh which affects the rest of the alimentary tract, and that the irritation encourages the child to convey a variety of infected objects to the mouth, with the result that the mucous membrane becomes further infected.

Treatment. By bandaging a strip of wood to the flexor aspect of the arms, the elbows can be kept extended so that the child's hands cannot reach the mouth. The nails should be cut very short and kept scrupulously clean. Silver nitrate 1 per cent. may be painted over the patches with a camel-hair brush, or, using an ordinary ear-syringe, the mouth may be douched with a 3 per cent. solution of hydrogen peroxide or a 0.1 per cent. solution of potassium permanganate. In using the syringe the child should be held upright, with the head

bent well forward and to the side opposite to that of the cheek against which the stream is directed. The nurse should wear a mackintosh apron. All lotions used should be cold. A fluid diet, lukewarm or cold, should be prescribed.

HERNIA. Hernia, both umbilical and inguinal, is frequent in infancy. Although common enough in well-nourished and muscular infants, it is relatively much more often found in meagre infants who have long suffered from the effects of chronic dyspepsia. When the abdominal muscles are stretched and atrophied by the pressure of the distended coils of intestine, and when there has been a great loss of subcutaneous and extra-peritoneal fat, the abdominal wall is apt to give way at its weakest points—the inguinal ring, the umbilical cicatrix, or the line of junction between the two recti muscles. It is difficult to determine how far inguinal hernia is produced by congenital defect. It is certain, however, that colic and flatulence play an important part in the production of hernia, whether by opening up a sac which has failed to become obliterated in development, or by actually producing the diverticulum by direct pressure. The frequent association of inguinal and umbilical hernia in the same infant teaches the importance of colic and flatulent dyspepsia in the production of both. In premature infants hernia is unduly common, but so also are the symptoms of dyspepsia. The presence of hernia is almost the rule in cretins and in Mongolian infants, but in these cases also it is commonly accompanied by general abdominal distension and weakness of all the abdominal muscles. Phimosis and preputial adhesions play but a small part in the production of hernia, and their importance has probably been much exaggerated. In infancy the cough is so little developed that bronchitis is less important in the production of hernia than in adults.

Treatment. The majority of hernial protrusions present during the first months of life disappear in the course of the first year. A very small number of the umbilical hernias and a larger number of the inguinal persist. The assumption of the upright position and the rapid development of the pelvic cavity which accompanies this change are probably helpful in assisting this spontaneous disappearance. The smaller the hernia and the better it is supported during infancy, the more likely it is to disappear. Treatment must aim at

controlling the colic and abdominal distension by a suitable modification of the diet. If this can be achieved, and if a rapid improvement takes place in the general condition of the infant and especially in the nutrition of the abdominal wall, experience shows that the hernial protrusion is usually short-lived. Treatment by means of a truss alone, without modification of the diet and correction of the abdominal distension, is seldom successful, and in this attempt time is often wasted during which the stretching of the orifice continues and the likelihood of spontaneous cure diminishes. The benefit derived from the use of the woollen truss usually recommended is very doubtful. If colic is persistent and the infant is constantly straining and crying, it is quite incapable of controlling the hernia. Its use is, however, to be recommended both as an additional safeguard and because it helps to reassure anxious parents, who, noticing that the hernia descends whenever the infant is attacked by a painful spasm of colic or breaks into a fit of crying, are only persuaded with difficulty that the hernia is in itself painless. Similarly a broad flannel belt, fitted with a light pad, should be worn over an umbilical hernia, or we may use strips of adhesive plaster, applied transversely to draw a fold of subcutaneous tissue inwards over the umbilicus from both sides.

If the hernia still persists at the end of one year and after the infant has learned to walk, an operation should be advised. When the condition of the abdominal wall remains unsatisfactory and there is still great distension of the gut and muscular atrophy, surgical interference may be delayed even longer in the hope of improvement and in order to diminish the risk of recurrence after the operation.

In infancy strangulation of the intestine in a hernial sac is very rare.

PROLAPSE OF THE RECTUM. Prolapse of the rectum is much less common in infancy than in children in the second or third year of life. It is found for the most part in children with protuberant abdomens and feeble musculature. Often the recti muscles are separated. As a rule prolapse is a complication of acute diarrhoea, accompanied by straining and tenesmus. It is less frequently preceded by constipation. Acute colitis is especially liable to be accompanied by some degree of prolapse of the rectum, as in the following case :

ILLUSTRATIVE CASE. J. G., aged two years, was admitted for acute diarrhoea, with the passage of blood and mucus. A mass had been felt low down in the rectum, which had been replaced with difficulty, and a diagnosis of intussusception had been suggested. The temperature was 101° F. A diagnosis of acute colitis and prolapse of the rectum was made. For some days the condition improved, but on the sixth day the temperature rose, and evidence of pericarditis developed. Death ultimately took place and the autopsy revealed acute pneumococcal colitis, pericarditis, and pleurisy.

In the same way the straining and tenesmus which are often a marked feature of acute follicular colitis, a common infection in the second year of life, not infrequently produce prolapse of the rectum in greater or less degree and increase the similarity between the symptoms of colitis and intussusception.

Treatment. The replacement of the prolapsed gut, should it have protruded from the anus, is not usually a matter of difficulty. Douching with hot or cold saline solution will sometimes assist steady pressure in an upward direction. If the projecting portion of gut is large it should be covered with a cloth which has been wrung out in boiling water and steadily compressed for a few minutes. During these manipulations the child should be placed in the lithotomy position and if necessary anæsthetized. After replacement has been effected the buttocks should be strapped together.

For some weeks afterwards defæcation should be attempted with the child lying upon his side. If this is resented, or if the prolapse recurs, an enema must be administered twice daily in order to wash out the contents of the rectum passively and to prevent the bowels acting with forcible downward peristalsis and increased abdominal pressure. As a rule, with the cessation of the diarrhoea or colitis, the tendency to prolapse disappears. If there is constipation, the bowels should be kept loose by a laxative, such as cascara sagrada or senna. An operation is very seldom needed.

CHAPTER XXVIII

WEANING. MIXED FEEDING AND THE DIET IN EARLY CHILDHOOD

It only remains to note shortly the rules which guide us in weaning the child and in gradually increasing the complexity of the diet.

WEANING. As a rule the infant should be weaned when nine months old. The time selected has varied much in the history of our own people, and even at the present day there are wide differences in practice in different countries (Forsyth). By the ninth month, however, the incisor teeth should be fully erupted. Infants who are suckled for more than one year are apt to become anæmic, perhaps because of the exhaustion of that depot of iron which each child brings with him into the world, and which is not sufficiently replenished by a diet consisting only of milk (Bunge).

Weaning should always be gradually accomplished. If the child is being nursed five times in the twenty-four hours, at 6 A.M., 10 A.M., 2 P.M., 6 P.M., 10 P.M., the feed at 10 A.M. or 2 P.M. should be replaced by five or six ounces of milk, suitably citrated. At intervals of a few days another breast feed may be omitted and another bottle feed take its place, until weaning becomes complete. Should dyspepsia supervene, a return must be made at once to exclusive breast-feeding. In susceptible infants the attempt may have to be renewed repeatedly before weaning is successfully accomplished without disturbance. Weaning in this gradual way is safer, because breast-nursing can always be resumed in case of emergency. It is also less irksome to the mother, who does not experience the discomfort and pain of a sudden accumulation of milk in the breasts.

It is well to be careful at first to prescribe an amount of milk which is within the limits of the child's power of digestion. It is of little account if the weight curve remains stationary for a week or two, and the risk of dyspepsia from over-feeding

or from the too early addition of other foods must be avoided. More than two pints of milk should never be given.

Diet from the Ninth to the Twelfth Month. Between the time of weaning and the end of the first year small additions may be made to the diet tentatively. To some or to all of the milk feeds a little baked flour or a food consisting of partially dextrinized flour may be added. A vegetable purée, made with tomatoes, spinach, carrots, or other vegetables, may replace the milk at one meal. Rusks or biscuits or crisp toast will afford the infant practice in biting. Cod-liver oil, malt extract, and cream are seldom needed.

Difficulties in Weaning. Although the difficulties which are met with in weaning are common enough in practice, they are seldom long sustained and usually yield in a few days to energetic measures rightly directed. The most frequent difficulty is the powerful resistance of the child against the proposed change. An infant nursed at the breast may resolutely refuse to suck from a bottle, although sucking well from the breast. Another child will offer a prolonged resistance to the attempt to induce him to enlarge his dietary and take food from a spoon. As has been mentioned before, both of these difficulties are encountered chiefly in excitable children of neurotic inheritance (*vide* p. 187). Often enough the mother or nurse is confessedly incapable of resisting the child's will. To force the child to leave the breast, it may be necessary to abandon the usual practice and wean suddenly. A visit of short duration to new surroundings and new attendants may be all that is required to break down the opposition which at home was so formidable. Steady and patient persistence is always successful. The difficulty is never alarming, although it may distress the mother and be prolonged by her inability to resist the child's cry. Not a few infants never learn to suck from a bottle at all, but after weaning are fed by spoon until they have learned to drink from a cup. All this trouble can be prevented if it is made a routine practice to accustom the breast-fed child from an early age to take food occasionally from a bottle and from a spoon. A breast-fed infant of a few months old may be given a little water daily from a bottle, and from the sixth month onwards a little meat-juice or fruit-juice from a spoon. At an early age resistance is not encountered, and the habit once formed is not again lost.

MIXED FEEDING. In practice it is quite usual, from the sixth month onwards, or even earlier, to replace one nursing at the breast by a feed from the bottle, in order to lessen the tie of nursing for the mother, and there can be no objection to this practice provided only that the infant is vigorous and the supply of milk so ample that there is no risk that we shall encourage the involution of the breast by diminishing the amount of suction. If dyspepsia should develop, or if the child should sicken of some infective disorder, a return must be made to exclusive breast-nursing and considerations for the comfort of the mother should not have weight.

In former chapters it has been urged that in young infants and when the mother's milk is deficient in amount to combine breast and bottle feeding—so-called mixed feeding—is a practice which has serious drawbacks. The loss of suction stimulus, which the giving of artificial food entails, reacts on the breast and causes a still further diminution in the amounts of milk secreted. On the other hand, in the later months of lactation mixed feeding is often very successful, and in every way preferable to complete weaning. Attention to two points will diminish the risk that the infant may refuse the difficult breast and drink only from the easily running bottle. In the first place the aperture in the rubber teat should be small and should call for a considerable effort of suction. In the second place, when breast and bottle are given alternately, the interval between any one bottle feed and the breast feed following should be longer than the corresponding interval between a breast feed and the next bottle feed. In these ways we may hope to hold in check the tendency to involution which the breast is apt to show when the suction stimulus is seriously diminished.

Diet in the Second Year of Life. With the beginning of the second year the diet becomes more varied. The midday meal may be changed from one of milk to one consisting of mashed vegetables and gravy, with milk pudding. One after the other, a little lightly boiled egg, boiled fish with egg-sauce, bread and butter, stewed fruit divested of all stones, skins, &c., and finally a little chicken or mutton mashed to a fine consistence, are added to the dietary. Here again resistance may be met with, and the child may for a time refuse all food except milk. At first the amounts offered should be very small. The

object in difficult cases is not so much to replace any considerable part of the milk by the new food as gradually to accustom the child to the new flavours and the altered consistence of the diet. If an attempt is made to force an unwilling child to consume a large helping, every meal-time resolves itself into a struggle, and the child comes to associate the attempt with force and the resistance to force. During all this time, while the child gradually accustoms himself to new sensations, the amount of milk taken in the day need not be reduced. On the other hand, when the desire for the new food develops and larger amounts are taken, the daily intake of milk is gradually reduced to one pint *per diem*. Mothers will often omit to do this, and the complaint will sometimes be made that a child of two years or even older refuses nearly all articles of food, dislikes vegetables, will not eat milk pudding, and so forth. In such cases inquiry will sometimes show that the child is still drinking two pints of milk or even more in the day. Such an amount is of itself almost sufficient to cover the needs of the child for food, and the refusal to take further amounts of food is explained. The practice of allowing the child to drink milk freely with the chief meal of the day or in order to quench thirst is especially harmful. From the time when a midday dinner is taken water only should be drunk with the meal.

Care should be taken that all the food is not of too soft a consistency. In addition to the soft food, the child should be given at least once a day something hard on which he may bite, as, for example, a hard crust, a piece of raw apple, or the leg bone of a chicken. Although the nourishment so obtained is very slight, the exercise is important for the proper eruption of the teeth.

The following scheme represents a diet suitable for a child of about eighteen months of age :

7 A.M. Milk (six ounces), with Benger's or porridge and milk.

10.30 A.M. Milk (six ounces), rusk or biscuit or a small piece of banana or other fruit.

1.30 P.M. Vegetable soup made with milk, or broth, or chicken soup, or mashed vegetables and gravy, or cauliflower and egg-sauce, or spinach and egg, or boiled fish and egg-sauce.

Milk puddings or baked apple or other stewed fruit without stones or skins, and cream.

5 P.M. Milk (six ounces), bread and butter.

APPENDIX A

RECIPES

1. *Barley Water.* A heaped teaspoonful of prepared barley is mixed with a little cold water to make a thin paste; boiling water is then added to make half a pint, and the whole poured into a saucepan and boiled for five minutes, with constant stirring.

Useful at times as a diluent of cow's milk, especially when there is marked vomiting of curd (p. 30), or constipation (p. 137).

2. *Whey.* Take half a pint of skimmed milk, heat it to about 98° F., and add a teaspoonful of essence of rennet. Set the milk to stand by a fire or over a lamp until it is set, keeping the temperature constant at about 98° F. When set, break up the curd with a knife and let it stand for a quarter of an hour, when the curd will sink. Then pour the whey into a saucepan and boil quickly.

Useful in the treatment of the vomiting in pylorospasm (p. 164), and, with the addition of carbohydrates, in the treatment of atrophy upon a diet of cow's milk (p. 85), and in anaphylaxis upon a diet of cow's milk (p. 88).

3. *Peptonized Milk.* A pint of milk is diluted with a quarter of a pint of water and slowly warmed to a temperature of 140° F. A teaspoonful of liquor pancreaticus, twenty grains of bicarbonate of soda, and a pinch of salt are then added. The mixture is kept at a temperature of 140° F. until the moment when a bitter taste becomes perceptible, usually after about fifteen minutes, when the whole is rapidly boiled to arrest the further action of the ferment. Before peptonization some part of the fat may be removed if desired.

Useful in enteral and parenteral infection in young infants (pp. 71, 72), in anaphylaxis upon a diet of cow's milk (p. 88).

4. *Milk with Malt Extract.* Four teaspoonfuls of baked flour are rubbed into a fine paste with a little milk. With constant stirring, more milk is added up to twelve ounces. The mixture is then strained through a sieve. In another vessel ten teaspoonfuls of extract of malt are dissolved in twenty-four ounces of lukewarm water, with twenty grains of carbonate of soda. The contents of the two vessels are then mixed and slowly, with constant stirring, brought to the boil and kept boiling for two minutes.

Useful in atrophy upon a diet of cow's milk (p. 85), enteral and parenteral injections in older infants (pp. 71, 72), spasmophilia (p. 153), constipation (p. 138). The soapy, foul-smelling stool rapidly gives place to a brown, somewhat fluid motion without smell. This mixture should not be continued as the sole diet for longer than three weeks, and should be diluted if used for infants under three months of age.

5. *Baked Flour.* A pint of wheat flour of good quality, without bran, is tied tightly in a pudding-bag. This is placed in a saucepan of water and boiled constantly for eight or ten hours. It is then allowed to cool, and, after removing the bag, the outer covering of dough is cut away. The yellowish-white interior of the mass, which consists largely of dextrin formed from the starch, is reduced to a powder by grating, baked in an oven with the door left open, and stored in an airtight canister. When used, it is to be rubbed into paste with a little milk as directed under Recipe 4.

Useful as an addition to cow's milk in the later months of infancy (p. 28) and to control constipation (p. 138).

6. *Finkelstein's Albumen-Milk.* One litre of milk is treated with a teaspoonful of liquid rennet. This is then placed in a water-bath for half an hour at a temperature of 107° C. until set. The whole is then placed in a linen bag, and the whey which filters off in half an hour is rejected. The remaining curd is then mixed with half a litre of water and twice worked through a very fine hair sieve. Half a litre of butter-milk is then added.

Useful in the treatment of acute fermentative dyspepsia (p. 58), intoxication (p. 93), and certain cases of marasmus (p. 112). It contains fat 2.5 per cent., sugar 1.5 per cent., protein 3 per cent., and ash 0.5 per cent. It is to be used in small quantities during the height of the disturbance, when the green and watery stools may be rapidly replaced by a formed, alkaline motion. After some days sugar, usually malt-sugar, 4 per cent. to 6 per cent., must be added.

7. *Vegetable Soups for Infants.* (a) *Spinach.* Take eight ounces of fresh young spinach, wash in cold water, and boil for about five minutes with one pint of boiling water and a pinch of salt. Mince the spinach finely as soon as it is well cooked, and during this time boil the water down considerably. Strain twice with this through a hair sieve, adding half a teaspoonful of butter the second time.

(b) *Purée of Carrots.* Six ounces of carrots (without the greens) are washed in cold water and scraped and cut into discs. They are cooked for three-quarters of an hour in half a pint of water with a pinch of salt. Drain and boil down the drained-off water. Add to this half a teaspoonful of butter and a quarter of a teaspoonful of sugar. Add the whole to the carrots and strain through a hair sieve.

(c) *Purée of Green Peas.* Shell 1 lb. of fresh green peas. Place them in a pot with six ounces of water, half a teaspoonful of butter, half a teaspoonful of sugar, and a little salt. Cook for half an hour over a slow fire and then strain through a fine hair sieve.

Other vegetables may be used in the same way.

Useful in the dietary of infants in the later months of infancy (p. 199), in the control of constipation (p. 138), in anæmia and in spasmophilia (p. 153), and in older infants in enteral and parenteral infection (pp. 71, 72).

APPENDIX B

METRICAL WEIGHTS AND MEASURES AND THEIR EQUIVALENTS IN THE IMPERIAL SYSTEM

- 1.00 = 1 gramme, equal to about 15 grains (15.432 grains).
 0.10 = 1 decigramme, equal to about $1\frac{1}{2}$ grains (1.5432 grains).
 0.01 = 1 centigramme, equal to about $\frac{1}{8}$ grain (0.15432 grain).
 0.001 = 1 milligramme, equal to about $\frac{1}{80}$ grain (0.015432 grain).
 0.0001 = 1 decimilligramme, equal to about $\frac{1}{800}$ grain (0.0015432 grain).

- 1 c.c. = 1 cubic centimetre = 16.9 minims.
 3.54 c.c. = 3.54 cubic centimetres = 1 fluid drachm.
 28.35 c.c. = 28.35 cubic centimetres = 1 fluid ounce.
 567 c.c. = 567 cubic centimetres = one pint.
 4536 c.c. = 4.536 litres = one gallon.

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