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THE PHYSIOLOGICAL FEEDING OF INFANTS

ERIC PRITCHARD

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THE

PHYSIOLOGICAL FEEDING OF INFANTS

A PRACTICAL HANDBOOK OF INFANT FEEDING, AND KEY TO THE "PHYSIOLOGICAL NURSERY CHART"

BY

ERIC PRITCHARD, M.A., M.D. (OXON.), M.R.C.P. (LOND.)

SECOND EDITION
GREATLY ENLARGED AND ENTIRELY REWRITTEN

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PREFACE.

When the first edition of this little book was written, my object was to describe briefly a method of accurate percentage feeding which I had found useful in my own practice. This method was founded on the American system of percentage feeding, but simplified and adapted to the requirements of our own nurseries. The many flattering testimonials to the merits of the system which I have received from practitioners and from nurses, who have adopted my method, have induced me now that the first edition has come to an end to rewrite and greatly amplify the description of the method. In doing so I have kept strictly in view certain objects. Firstly, to avoid as far as possible technical terms and expressions which would not be understood by a trained nurse of average intelligence. Secondly, to insist that there is no royal road to success in the feeding of infants, but that every case must be judged on its own merits and the food

adapted to the physiological requirements of the individual baby. There are still many people who appear to imagine that the art of infant feeding consists in the application of a universal formula for the feeding of all cases, no matter what be the age, or what be the idiosyncrasies or constitution of the infant. Others hold strong views on the question of boiled and unboiled milk, and exhaust their energies in trying to convert others to their own particular way of thinking. For my part, I believe that any person who understands the true principles of physiological feeding can manage the dietary of any infant with success, no matter what be the particular food which is employed. The success or failure of any system of feeding depends upon the manner in which it is applied rather than on the method itself. The proof of the appropriateness or the reverse of a food for any particular infant is shown by the development, the progress and the symptoms of the infant himself. If these are not satisfactory the food must be modified in accordance with the indications, but not necessarily changed. It has been my object to explain in this little book the indications both of satisfactory and unsatisfactory progress, and to indicate how to obtain the one and avoid the other. In Part II. I have attempted to explain as clearly

as possible the indications of satisfactory progress, so that those who refer to these pages may recognise undesirable and morbid symptoms at an early stage while they are still amenable to simple dietetic treatment.

My best thanks are due to Dr. E. H. Colbeck for many valuable suggestions and for correcting the proof-sheets of this book.

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PART I.

INTRODUCTION.

BEFORE proceeding to a description of the method of artificial feeding, which forms the subject-matter of this little book, I propose to criticise briefly the more important methods of hand feeding which are employed at the present time, to describe wherein, according to my opinion, they are unsound in principle, or unsatisfactory in practice, and to indicate the main principles which I conceive should guide us in the scientific and rational management of an infant's dietary. There are even at the present day a considerable number of medical men who believe that cow's milk, diluted with water in varying proportions, is the *ultima Thule* of infant feeding. And it goes without saying that this opinion is shared by a considerable following of mothers and nurses. Mercifully for the sake of posterity and the rising generation, the chastening operations of natural selection are slowly but surely eliminating these dangerous anachronisms. I do not for one moment mean to imply that an exclusive diet of milk and water is the worst which can be offered to an infant; indeed, I am prepared to admit that a perfectly healthy infant will thrive and wax strong on such a diet. Nay, I would go

further, and give it as my deliberate opinion that the interests of an infant's health would be better considered by adhering to this old formulary than by following the more modern practice of fortifying sterilised and pasteurised milk with patent foods. My main objection to the employment of milk and water as a routine dietary is a very practical one, namely, that it is only strong and healthy infants who can survive this rule-of-thumb treatment. Weakly and delicate infants almost invariably demonstrate the unsuitability of this method by symptoms of indigestion or imperfect nutrition. It does not require any great stretch of imagination, nor the application of any high degree of inductive reasoning, to recognise that a method which produces evident and demonstrable symptoms of disease in the weak is not a safe method for general use.

The art of infant feeding, as I shall hope to show in the following pages, is to suit the dietary to the physiological needs of the infant; but inasmuch as no two infants are moulded or constituted alike, it is clear that there can be no universal formulary which is scientifically applicable for all infants. What is a physiological diet for one becomes pathological for another.

An infant has physiological needs for a number of different elements of food which are combined in human milk in proportions which are, as a rule, well suited to his requirements; in cow's milk the same elements, or approximately the same elements, are combined in proportions which are adapted to the physiological needs of the calf. No amount of dilution will alter the relative pro-

portions of the elements in the latter so as to change them into the proportions which are suitable in the case of the human infant. By dilution we may and do alter the strength, but we cannot modify the relative proportions. If we admit, and I cannot see how it is possible to do otherwise, that different individual infants have different requirements with respect to the quantities of the various elements of their food, I maintain that those who assert that these nutritive requirements can be adequately satisfied by mere dilution of cow's milk are grossly ignorant. Now, although different samples of human milk are by no means uniform in chemical constitution, these differences are insignificant when compared to the degree in which they differ both chemically and physiologically from ordinary cow's milk. The chemical differences may be seen at once by referring to the accompanying table :—

	Water.	Fat.	Sugar.	Casein and other Proteids.	Ash.
Cow's milk (average) according to H. D. Richmond[1] . .	87·10	3·9	4·75	3·4	0·75
Human milk (average) according to H. D. Richmond . .	88·2	3·3	6·8	1·5	·2

Now, modern methods of infant feeding have, for the most part, aimed at the chemical modification of cow's milk to the standard of mother's milk, but the methods of attaining this object have been different. It will be noticed from a reference to the above table that cow's milk contains on an

[1] H. Droop Richmond, *Dairy Chemistry*. Griffin, 1899.

average nearly 4 parts (3·4 to be exact) of proteids[1] per 100 parts of milk, and that human milk contains 1·5. In other words, as far as this element is concerned, cow's milk is rather more than twice as strong as human milk. It is clear, then, that if cow's milk be diluted with an equal part of water, the percentage of proteids will be reduced to nearly the same strength as that of human milk, namely, 2 parts in every 100 (2 per cent.). But if this diluting process be adopted, all the other elements in the milk will be reduced in the same proportion, that is to say, the fat (cream), the sugar (lactose) and the salts will be reduced one-half: the percentage of fat will consequently be lowered to 1·75 parts in 100 and the sugar to 2·25. On comparing these figures with the ordinary standard of human milk, they will be found much too low, and practical experience proves that they are entirely unsuitable for the successful rearing of infants. The proportions can, however, be corrected, and brought up to the standard of human milk by the addition of adequate quantities of cream and sugar. This method of diluting milk with water and adding cream and sugar was one of the earliest of all

[1] Throughout this book it has been assumed that the average percentage compositions of human milk and of cow's milk are as follows:—

	Fat.	Sugar.	Proteids.
Human milk . .	4·	6·5	1·5
Cow's milk . . .	3·5	4·5	4·

These figures are for practical purposes quite accurate enough, although they do not quite agree with those given by Mr. Richmond.

the methods of scientific milk modification; and I will say at once that even at the present day I believe it to be the simplest, the best, and the most scientific. However, when this principle was first applied to the modification of milk, the operation was carried out in a rough and ready manner, with no appreciation of the importance of cleanliness, of accuracy, or of the refinements of which the method has subsequently proved to be capable.

Nevertheless, comparatively early in the history of milk modification another suggestion was made for reducing the proportions of the various elements (proteids, fat and sugar) in cow's milk to those required for infant feeding. This method consisted in allowing milk to stand for a certain number of hours and in syphoning off or pouring off the upper portion, and in diluting with varying proportions of water. If milk be allowed to stand, say for four hours, practically all the cream will rise and be contained in the upper half. This upper half, therefore, will contain twice as much cream as is normally contained in undiluted cow's milk, and if it be mixed with an equal quantity of water, the resulting mixture will possess approximately the same quantity of fat and proteids as human milk; so that, if an adequate quantity of sugar be further added, this variety of modified milk makes, as far as its chemical constitution is concerned, a very fair substitute for maternal milk.

This, then, is the principle which is employed in the preparation of Meig's famous mixture. By allowing milk to stand for various periods of time, and by syphoning or pouring off the top portions down to different levels, and by subsequent dilution,

mixtures may be prepared containing various proportions of fat and proteids. This method has more recently been amplified and extended by Dr. Henry Dwight Chapin, of New York, who has devised a graduated bottle for the purpose ; by the use of a special table in combination with this bottle, it is possible to prepare milk mixtures of the percentage composition which are more usually employed.

The method has many advantages, and I advise those who are interested in the subject to read Dr. Chapin's book on *The Theory and Practice of Infant Feeding*,[1] in which a full account of the method is given. There are clearly advantages in this method. It can be carried out at home, it is inexpensive and fairly accurate. However, if the percentage composition has to be altered from time to time, as indeed it should be in accordance with the varying needs of the infant, all sorts of difficulties at once creep in. Complicated tables have to be referred to, and the milk in all cases has to be allowed to stand for several hours before the mixture can be prepared. Although the disadvantage of bacterial contamination can be counteracted by keeping the milk on ice during the rising of the cream, this delay in the preparation is, to my mind, a sufficient reason for condemning this method for general application.

Now these so-called "top milks" are in reality nothing more nor less than creams of varying strength: much of the cream now sold in the towns is to all intents and purposes "top milk" which contains a large percentage of fat. An average sample of gravity

[1] *The Theory and Practice of Infant Feeding*, by Henry Dwight Chapin, M.D. Bailliere, Tindall & Cox.

cream (skimmed) contains about 16 parts of fat in 100 parts of cream (16 per cent. of cream). However, in the process of separating cream by skimming there is no certainty about the amount of fat which it will contain. Sometimes there will be as much as 20 per cent., sometimes as little as 8 per cent. of fat. Owing, however, to the newer process of separating cream from milk by the centrifugal method, it is possible to obtain with very little trouble a cream which accurately contains any desired proportion of fat. And thus it has come about that the old plan of preparing "Meig's Mixture" by a gravity method is at the present time more often replaced by one which depends on the use of accurate percentage creams obtained by the centrifugal method.

The substitution of centrifugal for gravity creams in the preparation of percentage mixtures has, I know, many advocates. For my part, I view with suspicion any milk or cream mixture which has been subjected to the process of centrifugalisation. No one is able to explain the precise effect of mechanical agitation on the vital and natural properties of milk. Indeed, some authorities deny that it has any deleterious influence at all. But the fact remains that scurvy and other disorders of nutrition are by no means unknown among infants who have been fed exclusively on Gærtner's, Backhaus's and similar milks, which depend for their preparation on the principle of centrifugalisation.

Progress in the methods of accurate percentage feeding was advanced many stages by the institution, in 1891, of the first Walker-Gordon milk laboratory in America. Since that time the number and

the scope of these establishments have been greatly increased, and it is impossible to exaggerate the benefits which directly and by example have been thereby conferred upon all branches of infant feeding.

These laboratories, which we owe to the genius of Dr. Rotch, are associated with dairy farms, which supply raw milk as free from germs and other contamination as aseptic, antiseptic and hygienic precautions can render it. The breed, the health, the feeding and indeed the toilet of the cows on these farms are attended to with solicitous care. The cows are milked under the most elaborate precautions, and the milk itself rapidly conveyed in closed vessels to the laboratories, where it is modified for use.

Thus the first element in the successful feeding of infants, namely, a pure supply of milk, is amply provided for, and as a result of the special care observed in the selection and feeding of the cattle on the Walker-Gordon farms, laboratory milk may be said to have an almost uniform percentage of its own at all times of the year. The laboratories themselves are kept in the same degree of scrupulous cleanliness which pervades all departments of the farms, and indeed almost as much aseptic ritual is observed in the handling of the milk in these establishments as is observed in the management of an up-to-date operating theatre. The rooms in which the milk is received are isolated, kept dust free, and maintained at a low temperature. And the same precautions are taken in the care of the practical laboratories where the milk is separated and modified. And finally the prescriptions for milk mixtures as ordered by the physician are dispensed by

the modifying clerks by a suitable combination of centrifugalised cream, separated milk, carefully prepared 20 per cent. solution of milk sugar and freshly prepared lime water, all of which ingredients stand ready at hand in jars with tightly fitting covers. The feeding tubes or bottles, the exact size and number of which are specified in the prescription, are filled by the clerks in accordance with the formula, stoppered with sterile, non-absorbent cotton, packed in racks or baskets devised to hold the number that is needed, and then if necessary sterilised. The rule of absolute cleanliness is carried out in every possible detail of the process, and the day's supply of modified milk is forwarded to every customer with the greatest possible despatch.

The above account of the process of laboratory milk modification, which is mainly drawn from Judson and Gitting's work on infant feeding,[1] does not profess to include particulars of the actual process of modification followed at the Walker-Gordon laboratories. These details appear to me to be unnecessary, as they cannot well be applied to the ordinary method of home modification. Those who wish for further details are referred either to Rotch's *Pediatrics*,[2] or to Judson and Gitting's book, which is mentioned above.

The Walker-Gordon laboratories have demonstrated to the world that a pure, uncontaminated milk supply for the purpose of infant feeding is no dream of Utopia, but a practical and feasible possibility. They have further proved that it is not only

[1] Judson and Gitting, *Infant Feeding*. Lippincott, 1902.
[2] Rotch, *Pediatrics*. Lippincott, 1902.

possible to dispense a milk of any desired composition, but they have enabled a host of competent physicians to record accurately their observations and to describe the results of their investigations in the intelligible symbology of percentage prescriptions.

Thus, under the tutelage of Dr. Rotch, there has grown up a school of rational therapeutics which, in the treatment of infantile symptoms, looks neither to drugs nor to pharmaceutical preparations, but depends solely and absolutely on the expedients of exact physiological feeding. It is only by the application of the principles of exact percentage feeding that we can hope to repeat our successes, or to avoid the recurrence of failures. The physiological feeding of infants is, or should be, an exact science, and it is to Dr. Rotch that we owe the very A B C, the very terms and the symbology in which this science can be accurately expressed. To advise that an infant of such-and-such a constitution, or one suffering from such-and-such symptoms should be fed on Dr. "So-and-So's" mixture conveys no meaning to anybody, but to write out a definite formulary in the symbols of a percentage prescription is a method which can be understood all the world over, and carried out with the utmost exactness. To write in percentages, to think in percentages, and to talk in percentages is, as Dr. Rotch justly remarks, the only possible means of obtaining accuracy in the management of infant feeding.

I have in the preceding paragraphs expressed my profound appreciation of Dr. Rotch's work, and of his principles for the supply of pure milk and milk mixtures of accurate percentage com-

position. There are, however, to my mind, certain objections to the method as carried out at the Walker-Gordon laboratories which are sufficient to interdict a general extension of the method in this country at least. In the first place there is the question of expense: this is no inconsiderable factor, although Dr. Rotch maintains that the mere question of expense ought not to weigh as a serious objection provided the system is the best that is practicable. In the long run the best system must prove the most economical, and in this I am bound to agree with him.

Although it is absolutely impossible to find fault with the Walker-Gordon method of obtaining a pure supply of milk, I do not believe that the principle of separating milk into its constituent elements by centrifugalisation and then of recombining them according to prescription is the best or even a good means of dispensing a milk mixture, although as far as mere accuracy is concerned no possible fault can be found with it. I believe that the less milk is chemically or mechanically interfered with the better for the milk and the better for the infant who consumes it. And I believe that infants who have been continuously fed on laboratory milk show less stamina and less resistance to disease than those who have been reared on milk which, though modified, has not been subjected to the mechanical manipulation adopted by these laboratories; moreover, competent observers have recorded instances of infantile scurvy which they have ascribed to the consumption of laboratory milk. Further, I think that, if the percentage modification of milk is to

be used as an expedient in the practical treatment of disease, it is desirable that we should have the means at hand of applying this expedient with the least possible delay. These conditions cannot be fulfilled by employing laboratory milk.

It may, perhaps, give occasion for surprise that among the methods of infant feeding referred to above no mention has been made of any method which depends on the employment of a patent food. This omission is deliberate. No method of feeding which is exclusively based on the use of these patent foods deserves honourable mention among those which have a claim to be considered scientific, although as adjuncts to milk or for occasional use they possess undoubted advantages. At the present day no pediatrist of experience either in England, America or Europe has a good word to say for these preparations, except as temporary expedients in times of emergency.

Thanks to the elasticity of the percentage method of feeding, any desired alteration in the composition of the food can be effected without the assistance of proprietary articles. The popularity of patent foods in their application to infant feeding is not far to seek. In times past they served as an excellent cloak to the ignorance of those medical practitioners whose resourcefulness was only limited by the length of their repertoire of proprietary preparations. When, owing to their ignorance of the true principles of scientific feeding, the infant's digestion broke down, or his general nutrition showed signs of failing, the Beelzebub of empyrical practice was ever at their elbow to suggest some fresh expedient in the form of a new

and untried patent preparation, the composition of which was as unknown as its ultimate failure assured. Thus the unfortunate victims of this dietetic ignorance passed from the Scylla of preparation A to the Charybdis of preparation B, or were wrecked on the commercial enterprise of Messrs. C.

The vendors of patent medicines are responsible for many a hecatomb of innocents sacrificed upon the altar of commercial enterprise, and they have much to be responsible for in the false education of mothers and nurses in matters which pertain to the rearing of infants. Through the medium of literature spread broadcast through the land they have become the chief instruments of instruction in the principles of infant feeding. These patent foods were, and, I regret to say, still are, the delight of mothers, they are so easily digested, in fact, they require no digesting at all. Under their persuasive influence the infant grows visibly and ponderably fatter, and to the parents' inexpressible delight present the appearance of an infant Hercules. Who cannot recognise at sight a patent food baby veiling under his outward serenity the germs of latent and inevitable trouble? Large and square headed, fatuously complacent, pot-bellied, spade handed and dumpy footed, for all the world presenting the appearance of animated jelly.

The reader who has so far had the patience to peruse this chapter will have gathered from my criticisms of the various methods referred to some idea of the essential principles on which, in my opinion, a reliable system of artificial feeding should be based. For the sake of clearness,

however, I will summarise these principles and at the same time refer to certain other important points.

1. Milk, as nearly as possible of the degree of purity attained by the Walker-Gordon dairies, should be the basis of every milk mixture.

2. This milk should be prepared at home strictly in accordance with the principles of percentage modification and with the exercise of the utmost cleanliness.

3. The directions of the prescription should be carried out by adding an appropriate quantity of cream (of known percentage) and an appropriate quantity of sugar and water to a basis of pure milk.

4. The table of directions for thus modifying milk on a percentage basis should be sufficiently simple for any nurse of average intelligence to understand.

5. The whole day's supply should be prepared at one operation, and poured in the requisite quantities into the requisite number of bottles. And these bottles should be securely stoppered, sterilised if necessary, and kept on ice or in a cool place until required.

6. The progress of the infant should be carefully watched, and the composition of the milk mixture altered from time to time in accordance with individual idiosyncrasies or in accordance with physiological indications.

The method which I shall describe in chapter ii. fulfils, I believe, all these conditions, and it has in my hands and, I understand, in the hands of others, proved very successful.

CHAPTER I.

BREAST FEEDING.

THE generally accepted axiom that breast feeding is in all respects superior to hand methods of rearing cannot be taken without reservation. If properly conducted under suitable conditions it is impossible to deny that the results are far better than can possibly be obtained by any artificial means, but in actual practice it is seldom that the duties of maternal feeding are carried out with that observance of detail and sense of responsibility which alone can make this method, or indeed any other method, a complete success.

It has already been stated that the art of infant feeding lies in the adaptation of the food to the physiological requirements of the nursling. Now, it is clear, that we cannot have the same control over the chemical constitution of maternal milk that we possess in the case of cow's milk, which can be readily and at pleasure modified to the varying needs of the child. However, provided that the mother be strong and healthy and of even temperament, and provided also that she devote due care to the regulation of her own diet and to the taking of proper exercise, her milk will in all probability be so superior in quality to any artificial substitute that the mere inability to alter its chemical constitution under

special circumstances is a matter of small moment. Since, therefore, we cannot alter the quality of the milk, in what respects can we so adapt the food to the physiological requirements of the infant as to render this method of feeding one which is scientific and exact? The answer to this question is simple. Although we must leave to nature the qualitative modification of milk, we can, on the other hand, control the quantity. I state without fear of contradiction that more than 90 per cent. of the troubles of digestion which occur among breast-fed infants are due to a want of proper regulation of the times of feeding and of the quantities given at each meal.

Although as regards its chemical composition maternal milk is more or less accurately adapted to the requirements of the offspring, there is as regards quantity no sort of co-ordination between the supply on the part of the mother and the demand on that of the child. In institutions abroad, where systematic methods of breast feeding have been introduced, it has been repeatedly found that one woman's supply of milk may be sufficient not only for her own offspring but also for the nourishment of one and sometimes two additional infants. A certain woman at one of these institutions[1] supplied daily 106 oz. (3,000 grms.) of milk, an amount sufficient for five infants at the second month, or nearly nine infants during the second week of life. It is impossible to imagine the effect on a new-born infant's digestion if such a woman were engaged and her milk devoted to his exclusive use. It is, of course, only in rare instances that

[1] H. Peters, *Arch. f. Kinderk.*, 1902, p. 295.

a woman is capable of supplying quantities of this amount, but it is by no means uncommon for a thoroughly healthy nurse to supply 50 oz. of milk per diem, and the largest amount that any infant ought to be allowed to have is very much below this quantity, as will be seen by referring to the table on page 19.

Ignorance as to their own capabilities for supplying milk combined with ignorance as to the amount which a nursling properly requires during the first few weeks of life, is one of the reasons why mothers so frequently believe that they cannot nurse their own infants. The experience of Dr. H. Peters,[1] who has had unique opportunities for arriving at his conclusions, is that it is only in quite exceptional instances that mothers—that is to say, among the humbler classes—are unable to supply sufficient nourishment for their infants ; the same, however, is more or less true of women in a higher social position.

An infant at the beginning of the second week of life should only receive 12 oz. of milk per diem, and it must be a poor breast indeed which cannot supply this amount. On the most inadequate grounds infants are frequently condemned to artificial feeding, and this though the mother may be perfectly willing to nurse the child herself. I believe that if the mother is willing, and with no definite contra-indications, that a child should be kept at the breast as long as the total mammary secretion does not fall short of 10 oz. per diem. There is no reason whatsoever why, if the supply is insufficient, provided, of course, the quality is up to the required standard, it should not be supple-

[1] H. Peters, *Arch. f. Kinderk.*, 1902, p. 295.

mented by an occasional bottle. Half a loaf is better than no bread, and a few ounces of mother's milk may make just the difference between health and disease, between the foundation of a good and a bad constitution. The enormous importance of giving an infant a good start in life, and the pitfalls which lie in the way of artificial feeding during the first few weeks of life, should make a woman consider twice before she declines to make at least an attempt to nurse her baby herself.

Now the question naturally arises how are we to know how much milk an infant at the breast ought to receive, and how are we to know that he actually receives the amount we intend? In answer to the first question I would reply in the same way as I should if the question were asked with reference to artificial feeding, that no two infants are constituted exactly alike, and therefore no two infants require exactly the same amount. To feed an infant on physiological lines we must watch the progress, the increase in weight, the condition of the bowels, the general development and the idiosyncrasies of the individual, and the rules that apply in artificial feeding apply equally in breast feeding, only it must be remembered that the qualitative properties of human milk are practically beyond control.

The following table of quantities will be found to be substantially correct for the ordinary purposes of breast feeding. It states clearly the total quantity of milk which an infant should be given during the twenty-four hours, the total amount which should be taken at each feeding, the number of feedings, and the length of the intervals between them. If these instructions are

Age of Infant.	1 day.	2 days.	3-14 days.	14-28 days.	2 months.	3 months.	4-5 months.	6-7 months.	8-12 months.
Quantity of food for each feeding .	Oz. ½[1]	Oz. ¾[1]	Oz. 1	Oz. 1¾	Oz. 3	Oz. 3¾	Oz. 4½	Oz. 6	Oz. 8
Total quantity for 24 hours . .	Oz. 5	Oz. 8	Oz. 12	Oz. 18	Oz. 24	Oz. 30	Oz. 36	Oz. 42	Oz. 48
Number of feedings	10	10	10	10	8	8	8	7	6
Intervals between feedings . .	Hrs. 2¼	Hrs. 2¼	Hrs. 2¼	Hrs. 2¼	Hrs. 3	Hrs. 3	Hrs. 3	Hrs. 3¼	Hrs. 4

followed, the results that will be obtained will be infinitely more satisfactory than is the case when the feeding is conducted on a haphazard system. But if the best possible results are to be obtained, slight modifications will have to be made from time to time in accordance with the requirements of the infant and with a fixed and definite purpose. For instance, it is not always desirable that an infant should receive exactly the same amount of milk at each feeding. As a rule infants are more hungry in the evening than they are the first thing in the morning. This is an indication for a departure from the routine amounts stated in the table. Further, the intervals between two consecutive feedings should be regulated to some extent in accordance with the amount of milk taken at the previous feeding.

Infants whose diet has been regulated from the first week of life, and whose stomachs have not been deranged by excess in quantity or irregularity in times of feeding, give, as a rule, no trouble or anxiety.

[1] It is seldom that a baby obtains as much as this if fed by his own mother.

This is far from being the case with those who have been mismanaged from the first. Such infants never appear to be satisfied, and they are continually crying out for more food and additional meals. In such cases it is generally said that the supply is inadequate, and consequently the infants are either weaned and placed on an alternative diet, or are supplied with bottles in order to supplement the maternal supply. This is absolutely wrong. If the infant repeatedly cries out for more food and never appears to be happy without a teat in his mouth, you may be absolutely certain that such an infant is suffering from some form of dyspepsia or indigestion. My own experience has been that in such cases it is exceedingly difficult to induce either the mother or the nurse to carry out conscientiously the only line of treatment which can effect a cure, namely, an absolutely systematic and regular management of the times of feeding and of the quantities to be taken at each meal, irrespective of the misleading demands for food on the part of the infant.

With regard to the question of how to ensure that the infant receives the quantity of maternal milk which is prescribed for him, the answer is quite simple. There is only one possible way, and that is by weighing the nursling before and after taking food. I know well the chorus of objections which this advice always excites, both from mothers and nurses. There is the expense of the weighing machine and the trouble of the operation, and the old time-hallowed argument that infants heretofore have got along well enough without all this unnecessary fussing and without the assistance of these new-fangled notions. However, what is the expense

of a weighing machine compared to the payment of doctors, nurses and chemists' bills? And what is the trouble of weighing an infant compared to the trouble of preparing his food and cleaning the bottles? Duties which are not considered in the least when the infant is brought up by hand.

Now, as a matter of fact, with a proper weighing machine, and with proper appurtenances thereto, the process of weighing takes about half a minute. Before feeding the infant is put comfortably in the scales, and the total weight ascertained. After feeding the operation is repeated, and the difference between the weights before and after feeding gives the weight of milk which has been consumed by the baby.

In conducting the operation of weighing it is absolutely necessary that accurate scales which weigh to a quarter of an ounce should be employed. Self-registering and automatic weighing machines are of no use whatever for this purpose. I have had some special scales[1] made for the purpose which can be procured at Bailey's, 38 Oxford Street. These are very strongly made, and are not liable to get out of order. The pan in which the infant is placed is large, roomy and deep. The infant should be tightly wrapped up in a shawl, so that he cannot move his arms and legs, and thus set the scales oscillating, and then placed in the pan. The weight of the shawl and clothes is of no consequence; all that we want to know is the difference in weight before and after feeding, so that if he wears the same clothes on

[1] These can be hired, or bought on the hire-purchase system. See page 175.

both occasions, the increase in weight after feeding will represent the weight of the milk which he has taken into his stomach. A systematic record of these figures is kept, together with the total amount taken in the twenty-four hours, and the time occupied in suckling. The subjoined chart, or

CHART FOR RECORDING RESULTS OF BREAST FEEDING.

DATE, 1ST JUNE, 1900. AGE OF BABY, 10 WEEKS.

Time of feeding.	Weight of baby before and after feeding.	Amount of food taken.	Time occupied.
3 A.M.	Weight of baby before feeding 10 lb. 1 oz. " " after " 10 lb. 4 oz. Difference	3 oz.	8 min.
6.40 A.M.	Weight of baby before feeding 10 lb. " " after " 10 lb. 2 oz. Difference	2 oz.	10 min.
9.15 A.M.	Weight of baby before feeding 10 lb. 2 oz. " " after " 10 lb. 5 oz. Difference	3 oz.	7 min.
11.30 A.M.	Weight of baby before feeding 10 lb. 2 oz. " " after " 10 lb. 6 oz. Difference	4 oz.	12 min.
2.30 P.M.	Weight of baby before feeding 10 lb. 3 oz. " " after " 10 lb. 7 oz. Difference	4 oz.	8 min.
5.15 P.M.	Weight of baby before feeding 10 lb. 5 oz. " " after " 10 lb. 8½ oz. Difference	3½ oz.	7 min.
8 P.M.	Weight of baby before feeding 10 lb. 3 oz. " " after " 10 lb. 6 oz. Difference	3 oz.	8 min.
10.30 P.M.	Weight of baby before feeding 10 lb. 2 oz. " " after " 10 lb. 6 oz. Difference	4 oz.	12 min.
	Total during 24 hrs. . . .	26½ oz.	72 min.
Average time occupied in obtaining 1 oz. of milk is 2½ minutes.			

one drawn up in some other practical form, should always be employed. If this be done at the end

of each day, the average time occupied by the baby in obtaining, say, one ounce of milk, can be easily calculated, and should always be noted down. This is of importance, because it gives a good idea of the time which the infant should be left at the breast on subsequent occasions. Practically, it is found difficult or impossible to keep taking the infant from the breast to see how much milk he has obtained, but if you know, say, from the previous day's experience, that he takes about ten minutes to obtain four ounces, it is very easy to regulate the feedings, so that at the end of the twenty-four hours he has consumed approximately the number of ounces which are appropriate for his age and general condition.

In starting this method of accurate feeding it is impossible, in the first instance, to estimate how long the infant should be left at the breast. The time required depends so much on the infant's powers of suction, on the formation of the nipples, on the fulness of the breast, the celerity of the flow, and on a hundred and one variable conditions which can only be estimated by actual experiment. However, with a very little experience you soon learn to know the capabilities both of the infant and of the breast, and then everything is plain sailing and extremely easy. Moreover, the eminently satisfactory results which are obtained by this method more than compensate for the initial trouble of obtaining a weighing machine and learning how to use it.

The health of an infant, as I have before remarked, depends mainly on the quantity and the quality of its food. In breast feeding the quality is regulated for us, and extremely well regulated

too, but the quantity must be regulated by yourself. Unless you measure the amount systematically, the baby may be taking, as far as you can tell, three or four times as much as is good for him, or on the other hand, he may be practically starving.

Now, before dismissing this subject, there are certain points of practical importance to which I would draw attention. One question is: What is to be done when the supply is greatly in excess of the demand? and another one is: How are we to supplement one which is insufficient? Both of these are important considerations. For, in the first place, not only is there a danger of the secretion stopping altogether if only a small proportion of the total is utilised by the infant, but also the concomitant distension of the mammary gland may be very distressing to the nurse. Therefore, under such circumstances, the breasts should be partially emptied by a pump or by compression. In this way the glands will be maintained in a condition of healthy and vigorous activity. Under the reverse condition of an inadequate supply, the deficiency must be made good by independent bottle feedings. The secretory functions can hardly be maintained unless the child is put to the breast at least once every six hours, and therefore the nursling should have at least four breast feedings every day, and his other meals should be obtained from the bottle. The milk which is supplied in these bottles should be modified in accordance with the instructions given on page 49, and supplied in the quantities which are appropriate to the age of the infant.

It is sometimes found, when we resort to mixed feeding of this kind, that the baby evinces a dislike

to either the breast or the bottle. If he refuses the breast, it is generally because he finds the substitute food sweeter and consequently more to his liking; in such a case the quantity of sugar in the modified milk must be reduced until he takes as readily to the breast as he does to the bottle. On the other hand the infant may refuse the bottle, and under such circumstances it may be found necessary to add more sugar or to resort to one of the substitute foods described on page 84. I would advise either No. 5 or No. 11, but a little perseverance and resource will nearly always overcome any difficulty in administering food by the bottle.

RULES FOR NURSING WOMEN.

DIET.

There must be absolute regularity in the meals and no food during the intervals, with the exception of a cup of cocoa or of milk, which may be taken before going to bed. The diet should be as simple as possible, and consist for the most part of milk, fish, eggs, vegetables, fruit, cereals, bread and butter, with meat not more than once a day. Although the total quantity of fluid taken in the twenty-four hours should be more than usual, there is no advantage to the mother, but rather the reverse, in taking stout, beer or other stimulants to which she has not been accustomed. Malt extracts, cod-liver oil and other medicinal preparations should be avoided.

EXERCISE

has so constant an influence on the changes which occur in the daily secretion of the milk that the

mother should be encouraged to be out of bed and to walk about her room as soon after her confinement as is possible without injuring her physical condition. Exercise is so important for promoting proper elaboration and equilibrium of the milk secretion during the entire period of lactation that it should always be insisted upon, and regular hours for walking should be as definitely arranged during the day as the hours for eating. The exercise must, however, be in accordance with the strength of the individual woman, for fatigue has the same deleterious influence on the production of the milk as has lack of exercise. (Rotch.)

HOW TO MODIFY THE QUANTITY OR QUALITY OF THE MILK.

If the progress of the infant proves unsatisfactory, it is a wise precaution to send a sample of the breast milk to be analysed,[1] in order that if there be anything abnormal in the chemical constitution, the error may be corrected by appropriate treatment of the mother, or by giving additional food in bottles. We know that emotions, diet, exercise and variations in the general health of the mother modify the character of the milk, and some physicians attempt to apply this knowledge in a systematic manner, and by varying the conditions of life to bring about changes in the milk in any desired direction. However, I believe that beyond studying the general health of the mother by strict attention

[1] An analysis of the milk may be obtained by forwarding a sample to the Clinical Research Association, or to the head office of any of the large London dairies.

to her diet and personal hygiene, very little reliance can be placed in this method.

If, however, chemical analysis indicates that there is, for instance, a deficiency of any of the important elements in the maternal secretion, it is comparatively easy to make good such deficiencies by supplying them independently in bottle feedings. At the same time, the following directions are given by Rotch, and may be found useful in certain cases :—

GENERAL PRINCIPLES FOR GUIDANCE IN MANAGING A DISTURBED LACTATION.

To increase the total quantity.—Increase proportionately the liquids in the mother's diet, and encourage her to believe that she will be able to nurse her infant.

To decrease the total quantity.—Decrease proportionately the liquids in the mother's diet.

To increase the total solids.—Shorten the nursing intervals, decrease the exercise, decrease the proportion of liquids in the mother's diet.

To decrease the total solids.—Prolong the nursing intervals, increase the exercise, increase the proportion of liquid in the mother's diet.

To increase the fat.—Increase the proportion of meat in the diet, and of fats which are in a readily digestible and readily assimilable form.

To decrease the fat.—Decrease the proportion of meat in the diet.

To increase the proteids.—Decrease the exercise.

To decrease the proteids.—Increase the exercise up to the limit of fatigue for the individual.

WOMEN WHO ARE UNFIT TO NURSE.

Those who are suffering from chronic disease.

Those who have an uncontrollable temperament.

Those who of necessity are of irregular habits, or who cannot obtain regular exercise.

Those in whom there is any tendency to insanity.

Those who have previously suffered from mastitis or disease of the breast, and those who at the end of three weeks cannot supply as much milk as 10 oz. per diem. It should be remembered that after the initial troubles of lactation have been overcome, that is to say, generally after seven or eight days, maternal feeding usually proceeds smoothly.

THE CHOICE OF A WET NURSE.

The woman chosen must be constitutionally strong, but spare rather than fat, and her health must be good, and free from hereditary tendency to mental or physical disease. Her age should be between twenty and thirty, and her child should, if possible, be of about the same age as the one to be adopted. For further particulars the reader is referred to one of the larger works on the subject of the diseases of infancy. In Dr. Koplik's[1] book there is a very excellent account of the choice of a wet nurse and of the medical examination to which she should be submitted.

THE CARE OF THE NIPPLES.

If previous experience in nursing has demonstrated a tendency for the nipples to become sore

[1] *The Diseases of Infancy and Childhood*, by Henry Koplik. London: Henry Kimpton, 1903.

and cracked, benefit is derived by regularly bathing the nipples with some astringent lotion (such as hazeline one part, water three parts) during the last few weeks of pregnancy. If the nipples are so small and depressed that the process of suckling is interfered with, nipple shields should be tried. Tender and excoriated nipples should be carefully bathed before and after suckling with boracic acid lotion (one part saturated solution of boracic acid and four parts water) and carefully dried with lint. The use of the breast pump for a few days may give the nipples time to recover.

HYGIENIC REGULATIONS FOR WET NURSES.

The rules which apply for the regulation of the mother's health during lactation apply equally in the case of the wet nurse. But it will well repay the employers of a wet nurse to see that the infant of the latter is not neglected. I have known several instances in which, owing to the illness or death of her baby, the wet nurse has fretted and worried to the great detriment of her milk supply, with consequent ill-effect on the health of the child she is nursing. In view of the fact that many women have a supply of milk which is ample for two infants, this knowledge may be utilised in cases in which the exclusive services of a wet nurse cannot be obtained. However, if recourse be had to double nursing of this character, it is more than ever necessary that the feeding of the two infants should be systematically superintended and scientifically conducted with the aid of an accurate weighing machine.

WEANING.

The progress of weaning should be a gradual one; to begin with, one bottle should be substituted for a breast feeding during the twenty-four hours, and for preference this feeding should be given during the night. A second bottle may be tried at the end of three days, a third at the end of six, and so on. In weaning an infant he should *not* at once be put on the food appropriate to his age; he should begin at the standard, which, under normal conditions, is suitable for a younger infant. The strength of the food should then be increased by gradual stages until at the end of three weeks it is of the normal standard, or at least as nearly so as the infant can tolerate. The following table gives the percentage composition of food suitable for infants when first weaned :—

TABLE OF PERCENTAGE COMPOSITION OF FOOD SUITABLE FOR INFANTS OF DIFFERENT AGES AT TIME OF WEANING.

Age of Infant when Weaned.	7-14 days.	14-28 days.	1-2 months.	2-3 months.	3-4 months.	4-5 months.	5-7 months.	7-9 months.
Percentage Composition of Food—	%	%	%	%	%	%	%	%
Fat	2·0	2·0	3·0	3·0	3·0	3·0	3·0	3·0
Proteid	·5	·5	1·0	1·0	1·0	1·0	1·0	1·0
Sugar	5·0	6·0	6·0	6·0	6·0	6·0	6·0	6·0
Amount of Food for each Feeding	1 oz.	1 oz. 6 dr.	3 oz.	3 oz. 4 dr.	4 oz.	4 oz. 4 dr.	5 oz.	5 oz. 4 dr.

For preparing foods of above composition, see table, p. 46.

It is a good plan when infants reach the age of six months to give them one bottle of food at

night whether it is intended to wean them at once or not. If the change is delayed much longer, the gastric disturbances which may accompany the commencement of teething sometimes render the substitution less easy. In all cases weaning should commence at the ninth month.

CHAPTER II.

GENERAL ACCOUNT OF THE PERCENTAGE FEEDING OF INFANTS.

It was stated in the first chapter that the only really accurate and scientific method of hand feeding was that which is known as the percentage method. On no other system is it possible to regulate with precision the quantity and the quality of the food in accordance with the physiological needs of the infant. It will be my object in this chapter to describe the principles on which this system is founded, and the details which are essential to carry it out in practice. I am, however, faced with the initial difficulty that a certain proportion of readers who will look to this chapter for instruction will only possess a limited knowledge of mathematics. I shall have, therefore, to explain a considerable number of elementary details, which are not as a rule considered in books which treat of infant feeding.

Now, in the first place, what do we mean by percentage feeding, and what do we mean when we say that the percentage composition of such-and-such a mixture is so-and-so? It means that in every 100 parts (pints, ounces or drachms) there are so many

parts (pints, ounces or drachms) of the different ingredients. For instance, if we speak of a 5 per cent. solution of sugar, we mean that in every 100 parts of the solution there are 5 parts of sugar. Ordinary cow's milk is a mixture of various elements or ingredients which are present in certain proportions. The chief elements which we need consider in this connection are (1) proteid (the element which forms the clot or curd when milk is coagulated, as also a small proportion which resembles white of egg, which does not clot on the addition of rennet, but which partly becomes solid on boiling and helps to form the skin on boiled milk); (2) fat (cream is a thick emulsion of butter fat); (3) sugar (the sugar or lactose which exists in milk is not so sweet as ordinary cane sugar, but resembles it in many respects). Cow's milk is a mixture or emulsion which contains in every 100 parts 4 parts of proteid, 3·5 parts of fat and 4·5 parts of sugar, and in addition small percentages of salts, extractives and other bodies. Human milk is a somewhat similar emulsion, with the difference that the proportions or percentages of the various constituents, *i.e.*, proteid, fat and sugar, are not the same as in cow's milk. The exact figures are: 1·5 parts of proteid, 4 parts of fat and 6·5 parts of sugar in 100 parts.

The chief, but not exclusive, reason why undiluted cow's milk is unsuitable for the purpose of infant feeding is because the constituents do not exist in the same proportions as they do in human milk. Physiologically, the infant does not require, nor can he digest, proteids in the proportions which are suitable for a calf. There

are, indeed, other differences between human and bovine milk. For instance, the proteids differ somewhat in character, and the salts and the ferments, and possibly even the sugar, present differences; but these differences are not so great as to debar cow's milk from being applied to the purpose of infant feeding, especially if it be properly modified, and the percentages of proteid, fat and sugar altered to the proportions in which they exist in human milk, or to the proportions which are physiologically required.

Now, just as the physiological requirements of infants and calves differ, so to a less extent do the physiological requirements of different nurslings. If, therefore, you can determine by observation and experiment the exact physiological requirements of each child, and in accordance with these requirements modify his food, you have made great progress in the art and practice of infant feeding. Now this is one of the chief aims of the percentage method of feeding.

It naturally requires considerable experience to say exactly what percentage composition is suitable for any particular case, but as the result of thousands of observations made by skilful and competent physicians, it is possible to estimate fairly accurately the amount and the strength of foods which are suitable for average infants during the various periods of their life from one day to one year, and to employ a table constructed in accordance with these estimates as a working basis. Moreover, it has been found that average healthy infants of the same age differ only slightly the one from the other, but such differences as do exist

must be diligently sought and allowed for. It has, however, been clearly proved that the capacity of one individual for digesting the various elements of cow's milk differ very materially at different ages. For instance, the new-born infant can only digest very small quantities of proteid as it exists in cow's milk, and if he be given a mixture in which the percentage of proteid is higher than he can digest, his digestion will immediately suffer. At a later stage it is found that he can digest larger proportions, and if we wish to maintain his physiological condition at the highest possible standard, it is essential that he should receive this higher proportion of proteid. Now, as I have said, as the result of thousands of observations, it has been possible to estimate the average amount of food which infants of different ages require, and a table has been drawn up which gives the quantities or percentages of proteid, fat and sugar which are suitable for infants at these various ages. Such a table is here supplied. It will be noticed that the first column gives the age of the infant, the second the quantity of food it is desirable that he should receive, and in the three final columns the requisite percentage composition is given in decimal figures.

This table has been drawn up by the Walker-Gordon laboratories as the result of experience in the feeding of thousands of infants, it represents in fact the accumulated knowledge of a very large number of physicians in this country and in America who have employed the percentage method of feeding.

TABLE DRAWN UP BY THE WALKER-GORDON LABORATORY SHOWING THE AVERAGE PROPORTION OF EACH CONSTITUENT WHICH IS ADVISABLE TO EMPLOY AS AN INITIAL BASIS FOR FEEDING INFANTS AT DIFFERENT AGES, AND THE AMOUNT THEY SHOULD RECEIVE.

Week of Life.	Quantity at each Meal in ounces.	Percentage Composition.		
		Fat.	Sugar.	Proteids.
First	1¼	2·00	4·50	0·75
Second	1¾	2·50	5·50	1·00
Third	2	3·00	6·00	1·00
Fourth	2¼	3·00	6·00	1·00
Fifth	2¾	3·25	6·50	1·00
Sixth	3	3·25	6·50	1·25
Seventh	3	3·50	6·50	1·25
Eighth	3¼	3·50	6·50	1·25
Ninth—eleventh	3½	3·50	6·50	1·25
Twelfth—thirteenth	3¾	3·50	6·50	1·25
Fourteenth	4	3·50	6·50	1·25
Fifteenth—sixteenth	4¼	3·75	6·50	1·25
Seventeenth—eighteenth	4½	3·75	6·50	1·50
Nineteenth—twenty-first	4¾	3·75	6·50	1·50
Twenty-second—twenty-third	5	3·75	6·50	1·50
Twenty-fourth—twenty-fifth	5¼	3·75	6·50	1·75
Twenty-sixth	5½	3·75	6·50	1·75
Twenty-seventh	5⅔	4·00	6·50	1·75
Twenty-eighth	5⅔	4·00	7·00	1·75
Twenty-ninth—thirtieth	5¾	4·00	7·00	1·75
Thirty-first—thirty-second	6	4·00	7·00	1·75
Thirty-third	6¼	4·00	7·00	1·75
Thirty-fourth—thirty-sixth	6¼	4·00	6·50	2·00
Thirty-seventh—thirty-ninth	6½	4·00	6·50	2·00
Fortieth—forty-first	6¾	4·00	6·50	2·00
Forty-second	7	4·00	6·50	2·00
Forty-third	7	4·00	6·50	2·25
Forty-fourth—forty-fifth	7	4·00	6·00	2·50
Forty-sixth—forty-eighth	7¼	4·00	6·00	2·50
Forty-ninth—fifty-first	7¼	4·00	6·00	2·75
Fifty-second	7¼	4·00	5·50	3·00

To take an example. An infant in the seventh week of life should receive, according to this table, three ounces of food at each meal, and this food should be of the following composition: Fat, 3·5 per cent.; sugar, 6·5 per cent.; proteid, 1·25 per cent. Now, if we write out these figures on paper and forward them to a milk laboratory where they

make and supply milk mixtures of exact percentage composition, we shall obtain in due course a mixture accurately prepared in accordance with the prescription. As a rule, in writing out the prescription, it is advisable to give further particulars. For instance, we state how many bottles of milk the infant will require during the day, and we also state whether we want lime water or barley water, or other ingredient added. In fact, we supply the directions just as we should write them out in giving an ordinary prescription to be dispensed by the chemist. If, then, we were to write out the above prescription in proper order on one of the blank forms supplied by the milk laboratory, it would run as follows :—

MRS. B.'S BABY. 1ST JAN., 1903.

	Per cent.		
R Fat . . .	3·50	Reaction . . .	Neutral
Milk sugar . .	6·50	Number of feedings .	8
Proteids . .	1·25	Amount at each feeding . . .	3 oz.
Mineral matter —Lime water	5·	Heated for . .	40 min.
		Heated at . . .	160° F.
Special direction—		*Remarks.*—Send two bottles unpasteurised.	
		Infant's age . .	7 wks.
		Infant's weight . .	8 lb. 5 oz.
		(Signed)	M. D.

With the services of a milk laboratory at our disposal, our duty ends when we have written out and despatched the prescription ; the laboratory does everything else, and the dispenser sends round the requisite number of bottles, each bottle containing the exact quantity ordered for each feeding of the mixture which is made up of the exact consti-

tuents which have been ordered. The bottles are kept in a cold place or on ice until they are required, and then one by one they are taken out, warmed and fitted with an india-rubber nipple, and given to the infant at the proper times of feeding.

The principle is almost perfect, the milk is of the purest and best (see p. 8), and you know exactly what you are giving the infant. A further advantage is that you can alter the composition if occasion should arise. There is no possibility of the infant's digestion being upset by dirty bottles, dirty tubes or dirty nipples, and it is hardly possible for the most inexperienced or stupid of nurses to make a mistake. Moreover, the physician has the gratification of knowing that the infant is receiving what he has ordered.

The only practical objections to this method are (1) that it is expensive, (2) that only a few milk laboratories have so far been established in this country, (3) that the method of preparing the milk mixtures depends on the principle of separating the cream from the milk by mechanical processes, and recombining them again in the required proportion with the addition of sugar and other ingredients as desired. This manipulation appears to have some deleterious effect on the milk. Further, there must necessarily be some delay in the execution of orders. Now, any person who has read the preceding pages must, I think, acknowledge that the advantages conferred by the percentage system of feeding are overwhelming, and that if a means could be devised of eliminating the few objections which I have mentioned, the method would deserve to be universally adopted.

The remaining pages of this chapter will be devoted to the description of a method which, while combining most of the advantages of laboratory preparation, obviates at the same time certain of the objections which I have mentioned above. It will be shown that it is possible to prepare at home a milk mixture of any desired percentage composition by diluting to the proper extent milk with water and by adding cream and sugar in the requisite proportions. If, however, we wish to avail ourselves of the same advantages conferred by a properly organised milk laboratory, it is essential that the milk we use for the home modification should be at least as pure as that used in the laboratories. Dairy methods have of recent years greatly improved in this country, and I take it that very shortly all or most dairies will adopt the same principles as those employed on the Walker-Gordon farms to ensure a pure and uncontaminated supply of milk.

The milk, therefore, which is to be used for the home modification should be especially sent from the dairies in clean, sterilised bottles well stoppered and sealed. It is not necessary to order so-called nursery milk, such milk is either fortified by the addition of cream or consists of the strippings or last portions extracted from the udder of the cow. This is of no advantage to the infant, and entirely vitiates the percentage calculation, which is based on the assumption that the milk which is used is ordinary average dairy milk.

The next step is to obtain cream which contains a definite and constant percentage of fat. Heretofore the difficulty of obtaining such cream has been the chief obstacle in the way of extending the home

method of percentage modification. For it makes all the difference in the world whether we employ a strong cream or a weak cream, a cream containing 50 per cent. or 10 per cent. fat. As a matter of fact, the ordinary thick cream we obtain in London contains, roughly speaking, about 50 per cent. of fat, that is to say, it is half fat, whereas ordinary gravity cream, the name given to cream obtained by skimming, as a rule contains no more than 16 per cent. of fat. In other words, London cream (centrifugalised) is almost exactly three times as strong as ordinary gravity cream (skimmed). Now, if the percentage composition of a milk mixture depends on the percentage of the various constituents contained in the milk and in the cream, it is clearly necessary that cream as well as milk of a constant percentage composition should always be employed. The composition of milk may be relied upon as fairly constant; the only question now to be considered is how to obtain a cream which also contains a constant proportion of fat.

All my tables for preparing percentage milk mixtures are based on the assumption that the cream contains 16 per cent. of fat. Sixteen per cent. cream may be obtained in any one of the following ways: (1) by using cream which has been obtained by skimming, that is to say, gravity cream; (2) by diluting one part of thick cream, such as is sold in London, namely, one containing from 45 to 50 per cent. fat, with two parts of milk; (3) by ordering 16 per cent. cream from the dairy. Now, with reference to the last-mentioned and apparently most obvious method of obtaining cream containing 16 per cent. of fat, I may say at once that up to within a few

months ago such cream could hardly be obtained in London from any of the dairies. I am glad, however, to be able to say that most of the large dairies in London have now adopted my suggestion and will supply to order cream which accurately contains 16 per cent. of fat. The dairies which have so far undertaken to supply cream of this character are the Belgravia Dairy Company, Welford's, the Express Dairy and the Aylesbury Dairy Company. I have no doubt that other dairies in London and in the large provincial towns will soon follow their example, and that it will be possible to obtain such cream in any part of the country.

The next ingredient which we require for the percentage modification of milk is sugar. I am not prepared to say that it matters very materially whether we employ cane sugar, beet sugar or milk sugar, but, personally, I generally use the latter, chiefly for the reason that it is either identical or nearly so with the sugar which occurs in maternal milk. Milk sugar can be bought in pound tins from any grocer, and it is quite inexpensive if bought in this way. It is sometimes recommended to prepare a syrup of this sugar containing 20 per cent. (one part sugar, five parts water), and to keep it in this form, adding as much as is required to the mixture instead of the undissolved sugar. For my part, I think it less trouble to keep the sugar in the dry form and measure it out in a medicine glass as required, and to dissolve it in a small quantity of water. An objection is sometimes raised to the use of milk sugar on the ground that when dissolved it is occasionally found to contain small particles of dirt or débris. This

objection, however, is not a strong argument against its employment, for, if necessary, the solution can be filtered through cotton wool or blotting paper.

I have now said all that is necessary about the ingredients which are required for the home preparation of a percentage milk mixture, namely, pure milk, 16 per cent. cream and milk sugar. For special reasons other ingredients may be employed in addition, as, for instance, barley water, plasmon, casumen, lime water or carbonate of soda, but, with the exception of lime water, none of these ingredients are required for the preparation of the ordinary milk mixtures referred to in this chapter.

I do not propose to describe the arithmetical calculations which are necessary for arriving at the individual quantities of milk, cream and sugar which are required to make mixtures of various percentages. Such calculations are difficult and complicated, and by means of tables which I have drawn up for the purpose, I have saved the reader all further trouble. In the first place, I have calculated the quantities of milk, cream and sugar which, if mixed together with the addition of water, will provide the percentage compositions recommended by the Walker-Gordon laboratories for the use of infants of different ages, that is to say, the table which appears on page 36 is again repeated here with instructions for the home-preparation of the prescriptions.

Taking, for instance, the case of an infant seven weeks old, according to the Walker-Gordon table, the percentage composition should be as follows: Fat, 3·50 per cent.; sugar, 6·5 per cent.; proteids, 1·25 per cent. If we were to write this out in the

TABLE FOR THE HOME-PREPARATION OF MILK MIXTURES OF THE SAME PERCENTAGE COMPOSITION AS RECOMMENDED BY THE WALKER-GORDON LABORATORIES.

Age of Infant.	Quantity at each Meal in ounces.	Percentage Composition.			Directions for Home-preparation.			
		Fat.	Sugar.	Proteids.	Quantity of Milk.	Quantity of 16 per cent. Cream.	Quantity of Milk Sugar measured in measuring glass.	Add sufficient Water to make.
Week.	Oz.				Oz. Dr.	Oz. Dr.	Oz. Dr.	Pint.
1st	1¼	2·00	4·50	0·75	1 4	2 2	0 7	1
2nd	1½	2·50	5·50	1·00	2 2	2 6	1 1	1
3rd	2	3·00	6·00	1·00	1 5	3 3	1 3	1
4th	2¼	3·00	6·00	1·00	1 5	3 3	1 3	1
5th	2½	3·25	6·50	1·00	1 5	3 3	1 4	1
6th	3	3·25	6·50	1·25	2 7	3 4	1 2	1
7th	3	3·50	6·50	1·25	2 3	4 0	1 2	1
8th	3¼	3·50	6·50	1·25	2 3	4 0	1 2	1
9th—11th	3½	3·50	6·50	1·25	2 3	4 0	1 2	1
12th—13th	3¾	3·50	6·50	1·25	2 3	4 0	1 2	1
14th	4	3·50	6·50	1·25	2 3	4 0	1 2	1
15th—16th	4¼	3·75	6·50	1·25	2 1	4 2	1 2	1
17th—18th	4½	3·75	6·50	1·50	3 5	3 7	1 1	1
19th—21st	4¾	3·75	6·50	1·50	3 5	3 7	1 1	1
22nd—23rd	5	3·75	6·50	1·50	3 5	3 7	1 1	1
24th—25th	5¼	3·75	6·50	1·75	5 1	3 5	1 0	1
26th	5½	3·75	6·50	1·75	5 1	3 5	1 0	1
27th	5¾	4·00	6·50	1·75	4 6	4 0	1 0	1
28th	5¾	4·00	7·00	1·75	4 6	4 0	0 7	1
29th—30th	5¾	4·00	7·00	1·75	4 6	4 0	0 7	1
31st—32nd	6	4·00	7·00	1·75	4 6	4 0	0 7	1
33rd	6¼	4·00	7·00	1·75	4 6	4 0	0 7	1
34th—36th	6¼	4·00	6·50	2·00	6 4	3 4	1 0	1
37th—39th	6½	4·00	6·50	2·00	6 4	3 4	1 0	1
40th—41st	6¾	4·00	6·50	2·00	6 4	3 4	1 0	1
42nd	7	4·00	6·50	2·00	6 4	3 4	1 0	1
43rd	7	4·00	6·50	2·25	7 6	3 4	0 7	1
44th—45th	7	4·00	6·00	2·50	9 4	3 0	0 5	1
46th—48th	7¼	4·00	6·00	2·50	9 4	3 0	0 5	1
49th—51st	7¼	4·00	6·00	2·75	11 0	2 6	0 5	1
52nd	7¼	4·00	5·50	3·00	12 4	2 6	0 5	1

To prepare any of the above mixtures the quantities of milk, cream and milk sugar stated in the table must be measured in a conical medicine glass and poured into a jug with one ounce of lime water and a sufficiency of water to make one pint of mixture. If the whole day's supply is prepared at one operation, it may be necessary to make more than one pint of the mixture.

form of a prescription for the instruction of the dispenser, the prescription would run thus:—

For Infant of Seven Weeks.

℞ Fat	3·50	per cent.
Milk sugar . . .	6·50	,,
Proteids	1·25	,,
Lime water . . .	5·	,,

Send eight bottles, each containing 3 oz. of this mixture.

With the assistance of these directions the dispenser would forward eight bottles or tubes each containing 3 oz. (the quantity for one feeding) of a mixture of the correct percentage.

Now, by referring to the table which I have prepared, we find the necessary information for preparing the same mixture at home. To make 1 pint of this mixture take 2 oz. 3 drs. of milk, 4 oz. of cream (16 per cent.), and 1 oz. 2 drs. of milk sugar, and pour the milk and cream into a jug (graduated in ounces); we then dissolve the sugar in a little hot water, and also pour it into the jug. We then add 1 oz. of lime water and water until the level of the mixture reaches the pint mark. The mixture must then be stirred. This modified milk is of the required percentage. We now pour the required number of ounces for one feeding into each of the bottles required for twenty-four hours, and sterilise them for the required time. This having been done, we remove the bottles from the steriliser and keep them in a cool place until required.

By this simple means we have accomplished all that could have been done at a milk laboratory at very much less expense and with very little more trouble, and with the additional advantages to which I have already referred, namely, that the milk has not been separated or deteriorated by any mechanical process, and that we can, provided we have the neces-

sary ingredients, alter the percentage composition at a few minutes' notice. The quantities given in this table are for making one pint of mixture. We may, however, wish to prepare more or less than this amount in accordance with the age of the child, or with the quantity required for the day's supply: in such a case we must proportionately increase the quantities of the ingredients. Although the calculations are perfectly simple, they should be written down clearly on a piece of paper before starting the operation, so as to avoid any possible mistake. The doctor or other responsible person should, in fact, write out the prescription in full. For instance, in writing out the above prescription it should be set down in the following manner:—

Total quantity of mixture required for twenty-four hours is 24 oz.
Total number of bottles for twenty-four hours is eight.
Each bottle must contain 3 oz. of mixture.
Prepare 1¼ pints by mixing 2 oz. 5 drs. of milk, 5 oz. cream (16 per cent.), 1 oz. 4 drs. of sugar, and adding 1¼ oz. lime water and sufficient water to make 25 oz.

The accompanying table will also be found useful. It supplies in a concise manner the details for preparing mixtures of various percentage compositions. The range of percentages is sufficient for all ordinary purposes, the proteids ranging from ·5 to 2·5 per cent., the fat from 2 to 4 per cent., and the sugar from 5 to 7 per cent.

The method of using the table is as follows: Suppose we wish to know, for instance, the quantities of the ingredients for preparing a mixture of the following percentage composition: Fat, 3 per cent.; proteids, 1·5 per cent.; sugar, 6 per cent. If we read

down the left-hand side of the table we see that all the 3 per cent. fat mixtures are contained in the compartments (namely, those numbered 4, 5, 6) which are limited by the two thick black horizontal lines, and further, on referring to the top line, we see that the 1·5 proteid mixtures are contained in the vertical column marked C. Mixtures, therefore, containing 3 per cent. fat and 1·5 proteids will be contained in the vertical column C between the two thick horizontal lines mentioned above, namely, in the compartments numbered C 4, C 5 and C 6. On the right-hand side of the table the percentages of sugar are clearly indicated, that is to say, 5 per cent. sugar is contained in compartment C 4, 6 per cent. sugar in compartment C 5, and 7 per cent. sugar in compartment C 6. For the prescription we are dealing with 6 per cent. sugar is required, therefore compartment C 5 is the one we want. In this compartment it is stated that we must take 4 oz. 6 drs. of milk, 2 oz. 6 drs. of cream and 1 oz. 1 dr. of sugar, mix them together and add water to make one pint. Such a mixture will be of the desired percentage composition, namely, fat, 3 per cent.; proteids, 1·5 per cent.; sugar, 6 per cent. This table will be found extremely useful when we come to study the question of modifying the milk in accordance with the physiological needs of the infant. At the present moment we need not further concern ourselves with it.

Now, for practical use in the nursery the tables which I have so far given are possibly too complicated in character, although for those who wish to avail themselves of the full advantages of the home preparation of percentage mixtures they will be

TABLE OF RECIPES FOR PREPARING MILK MIXTURES OF VARIOUS PERCENTAGE COMPOSITION. IN EACH CASE THE INGREDIENTS ARE FOR MAKING *ONE PINT* (TWENTY OUNCES) OF MIXTURE, AND THE NECESSARY WATER MUST BE ADDED TO MAKE UP THIS AMOUNT.

Fat 2 °/₀

		Proteid ·5 °/₀ (A)	Proteid 1 °/₀ (B)	Proteid 1·5 °/₀ (C)	Proteid 2 °/₀ (D)	Proteid 2·5 °/₀ (E)	
1	Percentage composition: Fat / Proteid / Sugar	A 1 Fat 2 °/₀ Proteid ·5 °/₀ Sugar 5 °/₀	B 1 Fat 2 °/₀ Proteid 1 °/₀ Sugar 5 °/₀	C 1 Fat 2 °/₀ Proteid 1·5 °/₀ Sugar 5 °/₀	D 1 Fat 2 °/₀ Proteid 2 °/₀ Sugar 5 °/₀	E 1 Fat 2 °/₀ Proteid 2·5 °/₀ Sugar 5 °/₀	Sugar 5 °/₀
	Milk	None	3 oz.	6 oz.	9 oz. 4 dr.	12 oz. 4 dr.	
	Cream	2 oz. 4 dr.	2 oz.	1 oz. 4 dr.	4 dr.	None	
	Milk sugar (by measure)	1 oz. 1 dr.	1 oz.	7 dr.	5 dr.	3 dr.	
2	Percentage composition: Fat / Proteid / Sugar	A 2 Fat 2 °/₀ Proteid ·5 °/₀ Sugar 6 °/₀	B 2 Fat 2 °/₀ Proteid 1 °/₀ Sugar 6 °/₀	C 2 Fat 2 °/₀ Proteid 1·5 °/₀ Sugar 6 °/₀	D 2 Fat 2 °/₀ Proteid 2 °/₀ Sugar 6 °/₀	E 2 Fat 2 °/₀ Proteid 2·5 °/₀ Sugar 6 °/₀	Sugar 6 °/₀
	Milk	None	3 oz.	6 oz.	9 oz. 4 dr.	12 oz. 4 dr.	
	Cream	2 oz. 4 dr.	2 oz.	1 oz. 4 dr.	4 dr.	None	
	Milk sugar (by measure)	1 oz. 3 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	5 dr.	
3	Percentage composition: Fat / Proteid / Sugar	A 3 Fat 2 °/₀ Proteid ·5 °/₀ Sugar 7 °/₀	B 3 Fat 2 °/₀ Proteid 1 °/₀ Sugar 7 °/₀	C 3 Fat 2 °/₀ Proteid 1·5 °/₀ Sugar 7 °/₀	D 3 Fat 2 °/₀ Proteid 2 °/₀ Sugar 7 °/₀	E 3 Fat 2 °/₀ Proteid 2·5 °/₀ Sugar 7 °/₀	Sugar 7 °/₀
	Milk	None	3 oz.	6 oz.	9 oz. 4 dr.	12 oz. 4 dr.	
	Cream	2 oz. 4 dr.	2 oz.	1 oz. 4 dr.	4 dr.	None	
	Milk sugar (by measure)	1 oz. 4 dr.	1 oz. 3 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	
4	Percentage composition: Fat / Proteid / Sugar	A 4 Fat 3 °/₀ Proteid ·5 °/₀ Sugar 5 °/₀	B 4 Fat 3 °/₀ Proteid 1 °/₀ Sugar 5 °/₀	C 4 Fat 3 °/₀ Proteid 1·5 °/₀ Sugar 5 °/₀	D 4 Fat 3 °/₀ Proteid 2 °/₀ Sugar 5 °/₀	E 4 Fat 3 °/₀ Proteid 2·5 °/₀ Sugar 5 °/₀	Sugar 5 °/₀
	Milk	5 dr.	1 oz. 5 dr.	4 oz. 6 dr.	8 oz.	11 oz.	
	Cream	1 oz. 7 dr.	3 oz. 3 dr.	2 oz. 6 dr.	2 oz.	1 oz. 4 dr.	
	Milk sugar (by measure)	1 oz.	1 oz.	7 dr.	5 dr.	3 dr.	

Fat 3 °/₀	5	composition { Sugar	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀
		Milk	5 dr.	1 oz. 5 dr.	4 oz. 6 dr.	8 oz.	11 oz.	
		Cream	[1] 1 oz. 7 dr.	3 oz. 3 dr.	2 oz. 6 dr.	2 oz.	1 oz. 4 dr.	
		Milk sugar (by measure)	1 oz. 2 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	5 dr.	
	6	Percentage composition { Fat	A 6 Fat 3 °/₀	B 6 Fat 3 °/₀	C 6 Fat 3 °/₀	D 6 Fat 3 °/₀	E 6 Fat 3 °/₀	Sugar 7 °/₀
		Proteid	Proteid ·5 °/₀	Proteid 1 °/₀	Proteid 1·5 °/₀	Proteid 2 °/₀	Proteid 2·5 °/₀	
		Sugar	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	
		Milk	5 dr.	1 oz. 5 dr.	4 oz. 6 dr.	8 oz.	11 oz.	
		Cream	[1] 1 oz. 7 dr.	3 oz. 3 dr.	2 oz. 6 dr.	2 oz.	1 oz. 4 dr.	
		Milk sugar (by measure)	1 oz. 4 dr.	1 oz. 3 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	
Fat 4 °/₀	7	Percentage composition { Fat	A 7 Fat 4 °/₀	B 7 Fat 4 °/₀	C 7 Fat 4 °/₀	D 7 Fat 4 °/₀	E 7 Fat 4 °/₀	Sugar 5 °/₀
		Proteid	Proteid ·5 °/₀	Proteid 1 °/₀	Proteid 1·5 °/₀	Proteid 2 °/₀	Proteid 2 °/₀	
		Sugar	Sugar 5 °/₀	Sugar 5 °/₀	Sugar 5 °/₀	Sugar 5 °/₀	Sugar 5 °/₀	
		Milk	None	None	3 oz. 2 dr.	6 oz. 4 dr.	9 oz. 4 dr.	
		Cream	[1] 2 oz. 4 dr.	5 oz.	4 oz. 2 dr.	3 oz. 4 dr.	3 oz.	
		Milk sugar (by measure)	1 oz. 1 dr.	1 oz.	7 dr.	5 dr.	3 dr.	
	8	Percentage composition { Fat	A 8 Fat 4 °/₀	B 8 Fat 4 °/₀	C 8 Fat 4°/₀	D 8 Fat 4 °/₀	E 8 Fat 4 °/₀	Sugar 6 °/₀
		Proteid	Proteid ·5 °/₀	Proteid 1 °/₀	Proteid 1·5 °/₀	Proteid 2 °/₀	Proteid 2·5 °/₀	
		Sugar	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	Sugar 6 °/₀	
		Milk	None	None	3 oz. 2 dr.	6 oz. 4 dr.	9 oz. 4 dr.	
		Cream	[1] 2 oz. 4 dr.	5 oz.	4 oz. 2 dr.	3 oz. 4 dr.	3 oz.	
		Milk sugar (by measure)	1 oz. 2 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	5 dr.	
	9	Percentage composition { Fat	A 9 Fat 4 °/₀	B 9 Fat 4 °/₀	C 9 Fat 4 °/₀	D 9 Fat 4 °/₀	E 9 Fat 4 °/₀	Sugar 7 °/₀
		Proteid	Proteid ·5 °/₀	Proteid 1 °/₀	Proteid 1·5 °/₀	Proteid 2 °/₀	Proteid 2·5 °/₀	
		Sugar	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	Sugar 7 °/₀	
		Milk	None	None	3 oz. 2 dr.	6 oz. 4 dr.	9 oz. 4 dr.	
		Cream	[1] 2 oz. 4 dr.	5 oz.	4 oz. 2 dr.	3 oz. 4 dr.	3 oz.	
		Milk sugar (by measure)	1 oz. 4 dr.	1 oz. 3 dr.	1 oz. 2 dr.	1 oz. 1 dr.	7 dr.	

[1] In this case ordinary 16 °/₀ cream cannot be employed. Cream containing 32 °/₀ of fat must be used. This may be prepared by diluting two parts of 50 °/₀ cream with one part of milk, or by using Dahls' Gold Medal Cream.

found neither too elaborate nor too detailed. I have found from practical experience that a greatly simplified table meets most of the requirements for ordinary domestic use. For this purpose it is impossible to have directions too explicit, too simple or too precise. And for this reason I have drawn up a special table or chart which is intended to be placed in the hands of the nurse.

I do not think, as a general practice, it is necessary to change the percentage of the mixture as frequently as recommended in the Walker-Gordon table, which I have given above. In the nursery table the percentages are altered on the second, third, fourteenth and twenty-eighth day, and at the third, fourth, sixth and eighth month: these changes will be found ample for ordinary purposes. The intermediate changes must be made by the responsible person in charge. For instance, at the end of the second month the amount of the ingredients must be gradually increased until the full amounts recommended for an infant of three months are reached. Sudden changes are bad for the infant and must not be tried. The accompanying table provides sufficient data for making these changes, and it should be given to the nurse with a brief explanation of the method of using it.

My physiological nursery chart,[1] which also contains a weight chart and many other hints for the management of infants, is especially designed for this purpose. This chart should be hung in the nursery and referred to by the nurse when preparing food for the day. Changes in the feeding which are not pro-

[1] *The Physiological Nursery Chart.* Henry Kimpton, 13 Furnival St., E.C. See page 171.

vided for in the chart should be left to the management of the doctor in charge.

The method of using this table is simple, but in order that there may be no misunderstanding, I append directions for its use. Take an example. We wish to explain to a nurse how to feed an infant of one month in accordance with the instructions on the table. You supply her with the chart and refer her to the vertical column, at the top of which is printed the age of the infant, namely, the second month. If she read this column from above downwards she will observe that the first compartment contains a statement of the percentage composition of the mixture which is recommended, at all events as a basis to start with, for an infant of this age. The figures in the next compartment below refer, in the first place, to the quantities of milk, cream, sugar and lime water which will be required for making the mixture. These ingredients must be accurately measured by the nurse in a conical medicine glass, and having measured them she must pour them into a large graduated glass jug, and then make up the total quantity by the addition of water, so that it corresponds to the amount stated in the table.

In preparing the mixture for an infant of the second month, we take 4 oz. 6 drs. of milk, 4 oz. 2 drs. of 16 per cent. cream, 1 oz. 2 drs. of milk sugar, 1 oz. of lime water and pour them into the glass jug, adding sufficient water to make up the total amount to 24 oz. This is the proper quantity for the twenty-four hours' supply. It must now be poured into the requisite number of bottles. The number is stated in the last line but one,

TABLE FOR PREPARING MODIFIED MILK FOR A HEALTHY INFANT OF AVERAGE WEIGHT DURING THE SUCCESSIVE STAGES OF HIS LIFE FROM ONE DAY TO ONE YEAR.

(The milk should be ordinary milk and the cream contain 16 per cent. fat.)

Age of Infant.	1st day.	2nd day.	3rd-14th day.	14th-28th day.	2nd month.	3rd month.	4th-6th month.	6th-8th month.	8th-12th month.
Percentage composition of mixture — Fat	0·0	2·0	2·5	3·0	3·5	4·0	4·0	4·0	4·0
Percentage composition of mixture — Proteid	0·0	0·5	1·0	1·0	1·5	1·5	1·5	2·0	2·5
Percentage composition of mixture — Sugar	5·0	5·0	6·0	6·0	6·0	6·5	7·0	7·0	7·0
Percentage composition of mixture — Lime water	0·0	5·0	5·0	5·0	5·0	5·0	5·0	5·0	5·0
Milk	None	None	1 oz. 4 dr.	1 oz. 4 dr.	4 oz. 6 dr.	4 oz. 2 dr.	5 oz. 4 dr.	13 oz. 4 dr.	23 oz.
Cream (16 per cent. fat)	None	1 oz.	1 oz. 4 dr.	3 oz.	4 oz. 2 dr.	6 oz. 6 dr.	8 oz.	7 oz. 4 dr.	7 oz.
Milk sugar (by measure, *not* by weight)	3 dr.	4 dr.	6 dr.	1 oz. 1 dr.	1 oz. 2 dr.	1 oz. 7 dr.	2 oz. 1 dr.	2 oz. 4 dr.	2 oz. 4 dr.
Lime water	None	3 dr.	4 dr.	6 dr.	1 oz.	1 oz. 4 dr.	2 oz.	2 oz. 4 dr.	3 oz.
Total quantity for 24 hours (made up by add. of water)	5 oz.	8 oz.	12 oz.	18 oz.	24 oz.	30 oz.	36 oz.	42 oz.	48 oz.
Quantity in each bottle (for one feeding)	4 dr.	6½ dr.	1 oz. 1 dr.	1 oz. 6 dr.	3 oz.	3 oz. 5 dr.	4 oz. 4 dr.	6 oz.	8 oz.
Total number of bottles	10	10	10	10	8	8	8	7	6
Intervals between feedings[1]	2¼ hours	2¼ hours	2¼ hours	2¼ hours	3 hours	3 hours	3 hours	3½ hours	4 hours

[1] These intervals are only approximate; during the night they should be longer, and during the day shorter.

namely, in the present case eight bottles, and the quantity which is to be poured into each bottle is 3 oz. In filling the bottles with the mixture it will be found to save time if they are placed accurately in a row, and into the first are poured 3 oz. of the mixture, which have been carefully measured in the glass ; if the other bottles, which are similar in size and shape, be filled up to the same level, they will each contain exactly the same amount, namely, 3 oz.

Now, the next question to consider is the sterilisation. I do not intend to say much on this subject. I think that if we could depend on the milk and cream being absolutely pure, and could keep them carefully in closed receptacles on ice until we required them for use, we could with approximate safety dispense with the operation of sterilisation. But from force of circumstances neither milk nor cream can be absolutely pure and germ-free. The very best milk or cream will contain millions of germs in every drop, and at the end of the day, if it has been allowed to stand at the temperature of the room, this number will have been greatly increased. So, for this reason alone, milk should be sterilised as a general principle, although, perhaps, it is a good plan to give the infant, say, two bottles per diem which have not been sterilised. These bottles should be the first two which are given in the day, as soon as possible after the milk and cream have reached the house, and the food has been prepared. They will at least contain a smaller number of germs than those which have been kept longer.

To sterilise the bottles and their contents it is necessary to use some form of steriliser. There

are several good varieties to be procured, but the Soxhlet apparatus answers all practical purposes. It may be ordered from any chemist or surgical instrument maker, or from Bailey's, 38 Oxford Street, W. The latter firm supply also a special form of apparatus which has been modified and improved in accordance with my suggestions, and if the complete apparatus is ordered all the necessary jugs and measures which are adapted for the preparation of my milk mixtures are supplied with it. The whole apparatus complete with jugs, bottles, nipples, cleaners, etc., costs £1 16s.

Although economy in the matter of purchasing a sterilising apparatus almost invariably brings its own retribution, for the sake of those who are unable to incur the expense of buying a more expensive apparatus, I may mention that the "Infant Steriliser,"[1] of which an illustration is appended, may be procured for 2s. 6d. The chief disadvantage of this steriliser is that it holds only six bottles.

The Soxhlet apparatus in its complete and improved form consists of the following:—

1. Oak rack stand for bottles with drawer, B.
2. Improved tin boiler with concave bottom and tray for holding bottles, A and C.
3. Improved enclosed safety stand for lamp.
4. Spirit lamp, D.
5. Tin warmer for one bottle, H.
6. Twenty 5-oz. superior white glass bottles with ground lips.
7. Twenty best india-rubber discs.
8. Ten metal caps for holding discs in position.
9. Three best Allenbury teats.

[1] Made by Browne & Sayer, 104 Upper Thames St., E.C.

10. One quart graduated glass jug, G.
11. One 6-oz. conical glass measure, E.
12. One glass funnel, F.
13. One special brush for cleaning bottles.
14. One packet of shot for cleaning bottles.

This apparatus has been specially designed for economy and convenience. The concave bottom of the boiler or saucepan offers a large surface to the flame of the spirit lamp, and the lamp itself is protected from draughts by a special screen, which also retains a considerable quantity of heat and accelerates the process of boiling.

The whole operation of sterilising the food can be completed easily in fifteen minutes if this apparatus be used. The ordinary Soxhlet apparatus is cheaper to purchase, but in the long run costs more, because the methylated spirit (a considerable item) which it requires is very much more in quantity than is required in my form of the apparatus.

I have heard one authority on infant feeding express an objection to the use of the Soxhlet apparatus on the ground that its use entails forty minutes' boiling of the milk. I believe it is recommended in the directions which are supplied by the manufacturers of the apparatus that this time should be occupied in the sterilisation, but, of course, this is optional, and to my mind quite unnecessary. Personally, I recommend that after the water in the saucepan has been brought to the boiling-point it should not be kept over the flame for more than five minutes. Now, the saucepan of the Soxhlet is necessarily a large one, and the source of heat usually small, *i.e.*, a spirit lamp, so that any means which can reduce the

time during which the lamp is kept burning will be found economical in time and money and beneficial for the milk. For this reason I recommend

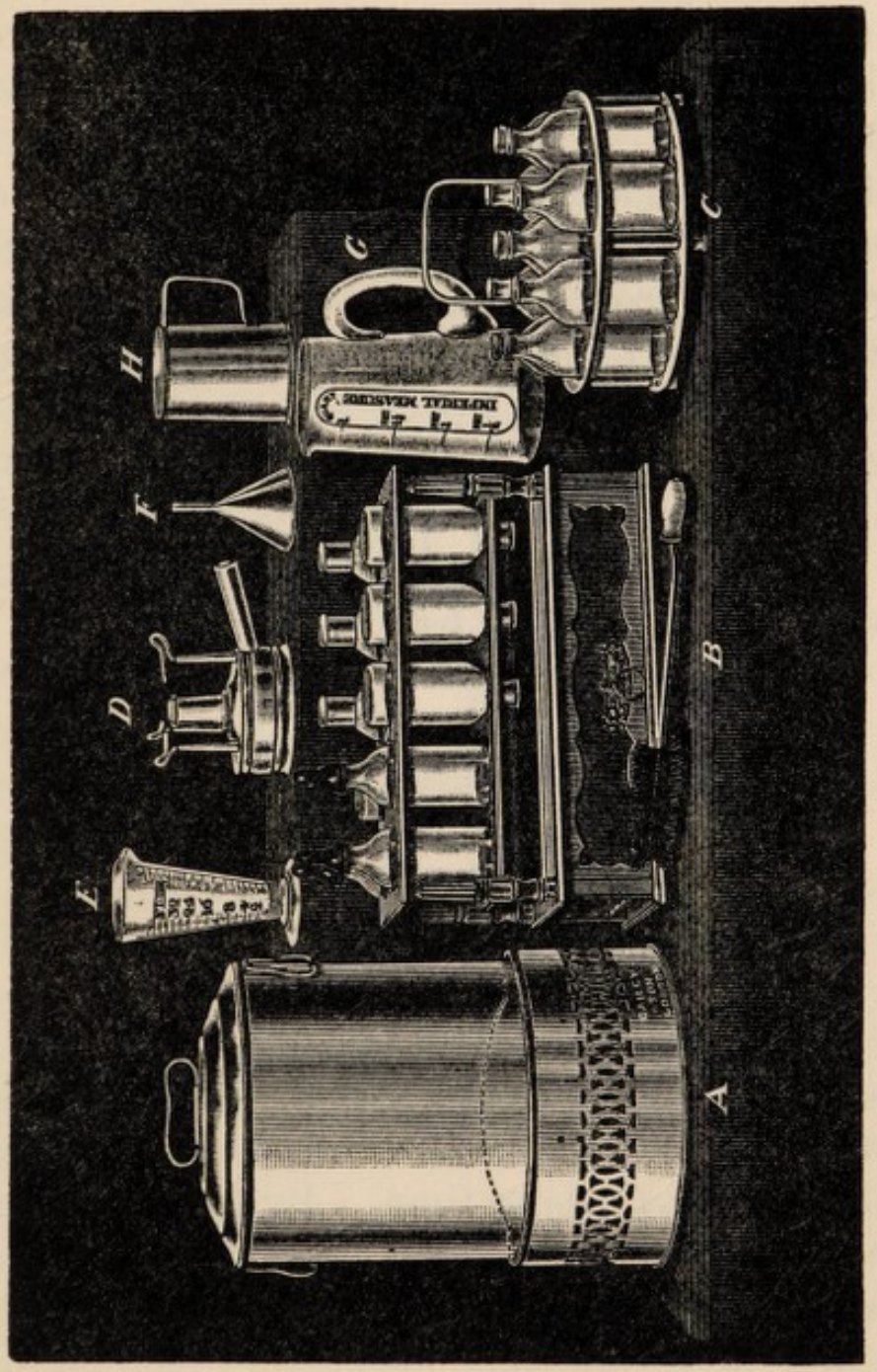

FIG. 1.—Soxhlet Apparatus, with Author's Improvements.

(1) that the water added to the milk mixture should be hot and not cold; (2) that the water in the saucepan be hot at starting, but not hot enough to crack the bottles; (3) that after the

water has reached the boiling-point it be allowed to boil for not more than five minutes; (4) that the quantity of hot water placed in the saucepan be not more than 1½ pints. If these precautions be adopted, the whole process of sterilisation will be found at the outside to occupy fifteen minutes.

This method has, in my opinion, advantages over pasteurisation. To carry out this latter method accurately the contents of the bottles must be maintained at a temperature of 158° F. for forty

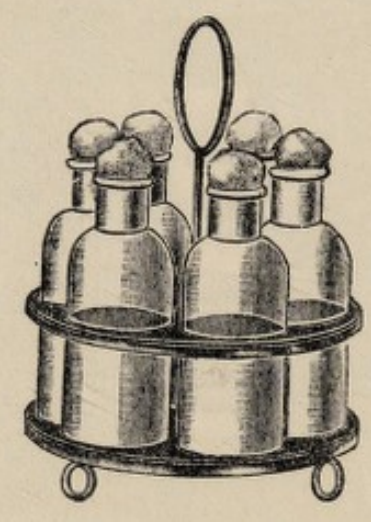

Fig. 2.—Infant Steriliser.

minutes. For this purpose a thermometer should be placed in one of the bottles and the temperature examined from time to time. By a proper adjustment of the flame, and the lid of the saucepan, it is possible to maintain the temperature at 158° F. I do not, however, recommend this method for domestic use.

After sterilisation the bottles should be removed from the saucepan and kept on ice or in a cold place. The india-rubber caps which have been

placed on the bottles will, as the contents cool, be kept in position by atmospheric pressure.

As each bottle is required it must be removed from the stock and warmed in a special can which is provided for the purpose, and the contents raised to a temperature of about 98° F. The temperature should be tested by a thermometer or by holding the bottle against the cheek but not by tasting. The common practice of nurses of putting bottles to their lips and tasting a few drops cannot be too strongly deprecated. When the contents have been raised to the proper temperature, an india-rubber nipple should be slipped over the neck of the bottle and the infant allowed to suck slowly until the contents are finished.

The rate of sucking can be regulated by the size of the hole bored in the nipple, and it is quite easy for the nurse to regulate this matter for herself by boring a hole, or holes, with a red-hot needle of the appropriate size.

The following may seem an unnecessary injunction: *always feed the infant out of the bottles in which the milk has been sterilised.* I have so frequently seen nurses pour out the contents of these exquisitely clean, sterile bottles into other feeding bottles which in design are more after their own ideas, that I must state most emphatically that one of the chief objects of the method I have described is the attainment of absolute cleanliness. If, however, after sterilisation the contents of the bottles are poured into other bottles which have not been properly sterilised, the whole aim and object of the method will be nullified. In the process of sterilisation recommended, the bottles as well as

the contents are boiled and rendered practically germ-free. To carry out complete cleanliness in every detail, it is necessary that the india-rubber nipples should also be boiled for a few seconds before or after use, or kept in a solution of boracic acid.

CHAPTER III.

THE MODIFICATION OF MILK IN ACCORDANCE WITH PHYSIOLOGICAL REQUIREMENTS.

In the previous chapter I have described the method of percentage modification of milk in its application to the feeding of normal infants. Inasmuch, however, as one of the chief advantages of this method of feeding is its high degree of adaptability to the cases of infants who depart in various respects from the normal standard of health either by reason of hereditary idiosyncrasies or from accidental causes, I propose in this chapter to describe the modification of milk mixtures in compliance with special indications.

Now, it must be carefully borne in mind that it does not necessarily follow because an infant manifests no clear and indisputable symptoms of disease, that he is progressing as satisfactorily as he might under improved conditions, or that we are making the most of the child's latent potentialities for development and growth.

It has frequently been forced upon my notice that the significance of many of the so-called trivial symptoms of infancy is very little appreciated. Nevertheless, as a matter of fact, it is often these trivial symptoms which are the danger signals that should arrest our attention and enable us to prevent the

development of really serious complications. I will illustrate my meaning by an example. It is by no means an uncommon event for infants to perspire profusely about the head and the back of the neck. Unless this condition is due to abnormally hot weather, it is a symptom of great significance, and for practical purposes may be regarded as one of the early indications of rickets. This symptom, which ought to be regarded most seriously, is generally looked upon by mothers and nurses as a normal and physiological incident of infancy. Again, the process of teething is usually regarded as an event which is normally accompanied by disturbances of digestion: while overflow and vomiting after food are believed to be of healthy significance, in the same way that growing pains (rheumatism of the joints and muscles) are held as physiological events in later childhood.

I am fully convinced that if mothers and nurses viewed these and other symptoms with less complacency, very many of the more serious complaints of later childhood, and, indeed, of adult life, would be prevented. In the second part of this book I shall deal more fully with these questions. In this chapter I propose only to give the more common and usual symptoms which are indicative of some failure of digestion, absorption or nutrition, and which can be benefited by dietetic expedients. Confining myself, then, to the comparatively slight symptoms which can be benefited by modification of the food, I shall, in the first place, discuss those which are referable to disturbances of the digestive organs.

Vomiting.—Sickness is as rare an event in infants who are fed on the carefully regulated dietary

formulated on page 49 as it is common in infants who are reared on the "feed-as-you-please" system.

Illnesses of various kinds, including those of an infectious nature, are not infrequently ushered in by an attack of vomiting, and this variety of sickness must, of course, be carefully distinguished from that which is due to errors of diet. Vomiting which is due to food causes may be occasional or habitual.

Occasional Vomiting may be caused by a too rapid consumption of food, by hiccough or eructation at, during or after feeding, or by joggling or dancing the baby too soon after food. It may also be caused by the accidental contamination of the milk owing to the cows having eaten rank food. I have sometimes met with cases of acute vomiting in infants who have been most carefully fed with sterilised milk. I believe in certain of these cases the sickness was due to the presence of sulphuretted hydrogen, which was pent up in the sterilised bottle and which was the result of a particular form of decomposition occurring in the proteid constituents of the milk. It sometimes happens that on opening bottles of sterilised milk there is a slight smell of sulphuretted hydrogen, which has the characteristic odour of bad eggs. For this reason nurses should form the habit of smelling each bottle as it is opened before giving it to the infant. This gas is very soon discharged from the milk if the bottle be warmed for a few minutes and smartly shaken, leaving the orifice of the bottle open. I do not think that the milk is necessarily bad because there is a slight smell of sulphuretted hydrogen, but if this gas be present in excess the bottle should not be used.

Habitual Vomiting.—By far the most common cause of this condition is excess in the quantity of the food, either from too frequent feedings or from giving too much at one time. Any condition or conditions which give rise to an enlarged or dilated stomach also predisposes to vomiting. Infants whose dietary has been mismanaged, specially during the early days of life, are specially prone to contract the habit of vomiting. This habit may, in spite of the most careful regulation of feeding, continue for a very considerable time after the cause has been removed. Some infants, though successfully reared on carefully modified milk, may suddenly take to vomiting for no apparent cause. It will be generally found that this form of vomiting is periodic and recurrent, and that the infants are of a degenerate type, of feeble constitution and born of unhealthy parents, and it may be assumed that they owe their previous immunity from sickness to the careful manner in which they have been brought up. Some infants may vomit and evince an intolerance of cow's milk which no degree of modification will overcome. Under such conditions it may be necessary, for a time at all events, to give up all attempts to feed the child with milk in any form, and it is then desirable to try one of the alternative foods described on p. 82.

It may indeed be necessary to change the constituents of the food again and again, but the quantity should, in the first instance, always be below the normal standard, and only gradually increased.

Vomiting may be due to the Quality of the Food.—For instance, a mixture too rich in cream will

sometimes induce vomiting. Vomiting due to this cause occurs about an hour after taking food, and the usual event is the regurgitation of a mouthful or two of sour-smelling milk. The treatment in such cases is the reduction of the percentage of fat. Milk containing too much proteid will also sometimes cause vomiting. The vomiting due to this cause is characterised by the regurgitation of masses of curd, generally about a quarter of an hour after feeding, though sometimes it may occur later. The treatment in such cases is to reduce the quantity of proteid, or to replace the water in the mixture by barley water, or even to peptonise the mixture.

Illustrative Cases.

Case 1.—An infant aged five months, fed on 7 oz. of milk (two parts milk, one part water, and a tablespoonful of patent food) eight times a day, vomited, sometimes immediately after food, sometimes about an hour afterwards. *Note.*—Quantity too much, percentage of fat insufficient. *Treatment.* — Fed according to directions on page 49 for infant from four to six months. *Result.*—Vomiting entirely ceased in two days. Infant at first seemed unsatisfied, but at the end of a week was quite contented with the changed diet.

Case 2.—Infant, twenty-eight days old, fed according to table, page 49, from birth, began to regurgitate small quantities of sour-smelling milk one and a half hours after feeding. *Note.*—Too much fat in mixture. *Treatment.*—Fat reduced from 3 per cent. to 2 per cent., that is to say, the percentage composition of the food was altered

from fat 3 per cent., proteid 1 per cent., sugar 6 per cent., to fat 2 per cent., proteid 1 per cent., sugar 6 per cent. Such a change can be accurately carried out by reference to the table, page 46. It could, however, be approximately effected by simply reducing the quantity of cream employed in making the mixture from 3 oz. to 2 oz. In cases of this kind the percentage of fat should again be gradually increased up to the normal standard. *Result.*—Satisfactory.

Windy Spasms and Colic.—These conditions are generally due to the fact that the proteids or curd of the milk are not properly digested. They can be recognised by the infant becoming fretful and restless, by keeping his legs tucked up tightly to his abdomen, and by the distended and hard condition of the abdominal parietes. The pain is usually spasmodic, lasting a few minutes, and during this time the infant's face becomes grey and pinched, and the feet are more or less cold. If the motions are examined they will usually be found to contain particles of undigested clot. *Treatment.*—Clear out the bowel with castor oil, reduce the proteids, peptonise, or try a substitute food, page 82.

Illustrative Cases.

Case 1.—Infant, six weeks old, fed on milk and water, equal parts, between 4 and 5 oz. Abdomen hard but not much distended, undigested clot found in copious motions. *Note.*—Quantity of food excessive, proteids (2 per cent.) excessive. *Treatment.*—Infant fed according to table, page 49. *Result.*—Colic ceased almost immediately.

Case 2.—Infant, five months, fed on humanised milk, about 6 oz. at a time. Belly enlarged, hard, passage of much wind, no undigested clot in motions, but much froth. *Note.* — Commercial humanised milk often produces these symptoms. In this case the proteid was evidently well digested, but froth in motions suggested that sugar was in excess and was fermenting in the bowel. *Treatment.*—Bowel cleared out with castor oil, and modified milk of following formula ordered: Fat 4 per cent., proteid 2 per cent., sugar 5 per cent. (see table, page 46, formula D 7). Quantity to be 4½ oz. seven times a day. In this prescription the proteid is higher than is usual for an infant of five months, and the percentage of sugar lower, for the reason that the infant could evidently digest a large proportion of proteid but found a difficulty in dealing with a normal quantity of sugar. *Result.* —Satisfactory, but infant inclined to constipation.

DIARRHŒA: OCCASIONAL AND CHRONIC.

Occasional Diarrhœa—Acute.—Sudden attacks of diarrhœa occurring in infants are not always easy to explain. They may sometimes be due to cold or chill or to teething, but more often to indigestible or poisonous material in the food. Summer diarrhœa is probably due to pathogenic bacteria contained in the milk. Hence, if the milk has been previously sterilised diarrhœa is not likely to occur from this cause. *Treatment.*—Dose of castor oil, warm fomentations to the stomach. All food should be withheld for at least eight hours, but barley water or plain water with five to twenty drops of brandy should be given at regular intervals. If

food be given in such cases it only aggravates the condition, because it supplies the bacteria in the bowel with food to decompose, and the infant derives no benefit. If at the end of twelve hours diarrhœa has ceased, there should be a gradual return to normal feeding, commencing, in the first place, with a peptonised milk mixture. However, if diarrhœa continues, medicinal treatment must be resorted to, and the infant fed on white of egg solution, or substitute food, No. 6, p. 84, with a few drops of brandy in each bottle.

Illustrative Case.

Healthy infant fed on diluted cow's milk and cream, both of which had been improperly kept in hot weather in open jugs and not sterilised, had a sudden attack of diarrhœa and vomiting. With the exception that the milk was not sterilised, there was no serious fault in the method of feeding. The cause of the diarrhœa was probably pathogenic bacteria in the milk. *Treatment.*—Dose of castor oil, barley water with fifteen drops of brandy given in 2 oz. quantities every two hours. The diarrhœa gradually improved, but at the end of twelve hours there was still exhaustion and the passage of small liquid motions. Fifteen drops of Valentine's meat juice were now added to each bottle, and at the end of twenty-four hours 1 oz. of peptonised milk was tried without increasing the diarrhœa. From this time forward the quantity of peptonised milk was gradually increased until, at the end of a week, a full quantity was reached. The peptonisation was then gradually left off. *Result.*—Satisfactory.

Chronic Diarrhœa.—Chronic diarrhœa, unless of tuberculous origin, is generally due to food causes, and inspection of the motions will, as a rule, afford reliable information with regard to the element or elements of the food which are causing the trouble. It is, therefore, of the utmost importance to be familiar with the normal and abnormal appearance of the stools.

NORMAL STOOLS.

Breast-fed Infants.—Towards the end of the first week the stools of the healthy breast-fed infant change from a green-black to a golden colour: the consistence is that of a soft, semi-liquid paste. They are acid in reaction. For the first two or three months two to four stools are passed daily; after that time the bowels should not act more than twice a day. *Hand-fed Infants.*—Infants fed on properly modified milk pass motions which closely resemble those above described, but the reaction is generally alkaline: they are sometimes neutral, and frequently very distinctly formed; they do not appear so uniform or homogeneous in consistency as is the case with breast-fed infants, and often contain little flakes of a whitish-yellow material, which usually consists of unabsorbed fat or inspissated mucus. The number of the evacuations in healthy infants is from two to four daily during the first month, from two to three for the next five months, and from one to two a day to the end of the first year. The quantity is usually stated to be more in hand-fed infants than in those which are breast-fed, but in those cases in which the food is properly managed they are com-

paratively scanty, especially when compared to the huge evacuations usually passed by infants who are fed on haphazard and unscientific principles. Small, scanty formed stools are by no means a bad sign ; infants who extract the full value from their food often pass motions of this character.

ABNORMAL STOOLS.

Green Stools.—Most stools, especially those of breast-fed infants, become green or greenish on standing. When, however, the green colour is evident immediately after the motions have been passed, the colour is generally due to fermentation taking place in the bowel, and the condition requires treatment. The green colour is also sometimes due to over-stimulation of the liver, and the hurried passage of food through the bowel, as after a dose of grey powder.

Curdy Stools.—Considerable fragments of undigested curd or proteid matter are found in the motions when the proteid is in excess. When this is the case there may be concomitant diarrhœa, griping and flatulence. Masses of undigested fat may, however, be mistaken for proteid. Fat and proteid may be distinguished by diluting a specimen with distilled water and adding Millon's reagent (nitrate of mercury) ; if proteid is present, it will form reddish lumps (Biedert). A more practical method which I have devised for my own use is to pick out a large-sized and typical lump of undigested material with a bonnet pin or long needle, dry it over a spirit lamp, and when dry burn it. If it is fat it will smell of burning

grease ; if proteid it will smell like burnt feathers, or, as often happens, there may be a characteristic smell of both combined.

Slimy Stools.—These are generally the result of catarrhal inflammation. When the mucus is mixed with the fæcal matter the inflammation is in the upper part of the bowel, but when flakes or masses of mucus precede, accompany or follow the motion the trouble is in the lower bowel. Elongated dry white threads of mucus are sometimes mistaken by nurses for thread worms ; the symptoms of chronic catarrhal inflammation of the bowel and those due to thread worms are not altogether dissimilar.

Yellow, Watery Stools.—These are seen in depressed nervous conditions, especially during the hot days of summer.

Foul-smelling Stools.—Generally caused by decomposition of the proteid, especially when an animal proteid such as meat juice is being given in the food. These stools are often greasy and slimy.

Frothy Stools.—Due to decomposition of excess of sugar or starch. They have a sour odour, and are generally accompanied by mucus, and the infant is troubled with flatulence.

Pale Clay-coloured Stools.—Generally in infants whose livers are out of order, or when there is catarrh of the duodenum or pancreatic ducts, a common symptom in degenerate infants.

Profuse Colourless, Watery Stools with little fæcal matter. Probably caused by a pathogenic germ akin to that of cholera. This condition is usually known as summer diarrhœa or cholera infantum.

TREATMENT.

These types are rarely found alone but are met with in various combinations. A knowledge of them, however, will greatly facilitate the understanding of the cause of any particular case of diarrhœa and thus accelerate the cure. The treatment in all cases must be directed towards the removal of the cause.

If the stools are green and foul smelling, the bowel should be well cleared out with castor oil, and a small dose of grey powder and 2 grs. of bicarbonate of soda given every night. The percentage of proteid should be decreased until the diarrhœa ceases. It may sometimes also be necessary to decrease the percentage of fat and sugar also, or to place the infant on a substitute diet such as No. 14, p. 87.

Curdy Stools.—Diarrhœa with curdy stools should be treated by a preliminary dose of castor oil, and the proteids should be reduced. If this treatment does not succeed, the milk should at first be completely peptonised and subsequently peptonised for shorter and shorter periods. Substitute No. 13, p. 86, can be tried if there is any difficulty in peptonising the food.

Diarrhœa with Excess of Fat in the Motions.—If the stools are greasy and sour smelling give a small dose of liquorice powder and reduce the percentage of fat.

Diarrhœa with Slimy Stools and much Mucus.—This condition requires medicinal treatment, and for a time a reduction in the quantity of food, especially if the stools are copious. Although strictly speaking medicinal treatment does not

come within the scope of this work, the following prescription may be found useful in this condition :—

℞ Vini. ipecac.	. . .	℥ss
Pulv. cret. preparat.	. .	℈i
Sod. bicarb.	. . .	℥ss
Aq. anæthi ad	. . .	℥iij

Sig.—One-half to two teaspoonfuls three times a day between feedings.

Yellow, Watery Stools.—This condition is generally benefited by tonic treatment and a change of dietary. Substitute food No. 5, page 84, should be tried.

Foul-smelling Stools.—Reduction of the proteids. A small dose of grey powder every night.

Diarrhœa with Frothy Stools.—Infants with this form of diarrhœa generally show evidence of intestinal irritation by redness of the skin about the buttocks. The gas to which the frothy stools are due is caused by fermentation of sugar or starch. It is best treated by reduction of the percentage of sugar and the addition of one or two grains carbonate of soda to each bottle.

Profuse Colourless, Watery Stools.—This condition is more often acute than chronic, and the treatment is described on p. 63.

Illustrative Cases.

Case 1.—Infant, five months old, fed on 5 oz. of diluted milk (two parts milk, one part water) with patent food had, on an average, five motions a day, green, slimy and offensive, with occasional vomiting. The stomach was evidently dilated, and there was gastro-intestinal catarrh. The cause

was excessive and improper food (proteids and sugar in excess, fat deficient). *Treatment.*—Purge of castor oil, ½ gr. grey powder every night for three nights. Substitute food No. 6 for one week, then substitute No. 14 for three days, then diet appropriate to his age (page 49). *Result.*—Satisfactory.

Case 2.—Infant, seven months old, partly breast fed and partly fed on milk and water with patent food, passed very copious motions, generally immediately after breast feeding. Motions sometimes green and offensive, but remarkably well digested. A quantity of mucus followed, and accompanied each motion. The infant took the breast voraciously, and evidently extracted a very large quantity of milk. The bottle food was also greatly in excess, sometimes 9 oz. were consumed for one meal. The baby was fat, and muscularly weak, sweated about the head and neck, and presented other evidences of rickets. *Cause.*—Excessive feeding. *Treatment.*—Infant was weaned and fed exclusively on the same artificial food as before treatment, only the quantity was reduced to 6 oz., and adjusted to the percentage appropriate to an infant of seven months; with mild medicinal treatment the diarrhœa and other symptoms completely disappeared in a few weeks. *Note.*—The proper treatment in this case would have been to place the infant on properly modified milk without the patent food.

CONSTIPATION.

The chief causes of this condition are :—

(1) Atony and muscular weakness of the intestine.

(2) A deficiency of fat.

(3) A deficiency in the total quantity of food.

(4) Improper and insufficiently stimulating food.

(5) Spasmodic closure of the sphincter ani from cracks, fissures, etc.

(6) Mechanical obstruction of the bowel.

(7) Excessive vomiting from causes which prevent food passing from the stomach into the intestine.

Constipation does not as a rule give as much trouble during infancy as during later childhood. In infants who are brought up on a physiological artificial dietary the symptom is most likely to occur during the first few weeks of life, because the amount of food which is then given is comparatively small and sometimes insufficient to fill the intestine and stimulate it to active peristaltic movements. However, if patience be exercised during this period, and there is no resort to drugs, this difficulty is soon overcome, especially so if the infant is properly trained by the nurse. On the other hand, with infants brought up on patent foods the trouble is generally looseness of the bowels. The bowels are at first too freely opened, and later on, towards the end of the first year, constipation develops. This form of constipation is difficult to treat, because the condition is due to atony and muscular weakness of the bowel owing to previous over-stimulation and distension. If the food is reduced—the course which is usually necessitated for the treatment of concomitant symptoms—the constipation is at first aggravated, and there is a great temptation at this period to employ drugs, enemas or suppositories. All these practices are bad, because they do not go to the

root of the matter and attack the cause. They tend rather to perpetuate the very condition which has given rise to the trouble. One of the best methods of overcoming constipation occurring in infants hitherto overfed is to increase temporarily the percentage of fat or cream in the food, and to give a tablespoonful of orange or other fruit juice with 3 oz. of cold water half an hour or so before the first morning feeding. This, combined with massage of the abdomen together with patient attempts to induce regularity in the habits, will ultimately overcome the difficulty.

Illustrative Cases.

Case 1.—An infant, three weeks old, fed on carefully modified milk had only one action daily, which was small, hard, brittle, and formed and passed with much straining. *Treatment.*—Fat increased from 3 to 3½ and then to 4 per cent., with distinct improvement in the symptoms, and no occurrence of vomiting, an event which sometimes occurs from increasing the percentage of fat too rapidly.

Case 2.—Infant, seven months old, had recently had food changed from milk and water with rusks and patent food to appropriate percentage diet. This change, which had been made because symptoms of sickness and flatulence were giving trouble, had led to the constipation which now necessitated treatment. The cause of the constipation was dilatation and weakness of the muscular walls of the intestine. The treatment was a tablespoonful of orange juice, with 3 oz. of cold water half an hour before the first morning meal. This, together

with systematic massage of the abdomen, produced gradual improvement.

MINOR AILMENTS OF NUTRITION.

The previous section has dealt exclusively with the minor disorders of digestion. I shall now proceed to discuss the question of disturbed nutrition. Disturbed digestion is one thing, disturbed nutrition is another, although the distinction is not always fully appreciated. If the infant loses weight, becomes emaciated, with pinched features, with a dry and inelastic skin, the cause is usually ascribed to disturbance of digestion. I by no means wish to suggest that disturbances of digestion do not usually accompany this group of symptoms, but the point which I wish to emphasise is that the same symptoms can occur, and do occur, without any evidence of disability on the part of the gastric and intestinal functions. They may, as a matter of fact, represent nutritional disturbances of the tissues in general and not of the digestive tract in particular. The nutrition of the nervous system (the brain and spinal cord), of the muscles, of the skin and of the connective tissues is perverted and abnormal. In a certain number of these cases the failure of nutrition of the tissues is due to the effects of improper feeding; moreover, except in the case of infants of feeble nutrition from hereditary causes, this mismanagement does not necessarily cause any obvious symptoms of indigestion. The food which is supplied to the infant may be perfectly digested and completely absorbed, but it does not nourish the tissues. It is not of a character

suitable for them, nor capable of physiological utilisation. For instance, certain classes of infants who may be briefly described as degenerates, and who are born of unhealthy parents, present remarkable idiosyncrasies of nutrition. They may digest and absorb their food quite satisfactorily, and yet fail to thrive. Cases of this sort supply the majority of instances of marasmic, scrofulous and rickety infants.

Now, the point which I wish to make quite clear is that infants with bad hereditary constitutions, or those with constitutions which have been undermined by injudicious dietetic management, are often infants with idiosyncrasies of nutrition (metabolism), that is to say, the tissues cannot make proper use of the nutritive material brought to them by the blood. Now, we may regard each tissue as a special furnace, which burns for its own purpose, or for the common benefit of the body, the fuel or the food brought to it by the blood. All is grist which comes to the mill of healthy, active tissues in a high state of nutrition by reason of the active combustion which there prevails. Everything which can be regarded as fuel is readily burnt up and utilised. But with the tissues of feebly constituted babies the case is different. The fire of nutrition is low and smouldering. If you pile up the fuel too liberally you put out the flame. This sort of furnace must not be stoked with coal dust or coke, it must be supplied with the very best and the most combustible fuel, and a forced draught should be brought to bear, or in other words, a free supply of oxygen should be ensured to maintain the process of

oxidation or combustion. Apart from simile, and in plain words, you must feed tissues of feeble nutritive power with exactly the right food and in exactly the proper quantities which their physiological activities require. Otherwise you will extinguish the smouldering vital spark.

It must be remembered that all the tissues of the human body consume and require as food proteids, fats and sugar. The tissues of some infants seem to experience difficulty in consuming proteids, others in consuming fats or sugars. It has been proved, for instance, that rachitic infants[1] can consume or oxidise less sugar than those who are in health. That marasmic infants[2] find a difficulty in utilising fat, and that most degenerate arthritic and feeble infants experience difficulty in dealing with large quantities of food of any kind, but of proteids in particular. To recognise these facts is to be able to treat these conditions rationally, and with the probability of success.

The practical management of infants with disabilities of nutrition is far more difficult than that of infants who suffer from disorders of digestion. In the latter case there are many obtrusive signs and symptoms to guide us in the management. For instance, the conditions of the bowels, character of the motions and the behaviour of the stomach, but the evidences of feeble nutrition are more intangible and difficult to appreciate. There are, however, certain general principles and practical rules which may be found of value in arriving at a suitable treatment. The first and chief of

[1] Nobécourt, *Rev. d. Mal. d. l'Enf.*, Ap., 1901, p. 161.

[2] B. Bendix, *Berlin Med. Woch.*, Nov., 1899.

them is to realise that in dealing with feeble constitutions and conditions of ill-health, the fire of life is burning at low ebb, and therefore requires a reduced supply of fuel and an increased supply of oxygen (fresh air). Secondly, that the children of unhealthy parents (syphilitic, alcoholic, rheumatic, gouty, scrofulous, tuberculous, aged, self-indulgent) always in varying degrees possess feeble powers of nutrition, no matter how healthy they may appear at birth, and are more liable to become rachitic, scrofulous, marasmic and atrophic than are normal children. Thirdly, in the majority of cases of feeble nutrition more difficulty is experienced in digesting, absorbing and metabolising proteids than other varieties of food. Proteids, however, are more essential than any of the other elements, and therefore in such cases it is all the more necessary that care should be exercised in selecting proper varieties of proteids which are suitable to maintain normal nutrition.

Next after proteids, fats are of most importance, and with them also difficulty is experienced both in absorption and utilisation. Sugars are most easily digested and absorbed, although, from the point of view of nutrition, they are probably a long way the least important. Sugar-fed babies are fat, feeble, sluggish, perspiring, rachitic infants with low powers of resisting disease, and subject in later years to weak ankles, knock-knees, nervous symptoms, rheumatism, etc. Care, therefore, must be taken that infants with a bad hereditary history do not consume excess of sugar, and that the proteids and fats are provided in such a form that they can be adequately digested, absorbed and assimilated by the tissues.

Excess or deficiency of any of the elements of food may be digested, absorbed and reach the tissues.

If excess of proteids reaches the tissues there will be an excess of uric acid and urea in the urine, and the latter will be strongly acid and perhaps cause irritation. There may be a tendency to nervous symptoms, night terrors, incontinence and frequent passage of urine, eczema and other symptoms due to a lithæmic condition.

If deficiency of proteids reaches the tissues the urine will contain little uric acid and urea; infants will be poorly developed muscularly, and perhaps fat and flabby, with little resistance to disease.

If excess of fat reaches the tissues the infant will be too fat but firm, the skin may be greasy and the perspiration smell offensively.

Deficiency of fat will probably lead to a rachitic condition. The infant may ultimately become marasmic and unduly sensitive to cold.

If excess of sugar reaches the tissues, in extreme cases there may be sugar in the urine. Infants will be large, fat and flabby, with a peculiar transparent puffy appearance of the skin. There will be muscular weakness, a too rapid increase in weight, free perspiration and a large liver and indications of anæmia. The infant will be extremely liable to wheezy breathing, bronchitis, pneumonia, croup and catarrhs of all the mucous membranes.

If a deficient supply of sugar reaches the tissues the infant will probably be thin though possibly strong; he will increase in weight slowly.

These types of malnutrition are naturally seldom found independently. For instance, excess of sugar

is a close companion of fat starvation, and fat starvation and proteid insufficiency are generally combined, but as a rule one or other of the symptoms referable to excess or deficiency of one particular element will predominate. It must not be imagined that proteids, fats and sugars are the only elements concerned in nutrition which have to be considered. Salts, extractives and the natural ferments of milk all play their part, but these are matters about which at the present time we know very little, although a study of them would probably well repay us.

DIRECTIONS FOR TESTING THE CONDITION OF GENERAL NUTRITION.

This subject is dealt with more fully in Part II., but the following are important points which should be observed :—

1. *The Increase in Bodily Weight.*—An infant of normal weight on appropriate dietary should not put on less than 4 or more than 8 oz. weekly for any consecutive number of weeks.

2. *The Condition of the Skin.*—The skin should be soft and elastic, the feet and hands should be warm, the head and back of the neck should not be moist with perspiration during the night. There should be no spots or eczema about the body.

3. *The Muscular System* should be well developed and the movement of the limbs active, with no tenderness on being touched or moved.

4. *The Fontanelle* should not be widely open, and the membrane which covers it should be neither depressed nor bulging.

Illustrative Cases.

Case 1.—Infant, six months old, fed from birth on condensed milk, with the occasional addition of cream, was large, fat, heavy, with muscles badly developed. He was a restless sleeper, and the motions were copious but well digested. *Note.*—Clearly a sugar-fed baby. *Treatment.*—Fed according to table, page 49, with the addition of 3 drs. of raw meat juice daily and a dessertspoonful of orange juice in 2 oz. of cold water one hour before the first meal in the morning. *Result.*—Improvement in general condition, with tendency to constipation and appearance of undigested casein in the motions. *N.B.*—Infants who have been reared on condensed milk or patent foods which are not prepared with fresh milk, when changed to a diet of modified cow's milk generally indicate incapacity for digesting the casein, and it is sometimes necessary to peptonise the food at first or employ low percentages of proteid.

Case 2.—Thin, emaciated baby of five months, fed on modified milk. The skin was dry and inelastic, bones of head soft, fontanelle widely open and membrane depressed; a bad sleeper, had periodical attacks of vomiting, but the appetite was good, and the food well digested. Weekly increase in weight was never more than 4 oz. and seldom more than 2 oz., although the food had been carefully regulated. *Note.*—The mother had been ill before the birth of the child and confined to the house. She had suffered greatly from neuralgia, and was a typical neurasthenic. The infant was consequently of feeble constitution and

degenerate type, and it was therefore only to be expected that his general condition of nutrition should be abnormal. *Treatment.*—The total quantity of food was reduced from 36 oz., which he had previously taken, to 28 oz. per diem. The percentage composition was not altered, but ½ oz. of meat juice and 2 drs. of virol were given in addition, and the body was well massaged every day with olive oil. *Result.*—General condition improved, but the weekly increment in weight continued below normal.

CHAPTER IV.

THE MODIFICATION OF FOOD IN DIFFICULT CASES AND IN SPECIAL CONDITIONS.

We are often told that certain infants cannot digest any form of cow's milk modified, peptonised or otherwise treated. My own experience has been that it is a very rare event to meet with an infant who cannot digest and thrive on milk in some form or other, provided that the milk has been judiciously modified during the first few weeks of life. I admit, however, that if the normal functions of the stomach have been upset at this period by a reckless dietary, the subsequent rearing on any form of milk may be difficult or perhaps impossible. For this reason it is essential that our scheme of percentage feeding, which is intended to cover the case of infants who have been initially mismanaged, should include a number of substitute foods which do not consist of milk in any form.

It is quite impossible in any given case of difficult feeding to predict what variety of food will give most satisfactory results. Indeed, it is a common experience to find that after early mismanagement, and especially in the case of degenerate types of infants, no variety of food can be continued for any length of time without change or modification.

The accompanying table contains a number of

substitute foods with full directions for preparation. Each of them contains the three elements of food, namely, proteid, fat and sugar standardised to the proportions of human milk, that is to say, the percentage composition is proteid 1·5 per cent., fat 4 per cent., sugar 6·5 per cent. It must be remembered, however, that these proportions are not always suitable, especially in those cases which have been seriously mismanaged. It is generally in the case of very abnormal cases that such mixtures are required, and in such instances it is very often found that a 4 per cent. cream mixture is far too strong, and a 1·5 per cent. proteid percentage too high. Under such circumstances the proportion of these constituents must be reduced. As a rule, this is a perfectly simple matter, and one requiring the exercise of no particular mathematical skill.

TABLE OF MIXTURES SUITABLE FOR DELICATE AND SICK INFANTS.

These mixtures contain, unless otherwise stated, fats, proteids and carbohydrates in the proportion in which they occur in average human milk, that is to say: Fat, 4 per cent.; proteid, 1·5 per cent.; sugar, 6·5 per cent.

In a great many instances, in which it is necessary to resort to these substitutes for properly modified milk, it is found that infants cannot digest mixtures containing 4 per cent. of fat. In such cases, therefore, the percentage of fat must be reduced in accordance with the requirements by decreasing the amount of the cream. It must be remembered that cream itself contains 4 per cent. of proteid. If the infant cannot digest even this small amount of proteid, emulsion of butter or other fat must be substituted for cream.

Directions for Preparing One Pint of Mixture.

No. 1.

Peptonised Milk.—Milk, 4 oz.; cream (16 per cent.), 3 oz. 4 drs.; milk sugar, 1 oz. 2 drs. (by measure not by weight); water to make 1 pint. To be peptonised for half an hour at a temperature of 98° F., with one small teaspoonful of liquor pancreaticus (Benger's) and 5 grs. of bicarbonate of soda. At the end of this time the mixture must be brought to the boil, and kept in a stoppered bottle until required.

This mixture is recommended for temporary use during acute illnesses, or in cases in which unaltered proteid cannot be digested.

No. 2.

Fresh Meat Juice.—Meat juice, 2 oz.; cream (16 per cent.), 5 oz.; milk sugar, 1 oz. 3 drs. (by measure not by weight); water to 1 pint. This mixture must not be boiled or sterilised, since by so doing the proteid will be rendered insoluble, it must be kept on ice.

To Make the Raw Meat Juice.—Take ½ lb. minced rump steak, mix well with 2 oz. of water; let it stand for half an hour, and then express the juice by squeezing through muslin. Meat juice prepared in this way contains 5 per cent. of proteid.

This mixture is recommended for debilitated and anæmic infants who are not thriving on ordinary milk mixtures.

No. 3.

Condensed Milk.—Condensed milk (Nestlé's), 2 oz.; cream (16 per cent.), 3 oz. 4 drs.; water to 1 pint.

This mixture is recommended for infants who are recovering from attacks of diarrhœa, to be used as a stepping-stone to milk mixtures containing the unaltered proteids of cow's milk.

No. 4.

Unsweetened Condensed Milk.—Condensed milk (unsweetened Ideal Brand), 2 oz.; cream (16 per cent.), 3 oz. 4 drs.; milk sugar, 1 oz. 2 drs.; water to 1 pint.

This mixture is recommended in preference to No. 3 when it is desirable to have the amount of sugar under control and to alter the percentage composition from time to time as is neces-

sary during the first few weeks of life. This can be done by reducing or increasing the milk sugar as required. The percentage of proteids or fats are not altered by the modification. If necessary the percentage of fat can be reduced by diminishing the quantity of cream, or the percentage of both proteid and fat by reducing the quantity of condensed milk.

The percentage composition of Ideal milk is: Fat, 10 per cent.; proteid, 7·36 per cent.; milk sugar, 11·03 per cent.

No. 5.

Horlick's Malted Milk.—Horlick's malted milk, 1 oz. (by measure); cream (16 per cent.), 4 oz. 4 drs.; milk sugar, 5 drs.; water to 1 pint.

This mixture has advantages for temporary use for those infants who are losing ground on ordinary milk mixtures.

No. 6.

White of Egg Mixture.—White of egg, 1 oz.; cream (16 per cent.), 5 oz.; milk sugar, 1 oz. 3 drs. (by measure); water to 1 pint.

To Make Solution of White of Egg.—Measure 1 oz. of raw white of egg, cut it in various directions with clean scissors, shake it up in a bottle with 13 oz. of cold water, strain through muslin, and add the cream and sugar.

No. 7.

Asses' Milk.—Asses' milk, 17 oz.; cream (cow's, 16 per cent.), 4 oz. 4 drs.

Asses' milk itself contains too low a percentage of fat for permanent use; it is therefore advisable to add cream in the quantity above mentioned. A mixture prepared in this way is an excellent substitute for modified cow's milk, especially for degenerate or delicate infants; it is, however, expensive. Asses' milk may be obtained at any of Welford & Co.'s branch establishments, or an ass may be hired for the exclusive use of the infant.

No. 8.

Condensed Milk and Virol.—Unsweetened condensed milk (Ideal Brand), 4 oz.; virol, 1 oz. 2 drs.; water to 1 pint.

This mixture is to be recommended for marasmic or atrophic infants who cannot assimilate sufficient fat in the form of cream.

The percentage composition of the above mixture is as follows:—

Fat, 3 per cent.; proteid, 1·5 per cent.; sugar, 6·5 per cent. It will be noticed that the fat is below the ordinary standard.

No. 9.

Whey, Virol and Prideaux's Casumen.—Whey, 18 oz.; virol, 1 oz.; Prideaux's casumen, 2 drs.; water to 1 pint.

This is a mild and bland mixture for infants subject to vomiting. The percentage composition is not, however, such as to render it suitable for other than temporary use.

The percentage composition is: Fat, 2 per cent.; proteid, 1·5 per cent.; sugar, 6·5 per cent.

The percentage of fat may be increased if thought desirable by adding a few drops of cream, and gradually increasing the amount. For preparation of whey, see p. 184.

No. 10.

Lahmann's Vegetable Milk.—Vegetable milk, 2 oz. 4 drs.; water to 1 pint.

This substitute for ordinary milk has certain advantages, and infants of delicate constitution appear to thrive exceedingly well on it, especially those who cannot digest or assimilate animal fats and proteids without modification. This vegetable milk contains vegetable albumin and fats prepared from nuts and almonds, and in such proportion that when diluted as above the percentage composition very closely approximates to that of human milk.

The percentage composition of the above mixture is: Fat, 4·3 per cent.; proteid, 1·5 per cent.; sugar, 4 per cent.

If this mixture be used for any continued length of time, I advise that a few teaspoonfuls of orange juice or meat juice be given independently to make sure that no symptoms of scurvy supervene from the use of a food which has been preserved and kept for some length of time. With this precaution I believe that Lahmann's milk gives really excellent results, but it is far better used in combination with milk, as in the following recipe:—

No. 11.

Lahmann's Vegetable Milk, Cow's Milk and Cream.—Lahmann's vegetable milk, 1 oz. 2 drs.; cream (16 per cent.), 1 oz. 3 drs.; milk, 2 oz. 3 drs.; milk sugar, 5 drs.; water to 1 pint.

This is an excellent mixture, apparently more easily digested than simple modified milk.

The percentage composition is as follows: Fat, 3·6 per cent.; proteid, 1·5 per cent.; sugar, 5·5 per cent.

No. 12.

Bread Jelly, Meat Juice and Cream.—Bread jelly, 2 oz.; meat juice, 2 oz.; cream (16 per cent.), 5 oz.; water to 1 pint.

The bread jelly is prepared as follows: Take 4 oz. stale bread, soak for six hours in water, changing the latter once or twice, and squeeze free of water; then boil for one and a half hours in a pint of fresh water, rub through fine hair sieve, and allow to cool and set into jelly.

For preparation of meat juice, see Recipe No. 2.

The specified quantities of jelly, meat juice and cream must be rubbed up thoroughly together, and the water gradually added. This mixture has a composition of: Proteid, 1·3 per cent.; cream, 4 per cent.; carbohydrate, 1·2 per cent.

The carbohydrate is very deficient as compared with the standard of human milk. This is, however, no disadvantage for most of the cases for which it is recommended. The deficiency can, however, be made good, if necessary, by the addition of 1 oz. of milk sugar.

This mixture is recommended for temporary use in cases of atrophy and catarrh of the bowel with copious discharge of mucus, or in cases in which the motions are frothy.

No. 13.

Bread Jelly, Egg Water and Cream.—Bread jelly, 2 oz.; white of egg, 1 oz.; cream (16 per cent.), 5 oz.; water to 1 pint.

The white of egg must be prepared as in Recipe No. 6, and thoroughly mixed with the bread jelly and cream.

The mixture has a percentage composition of: Proteid, 1·5 per cent.; fat, 4 per cent.; carbohydrate, 1·15 per cent.

Again, in this mixture the carbohydrate is very deficient. It can be raised to the standard of human milk by the addition of 1 oz. of milk sugar.

This mixture may be used as an alternative to Recipe No. 12. If the meat juice in the latter is too stimulating, it causes foul breath or offensive stools.

No. 14.

Veal Broth, Butter Fat, Milk Sugar.—Take 6 oz. of veal broth, 1½ oz. emulsion of butter, 1 oz. 2 drs. milk sugar. Shake well and add water to 1 pint.

To make emulsion of butter, mix equal parts of melted butter and hot lime water. Shake well for two or three minutes. This emulsion contains 50 per cent. of butter fat.

To make veal broth, see p. 182.

This mixture is useful for infants who cannot digest even the small quantity of casein which is contained in cream. It forms fine, soft motions, and is therefore indicated in irritable conditions of the bowel. It should not be given for too long a period. If the stomach is sensitive and there is vomiting, instead of using the emulsion of butter, the same quantity of butter should be melted down with the sugar into a sort of butter-scotch, and dissolved in hot water.

TABLE OF QUANTITIES.

Age of Infant.	3-14 days.	14-28 days.	2 mths.	3 mths.	4-6 mths.	6-8 mths.	8 mths.
Quantity of any of above mixtures for 24 hours not to exceed . . .	12 oz.	18 oz.	24 oz.	30 oz.	36 oz.	42 oz.	48 oz.

THE MANAGEMENT OF DIFFICULT CASES.

Under this heading there are two types of cases which I propose to describe. First, that of infants who prove intractable from birth upwards to the carefully regulated percentage feeding which I have described as suitable for normal infants; and secondly, that of infants who have been mismanaged and injudiciously fed from the time of birth, and whom we are called upon in the latter months of infancy to treat and establish upon a suitable dietary.

I.—INFANTS WHO ARE DIFFICULT TO FEED FROM BIRTH UPWARDS.

If the reader will refer to p. 74, it will be noticed that I have there stated that the majority of infants who are initially difficult to manage are those who are born of unhealthy parents, and especially so is this the case when during the intra-uterine life of the infant the mother has been a complete invalid. If we suspect that the case is likely to present difficulties, the less likely are we to fall into serious error in the dietetic management. If, then, we are called upon to regulate the dietary of a new-born infant, say, of delicate parents, we ought to be prepared to feed this baby on a *régime* different to that which we should adopt in the case of an infant of good presumptive constitution.

As a rule, delicate infants of the character referred to find a difficulty in digesting and assimilating any kind of proteid, and more particularly the variety which occurs in cow's milk. If, then, we put such infants from the outset on a mixture which contains the unaltered casein of cow's milk, it is highly probable that symptoms of wind and colic will supervene, and that the nutrition of the infant will suffer, because since the proteids have been ill-digested they cannot be absorbed and carried in the blood for the nourishment of the tissues. In the light of this knowledge we should consider the kind of substitute to provide in place of the casein of cow's milk. The most obvious means is to provide a wet nurse. If this can be arranged for, and the feeding conducted according to the principles laid down in Chapter I.,

this method of feeding affords the most likely prospect of success. However, there are usually so many obstacles in the way of obtaining this most desirable end that we must consider the next best course to pursue. I think on the whole the most reliable substitute, at any rate at the outset, is cow's milk which has been modified according to the table on p. 49, but thoroughly peptonised for at least thirty minutes with Benger's liquor pancreaticus and a few grains of bicarbonate of soda (see p. 184). If this method proves satisfactory, and if on examination of the motions the elements of food are found to be well digested and absorbed, we can congratulate ourselves on having made a good start. But unfortunately it is impossible to continue indefinitely with peptonised milk. If we do, symptoms of infantile scurvy, or rickets, or some other indication of malnutrition is certain to supervene. We must, therefore, slowly and by gradual stages wean the infant from this form of predigested food. As a rule it is advisable, at the end of ten days, to commence shortening the time of peptonisation; that is to say, on the eleventh day the food should be peptonised for twenty minutes instead of half an hour, and two days later the time should be further reduced to fifteen minutes, and in this way the time of peptonisation should be gradually reduced until there is evidence from the condition of the bowels that the infant is able to digest an ordinary milk mixture. At this point it may be of advantage to substitute barley water for water in the preparation of the mixture.

It is of the greatest importance that the motions should be daily examined in case there should be

undigested particles of curd. Should any be found, it may be necessary for a time to revert to peptonisation, or the quantity of proteid may be reduced and a teaspoonful of raw meat juice substituted in three or four of the bottles. If this meat juice be added, it must be prepared freshly at each feeding and added to the bottle immediately before it is given to the infant. It must not be sterilised, or the proteid in it will be coagulated.

I regard it as important that delicate infants of the kind referred to should always have two bottles of food per diem which have not been sterilised, and also an occasional teaspoonful of fresh grape or orange juice given independently of the bottle feedings. Such infants are particularly liable to develop symptoms of rickets or of scurvy; and further, they must not be expected to increase in weight at the same rate as do healthy babies. Some of them, indeed, grow exceedingly fat and increase in weight too rapidly. Others again never reach the normal standard even under the most careful methods of feeding. Our object, however, should be to obtain a steady increase in weight each week, no matter how small the gain may be.

Delicate infants of this kind not only find a difficulty in digesting proteids, but some of them appear to have the same trouble with fat. It is very difficult to find a reliable substitute for cream. The employment of butter has advantages, if, as in receipe No. 14, it be emulsified or melted down with sugar. Cod-liver oil is seldom tolerated if cream does not agree. Lahmann's vegetable milk,[1] which is made from nuts

[1] Dr. Lahmann's Agency, 15 Fore St., London, E.C.

and almonds and contains 3 or 4 per cent. of vegetable fat, is spoken well of by those who have tried it, and my own personal experiences have been similarly satisfactory. Theoretically, the use of vegetable fats of this character has much to be said for it when animal fats are found to disagree, but so far I have had few opportunities of putting their employment to practical tests. I can, however, speak highly of the use of virol in cases in which only such low percentages of cream can be digested as to render the addition of some other form of fat desirable. Infants may be induced to lick virol out of a spoon or when spread on the surface of an india-rubber nipple, or it may be beaten up thoroughly with the mixture which the infant is taking and supplied in this manner. I do not think it is advisable to give to an infant of three months old more than six teaspoonfuls daily of this preparation.

If, then, we keep in mind the fact that delicate infants have difficulty in digesting and absorbing the proteid and fatty constituents of their food, and that excess of sugar, though easily digested and absorbed, does not conduce to the development of healthy tissues, the management of ordinary cases of difficult feeding should not prove an insurmountable task.

If, however, after a thorough trial no form of modified milk affords satisfactory results, one of the substitute foods mentioned on p. 82 should be given a trial. Only, it must be remembered, that if there are indications that cream is not well tolerated, it must not be employed in the high percentage (4 per cent.) which is provided for in these mixtures. It must be reduced by one-third or one-half, or even more.

It is impossible in a limited space to anticipate

every eventuality which is likely to arise in the treatment of these cases. However, patience, a knowledge of the principles of percentage feeding and a little ingenuity and resource will help us out of most difficulties. The chief aim in these cases should be to establish the infant on a normal diet of ordinary modified milk at the earliest opportunity possible without running any unnecessary risks.

Illustrative Case.

New-born infant of unhealthy parents weighed 8 lb. at birth and appeared healthy. Was placed on peptonised milk, modified according to table, page 49. This succeeded admirably, but when later on the time of peptonisation was reduced to ten minutes, flakes of undigested proteid appeared in the motions, and the infant had evident attacks of colic. Seeing that he could not digest a sufficient quantity of unaltered proteid he was placed on substitute food, No. 9, page 85, slightly modified, consisting of Prideaux's milk casumen, cream and milk sugar. The infant being now three weeks old the percentage composition suitable for his age was proteid 1 per cent., fat 3 per cent., sugar 6 per cent. To observe these proportions 1 dr. of casumen, 3½ oz. of cream and 1 oz. of milk sugar were mixed together and made up with barley water to 1 pint; 18 oz. of this mixture were divided into ten bottles, each containing 1 oz. 6 drs. This alternative diet met with fair success, but still small flakes of undigested proteid appeared in the motions, evidently consisting of the proteid contained in the cream. To meet this difficulty the cream was replaced by an equivalent quantity of emulsified

butter. The attacks of colic now ceased and the motions became normal. When the infant was five weeks old it was found possible to revert to cream and increase the fat to the original 3 per cent., and at the end of two months he was capable of taking ordinary modified milk of the following percentage: Proteid, 1 per cent.; fat, 3 per cent.; sugar, 6 per cent. (formula B 5, page 46). This mixture was rather weak for an infant of this age, but under the circumstances fairly satisfactory, and better than employing a stronger substitute food. The progress subsequently proved uneventful, although the proteid percentage was always kept subnormal. In this case, by the early recognition that troubles of digestion were to be expected, serious results and complications were probably avoided.

II.—THE DIETETIC MANAGEMENT OF INFANTS WHO HAVE BEEN IMPROPERLY FED.

This class of case is very common, but unless the infant happens also to possess a constitution which is hereditarily bad, or unless serious complications, such as gastro-enteritis, have supervened, he usually responds readily enough to proper methods of feeding, and the results are, as a rule, quite satisfactory. The history of most of these cases presents peculiar similarities. The infant has generally been fed on milk and water for the first few days or weeks of life, usually, however, unsystematically and in excess, with no provision for cleanliness or with the precaution of sterilisation. As often as not feeding-bottles with long india-rubber tubes have been employed and the food allowed to remain in them between the

times of feeding, and kept warm in front of the fire until the contents becomes little else than an infusion of microbes. The consequence of this mismanagement is that sooner or later matters come to a crisis, the infant suffers from wind and dyspeptic symptoms, he generally appears ravenously hungry, and nothing seems to satisfy his appetite except frequent recourse to the feeding-bottle. The relief followed by taking food is only temporary, and this form of maltreatment naturally aggravates the condition until at last the conviction dawns on his responsible custodians that milk and water does not agree with baby. The next stage in this tragedy of errors is the introduction of a patent food. The infant as a rule appreciates the change, and the symptoms perhaps show some improvement, but the excess of sugar which is present in these patent foods soon conduces to additional fermentation in the bowel, and the infant suffers from colic and flatulence, with perhaps diarrhœa and irritation about the buttocks. These symptoms necessitate medicinal treatment and further changes in the diet, and one patent food after another is tried.

At this stage we will consider the line of treatment which is most likely to lead to satisfactory results. Irregularity in the feeding has induced bad habits, and in addition to a certain degree of enlargement of the stomach, the intestinal tract is infested with an excess of bacteria. The motions are frequent, green, slimy and offensive.

The first active step to be taken is to clear out the bowel and start afresh, and for six hours afterwards no food should be given at all, but the infant should be allowed to drink as much sterilised water as he

pleases. This privation of food is generally regarded as constructive cruelty, but as a matter of fact it is the kindest thing that can be done under the circumstances, for it affords the stomach an opportunity for rest and recovery.

Now, it would be a most improper proceeding to start at once on ordinary modified milk; the stomach would certainly be unable to digest so large a proportion of unaltered proteid of cow's milk, hence in the first place it is advisable to rely on one of the substitute foods described on p. 82. Perhaps the best of these to start with is No. 6, which is composed of white of egg, sugar and cream. The cream, however, should not at present be given in the full percentage, but reduced to about half strength, namely, $2\frac{1}{2}$ oz. instead of 5 oz., giving a 2 per cent. cream mixture. If this food is found to agree the cream should daily be increased by a small amount until the daily quantity reaches 4 oz. In this way the infant is habituated to increased quantities of milk proteid, for the cream contains the same amount of proteid as milk. The next step is to gradually substitute milk and raw beef juice for the white of egg. At the end of ten days or a fortnight, if the transition has been effected gradually, the infant should be able to manage a mixture containing milk 2 oz., meat juice 2 oz., cream 4 oz., milk sugar 1 oz., made up by the addition of water to 1 pint. The percentage composition of this mixture is proteid 1·3 per cent., cream 3·6 per cent., sugar 6 per cent. If the infant can tolerate and digest a substitute food of this kind, it ought to be possible to establish him almost immediately on a diet of modified milk

alone consisting of the same percentage. This treatment seems simple enough on paper, but it is not always so easy to carry out in practice. The infant has probably been used to much larger quantities of food, and resents the reduction, continually crying out for more, and appearing thoroughly unsatisfied. It is, however, of paramount importance to be firm in resisting his importunity; it is much more important for his general health that he should be able to digest and assimilate the small quantities which are being given than that he should consume and subsequently reject much larger quantities. Further, there is always the great temptation, when we notice indications of improvement, to advance too rapidly; this temptation should be resisted, or it may be necessary to commence again from the beginning. This sketch in outline is the sort of system we should adopt in cases of this kind. As regards the particular variety of substitute food there are, however, many alternatives. Nevertheless, whatever variety of food may suggest itself to us, we must work on a regular system, exercise the greatest care and cleanliness in the preparation of the food, and eradicate, as far as possible, the slovenly and haphazard nursery methods which have conduced to the condition we have to treat.

Illustrative Case.

Infant, seven months old, was originally fed on milk and water: this food soon disagreed, and was subsequently fortified with a variety of patent foods. At birth the infant weighed 9 lb., and at seven months half a pound less—the condition of

health had throughout been most unsatisfactory. The face was peaky and old looking, the skin was dry, hanging in folds, and the feet and hands were cold. He fed ravenously but was frequently sick, and the motions were green, slimy and offensive.

Treatment. — In addition to simple medicinal treatment, he was put upon substitute food No. 2, consisting of meat juice, cream and milk sugar in quantities of 2 oz. at a time. In spite of this change, however, the infant still vomited, and therefore the cream was reduced in quantity, with, however, no better success, so that substitute food No. 12 was tried instead. This food consisted of bread jelly, meat juice, milk sugar and cream, given in 2 oz. feedings. Vomiting, however, showed no improvement, so next the milk sugar was reduced by one-half and the cream further reduced, with the addition of fifteen drops of brandy to each bottle. Vomiting then became less frequent but still occasionally occurred. The milk sugar was consequently left out of the mixture altogether and five drops of liquor pepticus added to each bottle. This food was successful. Vomiting ceased entirely, and the infant appeared more comfortable, so that it was again found possible to gradually increase the amount of cream, until at the end of three weeks from the commencement of the treatment the food consisted of bread jelly, raw meat juice in the proportions stated in recipe No. 12, and cream 2 oz. to the pint. Five drops of liquor pepticus and ten drops of brandy were still added to each bottle. Between feedings the infant was given occasional drinks of sterilised water. On this very insufficient diet improvement was

marked, and the face began to fill out and to look less pinched. This diet was continued for one week longer, and then the cream was again increased daily by one teaspoonful until each pint of mixture contained three ounces of cream. The next advance was to add one dessertspoonful of condensed milk to each pint, the mixture then consisting of bread jelly 2 oz., raw meat juice 2 oz., condensed milk 2 drs., cream 3 oz., each feeding consisting as heretofore of 2 oz., or 16 oz. altogether in the twenty-four hours. In three days' time the condensed milk was increased by a teaspoonful every day and the bread jelly decreased by the same amount, and the quantity of each feeding was also increased by one teaspoonful every day. In this way the treatment continued, and the infant showed at the end of six weeks a gain in weight of 2 oz., which, under the circumstances, was satisfactory. From this time forward he continued to improve, and from condensed milk, meat juice, cream, etc., he was promoted to cow's milk, meat juice and cream, still, however, with the addition of liquor pepticus. Finally the liquor pepticus was omitted and the meat juice discontinued, and the mixture made simply of milk, cream and milk sugar in the proportions and quantities suitable to his weight and general condition.

THE DIETETIC TREATMENT OF RICKETS.

The management of these cases is not as a rule very difficult, since the majority of them have been improperly fed, and all that is necessary to do is to establish the baby on a properly constituted diet

of modified milk. It must be remembered, however, that infants born of unhealthy parents and brought up under bad hygienic conditions, are specially liable to become rickety even when there is no serious fault with the method of feeding, or even when they are reared on the breast. It is probable that in the majority of cases rachitis is due to inability on the part of the infant to digest, absorb and assimilate the proteid and fatty elements of the food on account of sluggish metabolism or tissue nutrition; the consequence is that he largely subsists on the carbohydrates or sugars in the food, which are easier to digest and utilise. Rachitis is liable to develop in infants (1) who, from hereditary causes, are from birth onwards possessed of low powers of nutrition (metabolism); (2) when the diet contains a genuine deficiency of fat or assimilable proteid, or when both are deficient; (3) when the diet, though containing an ample percentage of fat and proteid, contains also a great relative excess of sugar; (4) when the diet has been unsuitable and has so upset the digestive functions that neither proteid nor fat can be digested nor absorbed in adequate amount. This is practically the same thing as supplying an insufficient quantity of proteid or fat in the food.

The type of rickets which appears in the children of the poor is generally due to cause No. 2. These infants are frequently fed on condensed milk, which contains an insufficient percentage of fat, while the proteids are not of such a nature as to maintain nutrition in a high state of efficiency since their nutritive properties have been considerably vitiated by prolonged boiling. On the other hand, in con-

densed milk there is a very large excess of sugar, and the same holds good with most of the other forms of food which are employed by the poor. Even the milk which they purchase is generally very deficient in cream, and when it has been diluted with water the deficiency is still more pronounced. Sometimes, indeed, skimmed or separated milk is employed, which contains practically no cream at all.

The children of the better classes do not, as a rule, owe their rickety condition to any absolute deficiency of fat or proteid or to bad conditions of hygiene, but rather to hereditary weakness and to the patent foods which it is the fashion to employ. These consist chiefly of sugar, so that when added to diluted milk they so alter the proportions of proteids, fats and sugars that they can no longer maintain normal nutrition. The addition of patent foods which contain unaltered starch likewise conduces to the production of rickets, for the reason that infants are unable to digest starch during the first few months of life. The introduction of this indigestible element disturbs the functions of the stomach and bowels and prevents the proper assimilation of proteid and fatty elements.

That rachitis in most of these cases is not due to hereditary causes alone is proved by the fact that the condition is peculiarly amenable to treatment when the feeding is arranged on a sound physiological basis.

If, then, we understand the main causes of rickets, we are usually in a position to treat the condition rationally and satisfactorily. In the first place, if the digestive functions have been upset

this matter must be attended to and corrected. In the second place, we must supply a diet which contains the proper proportions of proteid, fat and sugar, and in such a form that they may be digested and absorbed; it is further essential that the process of sterilisation should be reduced to the lowest point compatible with safety, for the reason that rickety infants do better on fresh milk than they do on milk which has been boiled. A few teaspoonfuls of fresh orange or grape juice, or raw meat juice, given independently of the bottle, is usually a wise and safe precaution, since they contain organic salts in combinations which are easily utilised.

To repeat once more the principles of treatment: (1) a rickety infant should be fed on properly modified milk, with special care that sugar is not in excess, and that the proteids and fats are provided in an assimilable form; (2) the milk should either not be sterilised or sterilised as little as possible; (3) a few teaspoonfuls of fresh meat juice, orange or grape juice should be given in addition every day.

Illustrative Case.

Infant, nine months old, previously fed on milk and water and patent food, was muscularly weak, and incapable of sitting up. He sweated profusely about the head, which was large, square, flat at the top, with large, open fontanelle, bossed forehead, with prominent blue veins. The gums were anæmic, swollen and painful, but no teeth had yet been cut: there had been several attacks of convulsions. *Treatment.*—Bowel cleared out by castor oil. Diet unchanged, except that the proper proportion of

fat, proteid and sugar was secured by the addition of cream and the reduction of the patent food. Six bottles of food were given daily, each containing 6 oz. Two bottles daily were given unsterilised, one tablespoonful of orange juice was given independently in the morning. *Result.*—Satisfactory.

N.B.—Before treatment the percentage composition was as follows: Fat, 3 per cent.; proteid, 3 per cent.; sugar, 9 per cent. The total quantity of food, 54 oz., divided into six bottles, each containing 9 oz. This diet was incorrect on the following grounds: The total quantity of food was greatly in excess, and the relative proportions of fat, proteid and sugar were physiologically unsound. The fat was deficient and the sugar very excessive. The percentage of proteid also was rather higher than it should have been.

SCURVY.

This condition, which is characterised by extreme muscular weakness, tenderness of the limbs, sponginess of the gums, hæmorrhages, especially under the periosteum of the bones, with anæmia and a tendency to syncopal attacks or faintness, is due to the continued consumption of stale food. Infants who are fed exclusively on patent foods kept for a long time in tins or bottles, are practically certain to develop symptoms of the disease. They are less liable to do so if they receive in addition some fresh article of food, such as milk, cream, meat or fruit juice. In the full efflorescence of the symptoms, scurvy in infants can hardly escape detection. Nevertheless, early symptoms of a minor degree

especially, if complicated or obscured by symptoms of rickets, often pass unnoticed. Tenderness of the limbs, a dislike on the part of the infant to be bathed or otherwise handled, should always excite suspicion, and if the food has been of the character above described, in the absence of more serious symptoms we may be perfectly sure we are dealing with a case of infantile scurvy of a minor degree. The treatment is exceedingly simple and satisfactory. The diet must be changed from a patent desiccated food, stale sterilised milk, peptonised or condensed milk, or whatever form of preserved food has been used, to one which at least contains a large proportion of fresh elements. Fresh milk, raw meat juice, the juice of oranges, grapes, or the expressed juice of boiled spinach, all have an immediate and remarkable influence in curing the symptoms.

Illustrative Case.

Infant, five months old, fed on patent food added to milk, which was commercially sterilised and sold in sealed bottles, was anæmic, with muscles and limbs which were extremely tender. There was slight fever, with swelling below the left knee. *Treatment.*—Modified milk prepared according to table, p. 49, not sterilised, but kept on ice, with one teaspoonful of raw meat juice added to three bottles, and to the remaining bottles one teaspoonful of spinach juice (prepared by boiling spinach in a very small quantity of water, pounding in a mortar and squeezing through wash leather). *Result.*—Recovery in little over a week.

INFANTILE ATROPHY (ATHREPSIA).

It may be said without fear of contradiction that these cases are among the most difficult to treat. Although in many respects this condition has resemblances to the wasting which occurs in the case of constitutional diseases, such as tuberculosis and syphilis, or as the result of gastro-enteritis, the term athrepsia should strictly be confined to those cases in which there is extreme atrophy, or wasting of all the soft tissues, apart from demonstrable disease of any of the organs. The prominent symptoms of the disease are the progressive and extreme loss of weight, a dry and wrinkled appearance of the skin, coldness of the extremities, and the dry and red appearance of the tongue. The evacuations are generally abnormally large, but often there is nothing abnormal in the colour or consistency. The disease appears to depend on improper diet and bad hygienic conditions superimposed on a feeble constitution.

To treat the disease successfully we must eradicate the idea from our minds that the disease is one in which the digestive functions are exclusively at fault. It has been proved[1] that infants in an advanced stage of atrophy digest and absorb sufficient proteid and sugar to maintain a normal infant in health, much less one who, as is usual in such cases, is composed of little more than skin and bone. The disease is one which affects the nutrition of the tissues generally, and it is not improbable that the nutritional or metabolic processes have been overstimulated and over-worked by excessive excitation consequent on relative over-feeding. That is to say,

[1] B. Bendix, *Berlin Med. Woch.*, Nov., 1899.

we must regard these infants as organisms possessed of sub-normal powers for dealing with food material, and we must assume that these powers have been misused, with a consequence that failure of function and atrophy have followed.

However, be the explanation what it may, treatment based on this hypothesis answers exceedingly well. If the infant does not respond to treatment he will inevitably die. In most instances he is receiving more food than is required for his organic functions and the nutrition of his tissues, which are little else than bones and skin. He is rapidly losing weight, and feeding does not stay the downward course of events.

My principle in treating cases of this kind is to give the tissues and the nervous system (which is invariably exhausted and involved in the general failure of nutrition) time to recover. The infant should be allowed, as it were, to hibernate. He should be kept warm, rubbed with oil, wrapped in wool or flannel, and disturbed as little as possible, given plenty of water to drink and only the merest traces of food. As far as food is concerned, every effort should be made to provide elements of such a nature as to stimulate nutrition. In these cases it is no good whatever to rely on modification of milk. No matter how you ring the changes in the composition, the nutrition of the tissues will not be roused by the stimulation of milk. And, moreover, the infant has to a certainty been treated with milk before, peptonised or modified in some other way, and the atrophy has steadily progressed. Something therefore quite different should be tried. But it must be remembered that

whatever food you choose it must contain representatives of all the important elements, namely, proteid, fat, sugar and salts.

It would be impossible here to give a list of all the different varieties and mixtures which are available for use. The quantities of food are so small, and the mixtures so complicated, that it is practically impossible to work out an accurate percentage composition. However, we should attempt as nearly as possible to adhere to the percentage composition of maternal milk.

With regard to proteids and other nitrogenous forms of food, we can ring the changes on meat juice, beef tea, gravy, mutton broth, chicken or veal jelly, peptone jelly (Benger's), milk-somatose and casumen. As for fats, emulsion of cod-liver oil, almond oil, olive oil or butter can be tried, while virol or Lahmann's vegetable milk may be found to succeed when other preparations fail; and as regards carbohydrates, we may employ bread jelly, various sugars, patent and malted foods, malt extract, or honey. Among miscellaneous articles of food which are sometimes of apparent service, may be mentioned vegetable juice, such as spinach juice (see p. 103), vegetable soups, fruit juice, wine and spirits.

Now, as I have already said, the nutritive processes of infants suffering from atrophy have to be humoured and tempted by variety in the food. It is impossible to predict what forms of food will prove most useful. A large number must be tried, and those which do not succeed must be eliminated, while those which appear successful must be continued. As a guide to those who wish to follow this

method of treatment, I give a list of alternative diets in quantity apportioned to an infant of three or four months. As will be seen from examination of these mixtures, bread jelly, meat juice, beef tea, virol, marrow and vegetable soups occur over and over again in different combination. This is because from practical experience I have found these varieties of food particularly useful.

I have often heard the theoretical objection to this line of treatment that a diet of so mixed a nature is calculated to upset any infant's digestion, much less one of an infant in an advanced stage of marasmus. On whatever grounds this objection is based, it is not borne out in practice. The quantities are so small and the combinations so carefully arranged that I have never noticed the least difficulty originating on the ground of disturbed digestion. The progress of the case is necessarily very slow, and it requires the utmost patience. In all probability the loss in weight has previously been progressive, and at first, even with the greatest care, it may be impossible to arrest the loss. You may feel satisfied if, in the first instance, you can reduce the actual loss in weight, and if the weight remains stationary, this is an omen of excellent augury. That the loss of weight or failure to put on weight is not due to want of food or starvation under the *régime* I describe is proved by the fact that, after a time, the infant may begin to show substantial increase in weight on exactly the same diet which has perhaps for weeks previously produced no appreciable increase.

A very important point to remember is not to increase the quantities too quickly. The latter

should not be augmented until there has been a sustained increment in weight for two consecutive weeks, and even then the utmost conservatism should be exercised.

The following recipes are intended for an infant between three and four months. Each feeding should be made up separately with the closest attention to cleanliness. All food materials should be kept, if possible, in a clean refrigerator, for the reason that it is not generally possible to preserve them by sterilisation. The quantities, it will be noticed, are exceedingly small, and such as are suitable for use during the first three weeks of treatment: at a later period the quantities may be increased. The amount of the cream, or other fat substituted for it, is particularly small: under suitable conditions it may be increased, drop by drop, as long as it does not produce any symptoms of disagreement.

In using the following mixtures about $1\frac{1}{2}$ oz. should be given every two hours during the day; the intervals at night should be longer.

Recipe No. 1.—One teaspoonful of bread jelly (p. 86), 10 drops of cream, 1 oz. of water; all three thoroughly well beaten up together. To this mixture are added 2 teaspoonfuls of meat juice, $\frac{1}{4}$ teaspoonful of sugar, and 5 drops of brandy.

2. Bread jelly, 1 teaspoonful; cream, 10 drops; beef tea, 1 oz.; Mellin's food, $\frac{1}{4}$ teaspoonful; brandy, 5 drops; water added to make $1\frac{1}{2}$ oz.

3. Bread jelly, 1 teaspoonful; virol, 12 drops; mutton broth (in which plenty of vegetables have been boiled), 1 oz.; sugar, $\frac{1}{4}$ teaspoonful; brandy, 5 drops; water to $1\frac{1}{2}$ oz.

4. Mellin's food, $\frac{1}{2}$ teaspoonful; Prideaux's casu-

men, ½ teaspoonful ; 3 teaspoonfuls of grape juice ; 12 drops of virol ; barley water to 1½ oz.

5. Bread jelly, 1 teaspoonful, rubbed up thoroughly with 10 drops of butter emulsion (p. 87) ; 1 oz. of veal broth ; ¼ teaspoonful of sugar; brandy, 5 drops ; water to 1½ oz.

6. Mellin's food, ½ teaspoonful ; cream, 10 drops ; extract of red marrow (Benger's), 20 drops ; chicken broth, 1 oz. ; brandy, 5 drops ; water to 1½ oz.

These formulæ may be taken as types for the preparation of many other combinations. Nos. 1, 2 and 3 I have found particularly useful, although it is difficult to say why bread jelly should be so serviceable in cases of atrophy. It is possible that bread treated in this way is particularly bland and soothing to the stomach and bowel, and that although it may not be completely digested and play the part of a food, nevertheless it keeps up the action of the bowels, and constitutes the chief basis for the formation of natural motions, an important point when only small quantities of food are supplied. Cases of atrophy are so difficult to treat, that I once again repeat the chief rules which should be observed in their management :—

1. When possible the services of a trained nurse should be engaged.

2. Infants should be accurately weighed at least twice a week.

3. The skin should be well rubbed with olive oil or cod-liver oil, and the body should be wrapped in cotton wool or flannel.

4. A liberal allowance of sterilised water should be allowed.

5. The quantity of food must be exceedingly

small, not more than 1½ oz. for an infant between three and four months.

6. There should be great variety in the food.

7. Since great difficulty is experienced in enabling the infant to assimilate cream or other forms of fat, at the commencement of treatment not more than 10 drops of cream, or substituted fat, should be given at one feeding; and this amount should subsequently only be increased drop by drop.

8. Since the progress in cases of atrophy is always very slow at first there is need for great patience, but in the end it is, as a rule, very satisfactory, and the infant will eventually put on weight at an astounding rate, especially in those cases in which, by judicious management, it is possible to place him on a diet of modified milk.

Illustrative Case.

Infant, healthy at birth and weighing 8 lb., was at first fed on humanised milk. At the end of three weeks this milk was found to disagree, and a wet nurse was procured. At first there was some improvement, but later on this method of feeding also failed, and the infant was tried on various patent foods. At the third month the condition of nutrition was very unsatisfactory, with evident loss of weight. Peptonised milk was then tried; this proved more satisfactory, but was continued too long, and at the end of six months the infant was found to weigh 7½ lb., an actual loss of ½ lb. since birth. At the commencement of the following treatment, although six months old, he was little more than a skeleton; the skin was

dry and loose. *Treatment.*—Rubbed daily with olive oil, kept rolled in flannel in large airy room, with plenty of light. *Diet.*—Two oz. of recipes 1, 2 and 3 were given alternately every two and a half hours. This treatment seemed to agree, although he was sick once or twice after food made according to recipes Nos. 1 and 2. The cream in these mixtures was therefore reduced by half for three days, and then increased drop by drop daily until at the end of three weeks 30 drops were well tolerated. Although the infant now appeared a little fuller in the face there was no increase of weight. During the fourth week, under the same treatment, there was a gain of 2 oz.; during the fifth week, 1 oz.; and during the sixth, 3 oz. At the seventh week the quantity of food was increased from 2 to $2\frac{1}{2}$ oz., and the cream increased drop by drop from 30 to 60 drops in each bottle. When the infant was eight months old he weighed nearly $8\frac{1}{2}$ lb.—a gain of about 1 lb. since the commencement of the treatment. Milk was now introduced one teaspoonful at a time to each bottle, and the bread jelly was gradually reduced and replaced by barley water. At the ninth month he was placed on modified milk of the following percentage: Fat, 3 per cent.; proteid, 2 per cent.; sugar, 5 per cent. (see p. 46, formula D 4). Two teaspoonfuls of meat juice were also added daily to two of the bottles. After a week of this treatment the percentage composition of the milk was increased gradually week by week, until at the end of the tenth month a normal percentage for his age was attained. The weekly increase in weight at this period was from 1 to 5 oz.

GASTRO-ENTERITIS.

This condition is a very serious one, and unless promptly treated may end fatally. The special form of it known as summer diarrhœa has already been referred to on p. 63. The symptoms are frequent vomiting and diarrhœa with green, slimy motions, containing, as a rule, undigested particles of food. There is a rapid and serious loss of weight, sometimes a high temperature, rapid pulse, exhaustion, and other symptoms of toxæmic poisoning due to decomposition of food in the alimentary tract. The reason for the decomposition of food in the stomach and bowel is not always clear. It certainly depends to some degree on infection from without, but not necessarily introduced with the food, for the reason that breast-fed infants not infrequently are victims of the disease. The main predisposing cause is an unhealthy condition of the digestive functions, which may be due to constitutional causes, to the effects of long continued hot weather or what is more commonly the case, to improper feeding.

Provided that the digestive functions of the stomach are in an active and normal condition, food which enters it is immediately attacked by the enzymes and ferments of the gastric juice, and putrefactive bacteria are either killed or fail to establish their claim on food material. On the other hand, if the food is not digested by the natural secretions, as is the case when the stomach is temporarily incapacitated or contains too much at one time, it is completely at the mercy of the germs of putrefaction. The treatment of the dis-

ease consists in administering a purgative to remove the decomposing contents of the bowel, and to wash out the bowel by large enemas of warm water, to combat the attendant exhaustion and then to re-establish the normal digestive processes.

This end is most readily effected by withholding food altogether for a period, and thus starving the germs out, or by supplying stimulants and small quantities of food which are not easily attacked by the germs of putrefaction. At the same time it is a wise precaution to administer some intestinal antiseptic, such as bismuth, grey powder, salol or creasote to further check the growth of bacteria. In chronic cases in which the stomachic symptoms (vomiting, eructation, dilatation of the stomach, etc.) predominate, the best treatment of all is lavage, or the washing out of the stomach by artificial means. To carry out this operation, a No. 10 soft, flexible, india-rubber catheter, to which are affixed two or three feet of rubber tubing and a glass funnel, is passed into the stomach, and the latter organ washed out by syphonage, with a dilute solution of boracic acid. The stomach should be thus washed out at least twice a day, about half an hour before the time of feeding.

Since milk is especially liable to undergo fermentative and putrefactive processes in the stomach and bowel, it is advisable that all food of this nature should be stopped, and for a time egg water (see p. 183) should be substituted until it is found that a small quantity of milk can be added without symptoms of decomposition.

Illustrative Case.

Infant, six months old, had for three weeks vomited frequently, with constant diarrhœa ; there was reddening of the buttocks and rapid loss of weight. *Treatment.*—Castor oil, followed by ½ gr. of grey powder and 2 grs. of bicarbonate of soda every night. The food consisted of 3½ oz. of a mixture of egg water, sugar and brandy. The food was supplied every three hours. At the end of a week medicinal treatment was stopped and a teaspoonful of milk was added tentatively; as this addition resulted in no bad effects, the milk was gradually increased until the food consisted of half milk half egg water. *Note.*—In this case the stomach did not appear to be seriously involved, and the vomiting ceased soon after the commencement of the treatment, so that lavage was not considered necessary.

PART II.

DEVELOPMENT AND PHYSIOLOGY OF INFANCY.

THE human infant is the most plastic and responsive of beings. He reflects most accurately the various influences or stimuli which reach him from the outside world, and, within limits determined by heredity, his moral and physical development depend on the nature of these stimuli.

The human infant differs from the young of other members of the animal series by possessing a prolonged and helpless babyhood, during which period external factors in the environment determine, to a large extent, the development of the brain and nervous system. In view of the controlling influence which the nervous system exercises throughout life on all the bodily functions, it is of immense importance that the early development of this system should proceed along normal lines.

During the period of its early development the nervous system should be protected from overstimulation and from agencies which tend to disturb its equilibrium. On the other hand, it must be duly exercised in its normal functions, or development will be arrested in those centres which remain inactive. For instance, the use of the muscles is the normal stimulus to the growth of those parts

of the brain and spinal cord which control the motor functions.

It must clearly be remembered that atrophy always follows disuse, hypertrophy always follows over-stimulation, and in the end may lead to degeneration. In the case of developing organs in infancy such as the brain, arrest of growth rather than atrophy occurs as the result of inaction.

Among abnormal stimuli, which are likely seriously to interfere with the due development of the nervous system, must probably be counted toxic substances, such as alcohol and drugs, and those poisons which result from auto-intoxication; such, for instance, as are developed in the alimentary canal when putrefactive or fermentative changes take place, owing to improper feeding or feeble digestive powers. Pain of all kinds, and especially abdominal pain, is a most potent factor in disturbing the nervous system of an infant, and conducing to what in later life is called a nervous temperament.

The part which heredity plays in the development of individual characteristics must not be underestimated. On the other hand, it is easy to exaggerate its influence. Heredity implies little more than a tendency, under ordinary conditions of environment, to develop along certain lines and to resist development along others. Since in the case of an infant the environment or surroundings are eminently under control, it is to a certain extent possible to counteract hereditary tendencies by altering the conditions of life.

To illustrate my meaning by an example. We may take the case of a family in which the physiognomy of some of the individual members

is distinguished by certain similar characteristics, such as a high palate, a broad, flat nose, malformed, narrow jaws and maldeveloped teeth. These undesirable characteristics, which are by no means uncommon, are generally regarded as due exclusively to hereditary causes and beyond control.

Now, although heredity doubtless plays an important part in the determination of such morphological characteristics, if traced to their source they will generally be found to be due to an abnormal and hypertrophic growth of a degenerate lymphoid tissue at the back of the nose, which is more often an acquired than an inherited abnormality.

Hypertrophy of this tissue obstructs normal breathing through the nose, leads to mouth breathing, elevation of the palate, failure of development of the cavities of the nose, falling in and flattening of the bridge, contraction of the jaws and subsequently to the development of malformed and badly mineralised teeth.

Thus a preventable abnormality may, by injudicious management, lead to the development of morphological characteristics which run through whole families.

Many reasons have indeed been assigned for the growth of lymphoid tissue at the back of the nose, but for the purpose of the present argument it is immaterial what reason we assign for the growth of these so-called adenoid vegetations. The important point is, that they are preventable or curable by operation. It is perfectly clear that hereditary or intra-uterine conditions play an important part in their production, for infants are occasionally born with these growths well developed.

On the other hand, in those in whom there is a tendency for these growths to appear, the development is certainly encouraged by bad hygienic surroundings, hot air and careless dietetic management, especially when the mismanagement consists in overfeeding with patent and sugary foods.

Since, then, the growth of adenoids is to a large extent a controllable matter, and more or less preventable by altered conditions of environment, it is clear that their growth ought to be prevented by proper forethought, or, if it is impossible to prevent their appearance, they should promptly be removed by surgical interference, thus preventing a subsequent development of the anatomical deformities above described.

The argument which I wish to impress on those who read this chapter is, that a very large number of the anatomical deformities and of the so-called constitutional diseases which are usually regarded as inevitable and fore-determined, are, as a matter of fact, due chiefly to ignorance and neglect of physiological laws. To prevent them, however, we must understand the causes which bring them about. We must be cognisant of the effects and tendency of heredity, and with this necessary knowledge so alter the conditions of the environment that the progress of development shall proceed along normal and physiological lines.

The development of the individual must not be supposed to commence with arbitrary suddenness at the moment of birth ; indeed, although conception marks the date which may be reckoned as the commencement of the individual life of the fœtus, the separate rudiments of this living organism possess

a previous existence in the male and female sexual organs of the parents. The fœtus, *in utero*, owes its origin to the fusion of two living cells, the ovum of the female and the spermatozoon of the male. These living cells share in the general health and vitality of the individual from whom they originate. A healthy, vigorous spermatozoon can no more exist in the feeble debilitated male than a healthy vigorous ovum can develop in a sickly invalided woman; should, then, a fusion between two unhealthy sexual cells of this kind take place, the fœtus runs a serious risk of developing into a monstrosity, or if it survive until full time, it is liable to develop into a wretchedly feeble baby, with all the stigmata of degeneration obtrusively stamped upon him.

Thus individuals who are contemplating marriage, or married individuals who take upon themselves the responsibility of bringing children into the world, cannot too narrowly examine their own condition of health, or too zealously observe the laws of personal hygiene. The personal health of both parents at the time of conception is therefore one of the most important factors in the ultimate development and physical condition of the fœtus and subsequently of the child. The health of the mother during the whole period of pregnancy is further accurately reflected in the condition of the fœtus in her womb, and for this reason the woman who wishes to bear a healthy child must herself be healthy during the whole period of gestation. The condition of nutrition of the fœtus runs a strictly parallel course with that of the mother; from a physiological standpoint this

statement is a mere truism, but practically it is a statement which can be verified from the family history of most of our acquaintances and friends. Take, for instance, the case of a woman of highly strung and nervous temperament, the subject of nervous headaches and other symptoms of neurasthenia. If such a woman becomes pregnant, she generally lapses for the time being into permanent invalidism, giving way to the symptoms which are associated with the condition of pregnancy. In addition to this she frequently indulges in drugs, which exercise a most pernicious effect in the growing fœtus, and when she feels what she calls "sinking feelings," she generally has recourse to alcoholic stimulants, and to the frequent and irregular consumption of food. All these habits are fatal to her own health, and have a most disastrous influence on the development of the fœtus. Labour is not only effected with difficulty but fraught even with danger to the mother and to the child, and the latter, if he survive, is usually a fat, heavy, flabby, and thoroughly unsound and degenerate baby.

Now, to take the other side of the picture. It is a matter of common experience that illegitimate children, and especially the illegitimate children of domestic servants, are extremely healthy and robust. Why is this the case? Presumably for the reason that prospective mothers, under these unfortunate circumstances, are usually at great pains to conceal their condition; they dare not lay up, but go about their ordinary work as if nothing unusual were about to happen. And further, under the erroneous belief that free purgation is likely to bring about an early miscarriage, they usually keep their bowels

well open with Epsom salts, decoctions of aloes, or any other purgative which they can obtain. This regular purging has generally a very good effect on her general health, especially if, as is so often the case, the woman is inclined to constipation. Women who have thus conducted their lives during the period of pregnancy generally have a very easy confinement, and the baby is so strong and healthy that he generally disappoints his parents by surviving the trials and mismanagement to which illegitimate infants are often exposed. Reflection on the two sides of this picture suggest the following rules for observance by those who wish to maintain their health during pregnancy, and to give birth to a healthy child :—

1. Never give way to the early symptoms of pregnancy by laying up and becoming an invalid, except, of course, under medical advice.
2. Never indulge in drugs, especially those which act powerfully on or narcotise the nervous system. The drugs specially to be avoided are phenacetine, antipyrine, caffeine, antikamnia, sulphonal, trional, bromides, morphia, opium, nicotine (cigarettes). The bowels should be kept well open by Carlsbad or Epsom salts.
3. Become a teetotaller for the time being. Alcohol is a poison which acts most injuriously on the nerves and nerve cells of adult individuals ; it acts even more injuriously on the delicate and sensitive rudiments of nerves in the fœtus.
4. Be careful and moderate in your diet, and never take any food between meals.
5. Take plenty of exercise.
6. And remember that most miscarriages occur in delicate, unhealthy women who lie on the sofa, take drugs, alcohol and frequent meals.

I do not pretend that this list of suggestions is in any way complete ; however, those who take their

condition seriously and wish to lay the foundation of a permanently healthy child, should not at any rate do less than is here advised. I might say a great deal on the subject of the diet for a pregnant woman, but I will confine myself to the following generalisations: A vegetarian diet, with the addition once a day of animal meat is advisable, that is to say, eggs, milk, fruit, vegetables; cakes, biscuits, bread and butter and other farinaceous food should be taken with extreme moderation, and pickle sauces, curries, condiments and other highly seasoned dishes *not* at all. The best treatment for the "sinkings" is hot water and a few soda mint tabloids.

It is quite remarkable how ignorant many people are with regard to what may be called "the points" of a growing infant, or in a developing child, and also with regard to the early indications of maldevelopment and so-called constitutional diseases. While there are many people who recognise "the points" of and can judge a puppy or a foal, there are few who are capable of expressing a correct opinion on those of a baby.

One of the chief objects of this chapter is to show as clearly as possible what are the desirable points of a baby, how to recognise them, and how to encourage their development. A study of the physical development of the child is no less interesting and profitable than the study of his mental evolution; indeed, the two processes proceed hand in hand and are dependent on one another. If you wish a child to possess mental equilibrium, give him a sound body, sound circulation and a sound wind, and the *mens sana* will

take up its abode in the *corpore sano.* Similarly, if you give him a healthy, normally developed brain he is less likely to incline to the vices and perverted instincts which sap his bodily strength at a later period in his history.

As I have already indicated, popular views with regard to the conditions which constitute health or disease in infancy are often extremely erroneous, and it is of the utmost importance that those who are concerned with the management of children during the early days of life should thoroughly understand what is normal and what is abnormal in their development. Their aim should be to make the most of the material at their disposal, to have high ambitions and high ideals, and never to be satisfied with anything less good than the best.

In considering the normal development of infants, it will be occasionally difficult to confine the subject strictly to that period of life which is included in the first year, and in view of this difficulty I must claim the privilege of encroaching on the period of later childhood if at any time I find this course necessary for the unfolding of the argument. The order in which I propose to discuss the various details of development will be as follows : In the first place, I shall describe the bones or skeletal system ; secondly, the ligaments or fibrous tissues which link the bones together ; thirdly, the muscular system ; fourthly, the digestive system; fifthly, the respiratory system; sixthly, the circulatory system ; seventhly, the nervous system; eighthly, the organs of special senses ; ninthly, the genito-urinary system ; tenthly, the integuments ; and finally, general development or growth.

The Skeletal System.—With respect to his skeletal system, the most striking features of the new-born infant are (1) the shape of the head ; (2) position and shape of the legs ; (3) the extreme suppleness and softness of all the bones.

As regards the shape of the head it is considerably elongated, and the circumference is reduced owing to the exigencies of parturition and the necessity for the head passing through a narrow bony pelvis. On an average the head is about 13 ins. in circumference, if measured round the middle of the forehead in front and the occipital protuberance behind. In five weeks' time the head should have assumed its more natural formation, that is to say, it should become less elongated and more rounded, and should measure about 15 ins. in circumference. In five months it should have increased to $16\frac{1}{2}$ ins., and at the ninth month to 18 ins.

In certain conditions of disease the development of the head does not follow normal lines. It may remain too small as in microcephalic idiots. In such cases the circumference of the head may not increase beyond 17 ins. On the other hand, the head may be too large as in hydrocephalus. In such cases the head may increase to an enormous size, and owing to the pressure of fluid within the cranium, the shape is almost round, and the fontanelle is widely open and often bulging outwards. In rickets, also, the head grows too large, but in contradistinction to hydocephalus the head is square and not round, and the top is very often quite flat. The square shape is due chiefly to the overgrowth of the bones and not to pressure from within.

Since the last-mentioned condition is eminently preventable and amenable to treatment, it is very important that it should be recognised early. Besides being large and square and flat at the top, with large open fontanelle, the edges of the various plates of bone which form the vault of the head are thin and easily compressible, while the centres are greatly thickened and enlarged, constituting what are called "*osteophitic nodes*," or "*bosses*". These bony protuberances, especially those on the forehead, are very characteristic of the rachitic head. They are often ascribed by the public to great brain development, and are consequently regarded as hopeful indications of genius. This view is, of course, erroneous. Such bosses only indicate a disease of the bone which requires treatment.

Another feature with regard to the shape of the head which sometimes attracts attention, or even causes alarm, is want of symmetry or similarity in shape on the two sides. However, at birth the head is very seldom exactly symmetrical, and often does not become so for many months. If towards the end of the first year this want of symmetry has not greatly improved, and especially if it is accompanied by asymmetry of the face, it is a more serious symptom, likely to remain permanent, and often a sign of degeneracy.

The *anterior fontanelle* is more or less lozenge shaped. It differs considerably in size in different infants; it should not, however, be much larger than a shilling piece, and it should not increase obviously in size. At about the eighth month it begins to close, and at the eighteenth should not be detectable. It is enlarged and late in closing

in rickets and in hydrocephalus, and in cretinism it often does not close at all, or only does so at a very late period. In microcephalic idiots the fontanelle is small.

The *legs and feet* at birth are drawn up and flexed on the abdomen, and the feet are turned in, and the soles turned forwards and upwards. The curious bowing of the legs and the flexion of the thighs, legs and feet sometimes suggests to ignorant persons that the child is deformed. This position of the limbs, however, is due to the fact that this is the position assumed by the fœtus while still *in utero*, and this position persists for some considerable time after birth. The more rapidly the muscles develop the more rapidly does this flexion of the legs disappear.

The *softness and flexibility* of the bones, which is so obvious at birth, also rapidly disappears if development proceeds normally. If the nutrition of the body is faulty, as in rickets, the flexibility and softness is apt to persist, with the result that certain bony deformities occur partly through pressure and partly through abnormal muscular action. The influence of diet on the development, strength and size of the bones is enormous, as indeed may be judged from the following results obtained by the experimental feeding of pigs—animals which, like human beings, are omnivorous. W. A. Henry, of the Wisconsin Experiment Station, took a number of young pigs and fed some of them on a sugar diet and others on a diet which contained a high percentage of proteids. At maturity both lots of pigs were slaughtered and their bodies analysed. The thigh bones of the sugar-fed pigs broke under

a strain of 380 lb. The same bones in the proteid-fed pigs broke under a strain of 503 lb. The common experience of the fracture of bones in rachitic children is explicable on the same grounds. We also find very important differences with regard to the development of the muscular tissues under different methods of feeding, which explain the muscular weakness of sugar-fed infants and the associated deformities of bone; for it must be remembered that bones cannot be properly pulled into shape unless the muscles are properly developed.

Some of the most important deformities caused through soft bones and want of muscular development are those of the chest. The latter may develop into the so-called pigeon-breast variety, or become lop-sided, unequal, narrow or grooved.

At birth the chest is nearly round, but if development proceeds normally the width increases more rapidly than the depth. If the thorax retains its original circular shape it is very liable to become what is called the phthisical or consumptive chest. A circular thorax is not well adapted for the processes of respiration, since the lungs contained within it do not expand properly and are liable to become the seat of morbid changes, and especially of tuberculous disease. It is impossible, therefore, to overestimate the importance of the normal development of the chest. Everything possible should be done to prevent the development of pigeon-chest and to encourage the lateral expansion above referred to.

The causes which lead to pigeon-chest and other deformities of the thorax are (1) softness of the bones from rickets; (2) obstruction to the

entry of air into the chest, caused by anything which blocks up the nose or throat (adenoids, large tonsils, etc.); (3) anything which interferes with the proper action of the diaphragm, for instance, pot-belly, dilated stomach or intestines; (4) weakness of the muscles, especially of the muscles which constitute the shoulder girdle; (5) frequent coughing, croup, bronchitis or sore throat.

Pigeon-breast is therefore obviously a preventable condition in a large number of cases. Proper hygienic and dietetic precautions will save the child from soft bones and rickets. Surgical treatment will remove adenoids, large tonsils or other obstructions to the upper air passages. If the stomach and intestines are not loaded with food or distended with wind from injudicious feeding, the movements of the diaphragm will not be obstructed. The muscles about the shoulder girdle can be developed by allowing the infant to use the arms, and the muscles which are employed in active respiration can be strengthened by making the infant breathe deeply and freely, as, for instance, by pouring tepid water over his chest and back just before he leaves his bath. Frequent coughs, colds, attacks of croup and bronchitis are generally due to too much coddling, hot rooms, improper feeding and general bad nursery management.

Bandy-legs, knock-knees and flat-foot must be included among the errors of skeletal development, although to be strictly accurate they should be included among the results of weak muscles and lax ligaments. These conditions are seldom caused by the child walking too soon, although in certain cases it must be admitted that the results are in-

tensified by allowing the weight of the body to be imposed at too early a date upon bones and ligaments which are improperly shaped and hardly strong enough to sustain the pressure. As a rule, bandy-legs exist long before the child uses his legs for walking purposes, and the condition represents the persistence of an intra-uterine and early post-natal condition, and, as I have already stated, it is largely attributable to the fact that the morphological shape of the bones has not been properly controlled by the normal action of properly developed muscles. Children with bandy-legs have, as a rule, been infants who have seldom or never used their legs for kicking purposes during the period of infancy, in fact, have been infants who have been partially paralysed as a consequence of malnutrition or rickets, or hampered in their movements by clothing.

Flat-foot is a development which is more serious in later life, and which, as a rule, escapes notice during infancy and the early days of childhood. It is due partly to the stretching of the ligaments which support and hold together the arch of the instep, and partly to the feebleness and want of tone of certain muscles, the tendons of which pass under the arch and support it as supernumerary ligaments. The arch of the foot at birth is said to be supported by a pad of fat which can usually be readily observed on examining the sole; however, the part which this pad plays in preventing the development of flat-foot is altogether insignificant compared to the *rôle* which is played by ligaments and muscles. If the muscles of the leg and foot be allowed to develop normally by encouraging

active movement of these parts during infancy, in later life it will be found unnecessary to refer the development of bandy-legs, knock-knees, flat-foot and weak ankles to hereditary and other causes. These conditions are generally due to little else than to mismanagement, and the way to prevent them is to be on your guard when you notice an infant lying with quiescent legs in a semi-paralytic condition, for this condition implies some serious constitutional ailment, which interferes with the natural activity of the muscles.

The Muscular System.—A perusal of the foregoing sections will have demonstrated how important in many respects is the proper development of the muscular system. It is the growth and action of the muscles which pulls the individual bones into proper shape and determines the orderly formation and development of the skeleton. We cannot, therefore, too jealously watch the development of muscular movements.

It is, unfortunately, a popular tradition that a fat baby is an object to be admired. One of the worst "points" of an infant is an excessive deposition of fat, whereas one of the most valuable tests of a healthy condition is a normal development of muscular power, such as is more likely to be found in a comparatively thin baby. A healthy infant ought, during waking hours, to lie on his back, kick his legs and exercise his arms and hands by clutching at objects which come within his reach. The scope of these movements should not be hampered by heavy bedclothing or garments which confine the limbs. The infant who kicks freely when he is awake is more likely to rest peacefully

when he is asleep. A sluggish, inactive infant who never moves a muscle when he is awake, will be restless and fidgety when he begins to sleep.

Another nursery tradition is that a baby's limbs should never be pulled about. Within limits, the more we pull them about the better. A healthy infant at birth can grasp your index-finger sufficiently strongly to be lifted up by it. There is no logical reason why this power should be lost if only the infant be given sufficient opportunities to keep his muscles in exercise. It is equally important that the muscles of the toes and feet should be exercised in the same way by allowing them to work against gentle resistance. The muscles of respiration can be effectually exercised by encouraging the infant to breathe deeply, as, for instance, by splashing a little cold water on his back and chest immediately before he quits the bath, and the same object can be secured by moving him rapidly through the air and by exposing him to as much fresh air as possible. It is an exceedingly bad plan to cover up the infant's head with a thick veil when he is out of doors. Naturally, it is not a wise proceeding to take a new-born infant at once into the open air without some sort of protection for his face, but he should be gradually accustomed to cold air. In summer, if the weather is warm, an infant may safely have his face exposed to the air out of doors when he is ten to fourteen days old; and in winter, if the process be a gradual one, he need have no covering on his face by the time he is six weeks old.

The following tests constitute rough indications of the normal development of muscular movements:

(1) Almost immediately after birth the infant will automatically or reflexly clutch hold of objects which touch his hands. The grasp should be free and strong. He will draw his legs up forcibly if the soles of his feet are tickled, and flex his toes strongly if touched on the under surface. (2) At the fourth month he should be able to make distinct voluntary movements and grasp objects which he sees. (3) At four and a half months he should be able to hold his head up when the body is held in the erect posture. Many infants with well-developed muscles can accomplish this feat at a much earlier date. (4) At the seventh month the infant should be able to sit up unsupported. (5) At the tenth month he should be able to stand with assistance and should commence to crawl. At the twelfth and thirteenth month he should commence to walk if he be allowed to steady himself with his hands by holding on to chairs or other objects.

Ligaments.—The action of the ligaments is passive and largely subsidiary to the action of the muscles. They unite the bones together and prevent undue mobility of the joints. If the muscles are weak, toneless and inactive, a considerable strain may fall upon the ligaments, especially those of the back, the ankles and the knees. The result is that these ligaments become stretched and lax, and fail to give proper support to the joints, giving rise to, or contributing to, many deformities. If, therefore, the muscles are weak, care should be taken to prevent any undue strain falling upon the ligaments which support the important joints. For instance, the infant should not be allowed to sit up

or to stand upon his feet before the muscles of the back and of the legs have been strengthened by appropriate means.

Children exhibiting symptoms of rickets, or in whom the muscles are weak from other causes, are extremely liable to become flat-footed, to present spinal curvatures and weak ankles, conditions which, owing to the stretching of the ligaments, generally become permanent and persist through life.

The Digestive System.—The proper development of the digestive organs is perhaps more important than that of any other system, since, if digestion is disturbed, the nutrition of all the tissues must suffer at the same time. For the sake of convenience it will be discussed under the following headings: (1) teeth; (2) the salivary glands; (3) the stomach; (4) the intestines; (5) the liver.

A satisfactory development of the teeth is not only important from an æsthetic point of view, but it is practically essential to a good digestion, and, as a matter of fact, it is an easier matter to secure than is usually supposed, and especially is this true of the permanent teeth.

The manner in which the milk teeth develop is largely dependent on intra-uterine conditions, whereas the form and shape of the permanent teeth are determined chiefly during the first few years of life. Bad teeth frequently run in families, and, as I have already mentioned, it is usually regarded as a hereditary fault and beyond control. This is not literally true, although there is a germ of truth in the belief. There are certain facts connected with the development of

the teeth which can be readily verified, and which clearly prove that to a very large extent the development of a bad set of teeth is a preventable matter if due care be exercised and the conditions are properly understood. The following are among the more important facts to which I refer. (1) Healthy, breast-fed infants almost invariably have when they grow up a better permanent set of teeth than do those who are artificially fed. (2) Infants who have been fed on patent foods, or on an excess of sugar in any form, or who have manifested symptoms of rickets, or those who have had digestive disorders, or those who have cut their teeth late or with difficulty, ultimately possess a faulty set of permanent teeth. (3) It frequently happens that infants who have a beautifully formed and even set of milk teeth ultimately become the possessors, through indiscreet methods of feeding, of an ugly, malformed set of permanent teeth. (4) Infants with ugly peg-shaped milk teeth with plenty of space between, often have a good permanent set. (5) Infants and children who have been frequently dosed with mercury or grey powder, generally have a bad permanent set of teeth.

Now, what deductions can be obtained from a consideration of the above facts? In the first place, the state of general nutrition of the infant during the first year determines the manner in which the rudiments of the permanent teeth are formed in the jaws, for it must be remembered that these rudiments begin to develop while the infant is still at the breast, or while it is being fed from the bottle. The reason why infants who are fed on

patent foods or excess of sugar subsequently have bad permanent teeth is because such a method of feeding not only disturbs the general nutrition of the body but causes the development of a general acidity which seriously interferes with the structural formation of the teeth in the jaws.

The next point is why should milk teeth with plenty of space between them precede a good permanent set? The reason for this is that such a condition implies a good development of jaw with plenty of space for the coming teeth. If, therefore, we notice that the milk teeth are crowded together, we should take particular care to encourage the development of the jaws so as to provide ample space for the teeth which will ultimately replace them. This can certainly be done by encouraging the infant to gnaw hard but harmless substances, such, for instance, as pieces of decalcified bone or pieces of sugar cane, and by insisting on the child from one year onwards being provided with hard substances, such as dry biscuits, which require considerable mastication. Another important factor which determines the orderly development of the jaw is the absence of any obstruction in the nose or the back of the throat which interferes with normal respiration. A mouth-breathing infant from definite mechanical causes runs a serious risk of developing small, malformed jaws and consequently a bad set of permanent teeth. I would thus formulate the following rules to ensure, as far as possible, the development of good teeth :—

1. Maintain the general nutrition of the infant by careful dieting, breast-feeding for preference, and avoid excess of carbohydrates in the diet.

2. Exercise the jaws of the infant as well as of the child by making him gnaw hard substances.

3. Beware of mouth-breathing.

4. Do not give grey powder or mercury as a routine practice.

The period at which the milk teeth are cut varies in different cases. The following is the average date of rupture :—

		Months.
The two lower central incisors should be cut at		6 to 9
Four upper incisors	,, ,,	8 ,, 12
Two lower lateral incisors Four anterior molars	,, ,,	12 ,, 15
Four canines	,, ,,	18 ,, 24
Four posterior molars	,, ,,	24 ,, 30

If the teeth are cut much before these dates, it generally implies a precocious development, and there may be other indications of this condition. If the teeth are cut too late, it is often a sign of rickets, and other evidences of this condition should be carefully searched for. In good health the teeth are generally cut in the order above indicated and in pairs. That is to say, similar teeth on the two sides appear together or separated only by a short interval.

Little trouble should be experienced in the process of cutting, and beyond a little dribbling there should be no symptoms to disturb the baby. It is a popular belief that the period of tooth-cutting is a dangerous one for infants, and so it is if the infant has been mismanaged or is in a bad state of health, and especially is this true in the case of infants who possess excitable nervous systems.

The symptoms due to the cutting of teeth may be explained in this wise. The act of cutting or rupture

necessitates a high degree of physiological activity of the developing tooth and of the surrounding tissues in the gums. The nerves which control this process must necessarily be severely taxed during the process. This nerve activity, or, indeed, as it often is, nerve disturbance, is liable to overflow to other nerves not perhaps strictly connected with the teeth or with the gums but closely associated with them. And an indication of this reflex or irradiated activity of the nerves is the activity of the salivary glands of the mouth, or "dribbling". I have frequently also noticed a free secretion of tears from the lachrymal glands, and a discharge of mucus from the nose is by no means uncommon. This running from the nose is generally and erroneously ascribed to a chill or the commencement of a cold. Other indications of this sort of nervous disturbance are to be found in the vaso-motor dilatation of the capillaries of the cheeks or flushing, in the appearance of urticarial spots or nettle rash; in severe cases there may be convulsions or fits, or, indeed, the pneumogastric nerves may become involved, leading to disturbances of the organs which are supplied by these nerves, that is to say, of the stomach (vomiting, diarrhœa), of the lungs (bronchitis, pneumonia), and of the heart (fainting attacks and syncope). If teething be greatly prolonged and accompanied by great activity of the mucous membrane of the nose and back of the throat, it is not uncommon for adenoid growths to develop quite rapidly.

It will be generally noticed that rickety children with delayed, troublesome and prolonged teething, and with a continuous discharge of mucus from

the nose, are the children in whom at a later date adenoids are discovered. It is a common mistake to believe that because adenoids are not usually discovered until the child is four or five years old that they are of recent growth. As a matter of fact it is often during the period of teething that these abnormal growths first make their appearance, but their size is comparatively small, so that they do not cause any serious symptoms. As I have already stated, infants who have been properly managed during the early periods of infancy seldom have any serious trouble at the rupture of the teeth, so that the treatment is in a large measure prophylactic. Trouble is, however, to be expected if any organ or organs, such as the stomach or lungs, have been previously weakened by ailments which have disturbed their nervous mechanism. For instance, infants who have frequently vomited before the rupture of the teeth are extremely liable to develop dyspeptic symptoms, and those who have suffered from croup or bronchitis are liable to bronchial pneumonia or other disturbance of the lungs. The treatment of symptoms due to teething should be directed to quieting the nervous system by appropriate sedatives, to keeping the bowels well open and to sparing the nervous system as much as possible.

The Salivary Glands.—No great importance attaches to the development of these glands. Their activity appears to vary in different individuals, and the secretion as a rule is insignificant until the rupture of the teeth. This process acts as the reflex stimulus to their functional activity.

The Stomach.—On the normal development, both functional and organic, of this organ hinge matters of the greatest importance. At birth the stomach is strikingly small, and in contrast to the oblique position which it assumes at a later period, it is placed more or less vertically beneath the diaphragm. Moreover, in shape it is little differentiated from the æsophagus above and the intestine below, that is to say, it is almost tubular. The size, the position and the shape of the infantile stomach are such as to render the act of vomiting easy, and this fact should always be carefully borne in mind, especially in cases of artificial feeding.

The growth or development of the stomach depends on the stimulus of food, that is to say, the development of the stomach varies in accordance with the quantity and the quality of the food as well as with the times and intervals of feeding. It is on account of the great diversity in the methods of feeding that such remarkable differences exist in the dimensions of the stomach in different babies. As a rule breast-fed infants possess smaller stomachs than do those who are hand reared. This is partly because the amount of food which enters the stomach is less in such cases, and partly because maternal milk is more easily digested and remains there a shorter time. Consequently the stomach is at rest for longer periods, and hence has better opportunities to recover from the effects of dilatation.

During uterine life the stomach is poorly developed, because the chief influences or stimuli which subsequently determine its growth are as yet insignificant. It has, however, great potentialities

for growth, and it is peculiarly sensitive to the stimuli which it receives immediately after birth. And for this reason we must be most careful at this period to protect it from over-distension or from the powerful stimuli of indigestible food. It is of the greatest conceivable advantage to the individual, whether infant, child or adult, to possess a small, elastic, muscularly strong, functionally efficient stomach. A large stomach is a potential source of discomfort, and a stomach which is inelastic and dilated is a real and positive danger. A stomach which is never empty becomes not only permanently enlarged but it loses its power of elastic contraction—a most important function which is too often overlooked. The healthy stomach is capable of enormous elastic expansion under the temporary strains of distension. By reason of its elasticity it almost immediately recovers its normal size as soon as it is again empty. The stomach, like an india-rubber bag, soon loses its power of recovery if frequently over-distended. It loses tone and is incapable of contraction.

Although it has not been distinctly proved that a stomach need be completely distended to afford that sense of repletion which suggests to the infant that he has had enough, it is practically certain that an infant does not feel that he has had an adequate meal unless there is some degree of elastic distension and the viscus is more or less full. This is one of the reasons why infants with dilated stomachs are never satisfied and always cry out for more food.

The four chief causes of distension are: (1) Ex-

cess in the quantity of the food; (2) the indigestible character of the food; (3) too frequent feeding; (4) inability of the stomach to empty itself through obstruction at the pylorus or through want of properly co-ordinated muscular movements. The third cause mentioned is peculiarly pernicious in its effects, because the stomach is practically never empty, and retains the decomposed remains of an indefinite number of past meals. It cannot contract like a small india-rubber bag and empty itself completely, and the stagnant remains which are left in the stomach undergo fermentation and set up catarrh and irritation of the mucous membrane, one of the most serious disorders of infancy.

The development of the digestive functions of the stomach will next be considered. Gastric digestion is accomplished by the action of gastric juice on the food with which it comes in contact. Three substances of importance are contained in gastric juice: (1) The rennet ferment which coagulates the casein or proteid of milk; (2) pepsin, a ferment which renders all proteids, including the clot formed by the rennet ferment, soluble by converting them into peptones; (3) chlorine compounds which unite with the casein in process of transformation, forming chloro-organic compounds, which can disengage free hydrochloric acid when this transformation is near its end.

In the healthy infant's stomach free hydrochloric acid is absent, or present only in very small quantity. This is an important fact to remember, because it is the presence of free hydrochloric acid which is the chief agent in preventing abnormal fermentations occurring in the adult stomach. Hence it is that

the contents of the infantile stomach are very apt to ferment if the normal processes of digestion do not proceed rapidly and smoothly.

Since the rennet ferment normally takes about fifteen minutes to completely coagulate the casein, if vomiting occurs before the expiration of this time, the milk is returned unclotted, and, as a rule, such vomit is neutral or alkaline in reaction. In half an hour after the reception of food in the stomach, its contents become acid from the presence of lactic acid, and the casein unites with chlorides of the gastric juice. Towards the end of digestion, that is to say, from one to three hours after the reception of food, the contents of the stomach usually become acid from the presence of free hydrochloric acid.

Experience has proved that maternal milk is completely digested in one to one and a half hours, that sterilised diluted cow's milk takes from two to three hours to digest, and that undiluted cow's milk takes nearly four hours. The advantages, therefore, of maternal milk over cow's milk in preventing dilatation of the stomach are very obvious.

Starches, sugars and fats are not digested in the stomach, but if they remain long in this organ they are liable to undergo fermentation, to distend the stomach with wind, and to cause various forms of indigestion and dyspepsia.

It is important for the due development of the functions of digestion that the processes of secretion should be gradually evolved. The function of gastric digestion is to render proteids completely soluble; therefore during the early days of life proteids should only be supplied in quantities

which the stomach is capable of rendering soluble, and the amount gradually increased. If the proteids enter the stomach in a pre-digested form, as is the case when peptonised milk is employed, there is no need for the stomach to secrete pepsin, and hence the stomach receives no training in its normal function. For this practical reason it is far more satisfactory at the commencement of life to feed an infant on milk which contains a low proteid percentage, than to supply him with a larger percentage of proteids which have been previously digested. *The use of pre-digested foods, therefore, except in cases of emergency, is to be highly deprecated.*

The Intestines.—The due development of the intestines is a matter of as much importance as that of the stomach, and the general conditions which determine their growth are the same in both cases.

It is a most significant fact that at birth the length and size of the intestines in different infants are peculiarly constant, whereas if measured post-mortem at later periods of life they are found to offer the most extraordinary variations. The reason for this is that, like the stomach, the intestines of the new-born infant possess enormous potentialities for growth provided that the appropriate stimuli be applied. If they be full of food or blown out with wind they will continue to increase in size almost indefinitely, and hence it is that overfed infants, or infants whose abdomens are distended with wind, possess long and distended intestines, while infants who have been carefully fed, and in whom there have been no symptoms of flatulence, possess comparatively small and contracted bowels, which act efficiently.

The amount of food which passes into the intestines depends very accurately on the size of the stomach. If the stomach is large and gastric digestion efficient, large quantities of digested food will pass into the intestines, thus affording the appropriate stimulus for abnormal growth of the bowel.

Now, the size and length of the intestines are matters of the greatest moment for many reasons. Small, functionally efficient intestines are of as much value to the organism as a small active stomach. Some of the disadvantages of a large intestine may be summarised as follows: (1) A long intestine performs its motor functions indifferently, since it acts at a mechanical disadvantage. It is, therefore, the predisposing cause of both constipation and diarrhœa. (2) A long intestine increases the time during which food remains in the bowel, and hence encourages decomposition of food, growth of bacteria, absorption of poisons generated by them (toxins), leads to poisoning of the nervous system by the absorption of these poisons, to anæmia and other constitutional diseases due to auto-intoxication and to appendicitis. (3) A long intestine produces pot-belly and increases pressure within the abdomen, strains the abdominal muscles and ligaments and predisposes to rupture or hernia, prolapse of the bowel, intussusception and volvulus. (4) A large intestine, combined with a large stomach, interferes with the action of the diaphragm, and hence with the normal development of the chest. The fact that rickety, marasmic and many ill-developed, unhealthy infants possess unduly long intestines proves, if proof were needed, that the

best way to prevent these diseases is to protect an infant's stomach and intestines from all forms of stimulation which conduce to over-development.

The Development of the Intestinal Functions of Digestion and Absorption.—The secretion of the intestinal glands is particularly active during infancy, and large quantities of mucus are normally found in the fæces; in pathological conditions the amount of mucus may be very excessive. The secretion of the intestinal mucous membrane does not appear to play any very important part in the process of digestion, except in so far that the secretion contains a considerable amount of alkaline salts, which neutralise the acidity of the contents of the stomach as they become discharged into the intestine.

Normal stools consist for the most part of broken down epithelial cells and excretory products derived from the mucous membrane of the intestinal tract. They do *not* exclusively consist, as is usually supposed, of the débris of unabsorbed food, although a certain small proportion of the remains of food is invariably found in the motions.

The process of absorption even in early infancy is relatively good. It is estimated that 93 per cent. of modified cow's milk and 96 per cent. of human milk is absorbed. The small residue of unabsorbed milk is partly decomposed into gases and other bodies and partly found unaltered in the fæces. Sugar is so easily decomposed that it is seldom found as such in the fæces. Proteid is also fairly easily decomposed by the action of bacteria into bodies such as indol, skatol, phenol and various toxins which give rise to symptoms of poisoning,

and impart a characteristic odour to the stools. Fat is the chief element of food found unaltered in the fæces, for the reason that it is not digested in the stomach nor easily absorbed from the bowel. One of the aims of physiological feeding is to prevent any excess of unabsorbed food remaining in the bowel and becoming decomposed.

The Liver.—The new-born infant possesses a liver which, in proportion to the other abdominal organs, is very large. This is probably because the liver performs functions in the fœtus which are closely associated with the processes of nutrition, though not directly connected with those of digestion. As development proceeds in the infant the liver becomes, in relation to the other organs, of smaller bulk, or at least should do so. However, in certain cases of improper feeding and over-taxation of the functions of this organ, it remains relatively large, and fills a considerable space in the abdomen. A large liver, therefore, in an infant or in a child is frequently an indication that the infant has been improperly fed, and that the hepatic functions have been over-stimulated. A large liver, like a large stomach or intestine, offers direct mechanical resistance to the action of the diaphragm.

Bile is secreted by the liver from the third month of fœtal life onwards, and the total quantity in the new-born infant is relatively great as compared with the amount secreted by adult individuals. The colouring matter of bile, namely, bilirubin and biliverdin, is abundant. The presence of the latter in excess is the occasional cause of green stools. The physiological uses of bile are

chiefly to assist the emulsification of fat and to lubricate the surface of the intestine, and thus to assist the onward movement of the intestinal contents by peristaltic movements. Although bile is generally supposed to inhibit the development of bacteria, it is probable that its action in this direction is extremely limited. The amount of bile secreted is, however, in some degree the index of the physiological activity of the liver. The light-coloured stools which are so frequent in delicate and degenerate infants are certainly associated in some way with inactivity of the liver. It may or may not be due to the absence of secretion of bile.

The Respiratory System.—This system for the purpose of description will be regarded as consisting of the nose, the naso-pharynx, the larynx, the trachea or windpipe, the bronchi and the lungs. However, only those points which have a direct and general bearing on the development of the infant will be considered at any length.

The respiratory movements during infancy are chiefly abdominal, that is to say, that air is sucked into and expelled from the lungs by the bellows-like action of the diaphragm rather than by the expansion and contraction of the upper portions of the chest. It is, therefore, of great importance, as has been already stated, that the movements of the diaphragm should be impeded as little as possible by a large stomach, liver or intestines.

At birth the respirations, which can be most easily counted during sleep, should number from thirty-two to fifty per minute. As the infant grows older the number gradually decreases, and at the twelfth

month number between twenty-five and thirty-five per minute. If there is no obstruction to the nasal passages respiration is carried on through the nose and the mouth remains closed. If there is any obstruction to the nose the infant will breathe with his mouth open and find considerable difficulty in sucking, because when his mouth is thus closed he soon becomes partially asphyxiated and has to stop sucking to obtain breath. With normal respiration through the nose, the alæ or sides of the nose will be noticed to move slightly. In feverish conditions, or any other conditions which cause an acceleration in the rate of breathing, the alæ move vigorously. Breathing should under ordinary circumstances be conducted quietly, and the breath sounds should only be audible by listening within a few inches of the infant's head. Snuffling indicates a catarrhal condition of the mucous membrane of the nose. Snoring indicates nasal obstruction and a partially paralysed condition of the soft palate, and wheezy breathing indicates laryngeal or bronchial catarrh.

The Nose.—The nose of the new-born infant, though small, is generally straight and symmetrical. The orifices of the nostrils should be similar, and there should be no difference in the movements of the alæ on the two sides. As development proceeds the bridge of the nose should become more sharply defined and not flattened. Flattening of the bridge of the nose is generally a bad sign and suggestive of nasal congestion and obstruction. If a clearly defined blue vein can be recognised running across the upper portion of the bridge between the eyes, the diagnosis of nasal congestion is confirmed.

Asymmetry of the nose in later life is a great

disfigurement, and is practically always acquired in childhood or early adult life from obstruction to the free passage of air through one of the nostrils. If one nostril be thus obstructed the child acquires the habit of breathing through the sound one only. The hinder parts of the nose on this side thus become dilated, and the septum of the nose is pushed over to the other side, carrying the cartilaginous portion of the bridge of the nose with it, and thus producing what is generally described as a crooked nose. The importance therefore of examining the condition of the nose from the early days of life is very considerable. The chief cause of nasal obstruction is the congested catarrhal condition of its mucous membrane. If such a condition persists for any length of time adenoid growths are extremely liable to develop. The growths occur chiefly at the back of the nose above and behind the tonsils. If carefully examined, it is only in quite exceptional cases that a child of four years old will be found quite free from them. Since they are occasionally present in new-born infants, hereditary influence and intra-uterine conditions must play at least some part in their formation. As a rule they begin to grow during infancy but produce no symptoms, and generally escape detection. They do not usually attain any considerable size until the second, third or fourth year.

It is practically certain that frequent colds and nasal catarrhs are among the chief factors in the determination of adenoids, while the colds themselves and the nasal catarrhs may be due to a great variety of causes. The fat, flabby, rickety, overfed and under-exercised child is the one who

is assuredly predisposed to develop adenoids to a degree which will necessitate eventual operation. Other important predisposing factors in their production are prolonged and difficult teething, constant crying, want of ventilation and fresh air in the nursery, and the maintenance of a high temperature in the sleeping-room. In London and other large towns a foggy atmosphere and one heavily charged with sulphurous fumes undoubtedly play a most important part in the determination of nasal catarrh and in the development of these growths. Several experienced nurses have told me that they can tell when there is a fog outside even before they have drawn up the blinds in the morning by the snuffling, wheezy breathing and sneezing of the children. The irritation of the mucous membrane of the nose and of the eyes in adults by sulphurous fumes during a fog is the exact counterpart of the snuffling which occurs in infants and children under the same conditions.

Since, therefore, we know the chief conditions which lead to the production of adenoids, we can, to a certain extent, exercise precautions which will hinder their development. The most important preventive measures consist in regulating the hygienic surroundings of the infant. The temperature of the nursery by day and night should be maintained as low as possible. The diet must be carefully regulated, and the amount of carbohydrate food strictly limited, and the infant or child should be taught to breathe exclusively through the nose and not through the mouth. Actual treatment of the condition when once fully established is no easy matter during infancy or early childhood. The con-

sequences of mouth-breathing are, however, so serious that even in early infancy the question of an operation should be seriously considered. An infant is never too young to be operated upon, and I know of one instance in which an operation was successfully performed on a Jewish baby six weeks old. In later childhood irrigation of the nose by antiseptic and astringent sprays or douches has frequently a beneficial effect, especially if combined with breathing exercises such as those recommended by Mr. Arbuthnot Lane, but this method cannot be carried out in infancy.

The Pharynx, the Larynx, Trachea and Bronchi. —These portions of the respiratory tract are subject to the same catarrhal conditions as the nose, and the predisposing and exciting causes are very much the same. Sugar-fed and rickety babies are particularly liable to catarrhs of the mucous membranes, and the mucous membranes of the respiratory tract form no exception. Infants who are properly fed and hygienically managed very rarely indeed suffer from croup, wheezy breathing, bronchitis or other symptoms indicative of catarrh of the lower portions of the respiratory tract, at least such has been my personal experience. On the other hand, it is only a matter of time for symptoms of catarrh to supervene in the case of infants who have been reared in a hothouse manner with every possible precaution to prevent exposure to cold air. In very foggy weather during the winter time in London all children are liable to slight catarrh of the mucous membrane of the nose and throat. This, however, is quite a trifling matter and passes off immediately the atmospheric conditions improve. In the case,

however, of unhealthy, rickety infants these slight catarrhs of the upper portions are very liable to descend and cause bronchitis or even pneumonia, or, in any case, to persist for considerable periods of time.

The Lungs.—The development of the lungs depends largely on the development of the chest, and the conditions which are favourable to the normal development of the thorax are favourable also to the adequate development of the lungs. Therefore a free action of the diaphragm and free exercise of the respiratory muscles by deep breathing are of the greatest importance. Pneumonia or tuberculous disease of the lungs is not liable to occur in infants whose lungs can freely expand in large well-developed chests.

The Circulatory System.—The pulse rate at birth is between 120 and 140 per minute. The rate gradually decreases to 105 to 110 at the end of the first year. With serious weakness of the heart or congenital malformation there is cyanosis or a blue coloration of the cheeks, the ears, fingers and toes. The finger tips generally show the effects of defective circulation by becoming square or clubbed instead of being rounded and more or less pointed. Blue veins standing out clearly over the scalp and forehead forming a well-marked webbing of blood vessels are a very common feature of rickets.

A bright red coloration of the cheeks—the traditional rosy cheeks of health—indicates vascular dilatation or weakness of the capillary vessels. It is quite common in the children of gouty parents, and is, to a certain extent, a sign of degeneracy. It represents the same rosy condition of the cheeks which is a noticeable feature in some cases of

anæmia in girls, or in men of gouty habit. The healthy colour of an infant's cheeks is, under normal circumstances, a uniform pale pinky yellow without any marked central flushing. However, under the stimulus of exercise or cold air the colour should become more pink and less yellow. Beefy, brilliant scarlet cheeks, under similar conditions, indicate a want of vascular tone.

Cold feet and clammy hands do not necessarily imply a feeble action of the heart. They indicate rather a sluggish and impeded circulation through the vessels of the extremities, due possibly to an impure condition of the blood and increased peripheral resistance. This condition is frequently found in infants and young children who are suffering from stomachic and intestinal disorders. The treatment is friction of the hands and feet, salt-water baths, warm gloves and socks, combined with attention to the stomach and intestines rather than by stimulants and heart tonics.

The Nervous System.—The chief indications in infancy of a normal development of the nervous system are: (1) Quiet, peaceful sleeping; (2) smiling, playful mood during waking hours; (3) free movement of the limbs; (4) normal muscular development, the drawing up of the feet and flexion of the toes on tickling the soles; (5) normal development of the special senses, namely, sight and hearing; (6) absence of excitability for small causes; (7) absence of vomiting for trivial causes; (8) absence of squint and convulsions.

Infants who from hereditary causes or by reason of improper dietetic and hygienic management develop an unstable nervous system, as a rule

sleep badly, are fretful, restless, and subject to fits or convulsions. They possess a sensitive skin, namely, one which is subject to urticaria or nettle rash, and to eczema, and one which very readily shows red marks from slight friction or knocks (dermographia). They vomit or hiccough on slight provocation, are liable to asthmatic attacks or spasmodic croup and laryngismus stridulus, squinting or rolling of the eyes.

More serious symptoms are actual paralysis or inability to move any of the limbs, rigidity or stiffness of the limbs, retraction or backward flexion of the head, spasmodic movements, tremors and over-extension of the big toe on tickling the sole of the foot. This sign, which is known as Babinski's reflex, is not reliable in children under two years of age. These conditions may be due to damage of the brain at the time of birth, or may be due to pathological disturbance of the nervous system from other causes. Fits or epileptic seizures occurring soon after birth generally imply some damage to the nervous system occasioned during birth.

Idiocy.—In early infancy it is often difficult to say whether a child will be an idiot or not. Idiocy is less difficult to diagnose if combined with abnormalities of bodily development such as occur in cretinism and in microcephalic or hydrocephalic infants, or in the paralysed, or in those subject to periodic attacks of convulsions. Constant restless rolling of the eyes, protrusion of the tongue, malformation of the fingers, hare lip, cleft palate, absence of the thyroid gland combined with deficient intelligence, are conditions which should arouse suspicion.

Precocious development of the mental faculties in infancy and early childhood is by no means a favourable sign. The child who talks before he can walk is less likely to make a useful citizen than when the conditions are reversed. A slow, steady mental development progressing *pari passu* with the bodily growth with well co-ordinated movements of the limbs and fingers is of excellent augury.

THE SPECIAL SENSES.

The Eye.—Very soon after birth the infant is able to distinguish light from darkness, and at the end of the first month usually manifests pleasure when a light or a bright object is moved about before his eyes. By the third month he should be able to recognise his nurse, and by the sixth various familiar objects.

The power of winking is usually developed about the second month, that is to say, about this time the eye closes automatically for the purpose of protection if an object is brought suddenly near it. It is obvious that before this power is developed the eye is helpless to protect itself, and therefore the greatest care should be exercised in preventing damage from knocks or blows or from the entrance of foreign matter or dirt.

The eyelids should be closed tightly during sleep. They remain half closed in serious acute illnesses, in collapsed conditions during a time of rapid emaciation and in atrophy.

Acute inflammation is sometimes caused by purulent discharges entering the eyes as the head passes at birth through the maternal passages.

If the mother be known to have a vaginal discharge the passage should be carefully cleansed with some antiseptic lotion before confinement. The secretion of tears does not commence until the infant is some months old, and this is an additional reason why the eyes of new-born infants are particularly liable to become inflamed, since they are not provided with this natural means of irrigation. Photophobia or intolerance of light is generally a serious symptom which occurs in inflammatory or excitable conditions of the brain; it is also an early symptom of measles and influenza.

Strabismus, or squint, may occur in infants because the sight is different in the two eyes. It may also be due to paralysis of one or more of the muscles which move the eyeball, or it may be one of the indications of asymmetry occurring in degenerate infants. It may be present temporarily during teething as the result of reflex nervous irritation. It is generally noticeable before or during convulsions or fits.

Nystagmus, or rolling of the eyes, is also a sign of nervous instability or irritability. It sometimes occurs as a symptom of rickets or in diseases of the brain or of the eyes. It is sometimes combined with a jerky movement of the head.

Short-sight.—The causes of short-sight may be hereditary or ante-natal. But, as a matter of fact, short-sight is often an acquired condition produced in infancy and childhood, probably by the same causes which produce lax ligaments and weak muscles in other parts of the body, and by a high tension of the fluid contents of the eyeball. A

high tension inside the eyeball acts as a constant stimulus to general enlargement of the eyeball, which, owing to the restraining influence of the bones of the orbit, is more liable to take effect in the antero-posterior diameter, that is to say, the eyeball tends to project forward and become lengthened from before backwards with an abnormally long antero-posterior axis. It is the lengthening of this antero-posterior axis which produces short-sight or myopia.

In addition to the increased length of the antero-posterior diameter in myopia there is generally a concomitant weakness or stretching of the ligaments and muscles which support the crystalline lens. It is probable that in conditions of malnutrition and rickets these ligaments and muscles are particularly liable to become stretched or weakened. It is difficult to prevent children who live in towns, where there is seldom a free field of vision, from constantly looking at objects which are close at hand. In the country they have opportunities of looking at distant objects, such as birds, animals and mountains, or ships at sea, and, as a rule, they spend a greater part of their time in outdoor occupations than do children who live a town life, and who necessarily spend more time indoors looking at picture books and playing with small toys.

Short-sight should not therefore be accepted as a hereditary misfortune. It is as often as not a fault of the environment and in the bringing up. It is true that all the children in one family may be short-sighted, but not necessarily so because they have been born with defective vision, but quite as probably because they have all been exposed to

the same conditions which in the end lead to short-sight, *i.e.*, the condition which determine rickets in infancy, and anæmia and rheumatism in later life.

The Ears.—The anatomical development of the ears is not so likely to be at fault as is that of the eyes. Sometimes defects in the shape of the external ear or pinna are obvious, and when they occur in an extreme form they are not infrequently to be regarded as indications of degeneracy. Sometimes the shape of the external ears is different on the two sides, and this example of asymmetry has the same significance as other forms of asymmetry. Sometimes both ears project from the side of the head in a very unbecoming manner. This condition, however, more often than not rights itself if the infant or child does not acquire the habit of lying upon his side with the pinna folded back.

At birth the sense of hearing is undeveloped, and usually it is not until the second week of life that the infant is capable of appreciating sounds. Hyperacusis, or a morbid acuteness of hearing, is sometimes present in infants suffering from excitable conditions of the nervous system: it is not a good sign. If by the end of the first month he cannot appreciate loud sounds he will probably be permanently deaf or an idiot. At the end of the third month the baby should be able to appreciate the direction whence a sound comes and turn his head towards it. When six months old he should evince pleasure at music or when sung to.

Ear-ache.—Sometimes ear-ache occurs in infancy, though it is difficult to diagnose with certainty. Constant screaming and the application of the hand to the ear is suggestive of this condition,

though the same symptoms are sometimes evinced during the cutting of the lower back teeth. The membrana tympani of an infant can generally be examined with an otoscope, or, indeed, sometimes without, as the external passage of the ear is short. Suppuration in the drum of the ear is a serious condition, as the inflammation may spread to the brain and cause death. Suppuration in this situation is generally due to inflammation which spreads from the naso-pharynx up the eustachian tube; it generally is accompanied by adenoid growths. Facial paralysis or inability to move the muscles on one or both sides of the face is generally due in infancy and childhood to ear disease, and, therefore, in all cases of facial paralysis the ears should be most carefully examined.

Taste, Smell and Sensibility.—These sensations are all developed early in infancy, but not to any high degree. The sense of temperature is sometimes so imperfect that infants will not resent poultices, baths or hot-water bottles which are so hot as actually to cause damage to the skin and blistering. The sense of touch when feebly developed is generally indicated by clumsy movements with the fingers. This, if combined with badly co-ordinated movements of the arms and legs, is usually a sign of abnormal nervous development.

GENITO-URINARY SYSTEM.

Although an examination of the external genitals is usually the first one to which the infant is subjected, it is seldom made with any ulterior reason beyond that of deciding the sex of the baby, so that

important malformations and even indications of hermaphroditism are not infrequently overlooked. It should be the doctor's duty to examine the external genitals thoroughly, in the case of a female to see that the external sexual characteristics are normally developed, and in the case of a male to satisfy himself that the testicles have descended into the scrotum, and that the foreskin is not unduly tight or long. While making this examination the anus should also be inspected, for to say the least it is humiliating to a doctor's professional pride to discover at a subsequent date that an inperforate anus is the cause of an obstinate constipation which has been treated diligently with castor oil.

The Foreskin.—A long and tight foreskin is a great disadvantage not only during infancy and childhood but in after life as well; during the former it is a predisposing cause of rupture, owing to straining during the act of micturition, while from the irritation to which this condition gives rise it not infrequently conduces to habits of masturbation and bed-wetting. In after life a long foreskin renders the possessor extremely liable to contract venereal disease if exposed to infection. For these reasons I strongly advocate circumcision, even when the prepuce is not particularly long or tight. There are distinct advantages in having the necessary operation performed after the Jewish method of procedure, or at any rate without an anæsthetic; if the operation is skilfully performed, it takes but a few minutes, and I doubt very much whether the infant experiences any serious pain if it is performed within the first few days of life.

The Testicles.—The testicles should descend into the scrotum during the eighth month of fœtal life, and therefore at birth both of these glands should be found in their normal position. In certain cases they do not descend, but may be retained within the abdomen, or within the inguinal canal. If they do not descend during the first few years of life, they will atrophy and remain functionless. An operation is sometimes successful in assisting the descent of an incarcerated testicle.

Rupture.—Infantile rupture, or the descent of a loop of the intestines into the scrotum, is a common event. It is due to a want of closure of the opening in the abdominal wall through which the testicle descends. It is clear that any condition which increases the pressure or tension inside the abdominal cavity must operate adversely on the closure of this opening. The chief causes which bring about an increase of abdominal pressure and interfere with the normal closure of the inguinal opening are :—

1. Straining at stool from constipation.
2. Straining during micturition from a tight foreskin.
3. Frequent coughing from catarrh of the respiratory mucous membrane, or frequent crying.
4. Over-distension of the stomach or bowel with food or wind.
5. Large stomach, liver and intestine.

Hydrocele.—Hydrocele is a collection of fluid in the funicular process of the spermatic cord, or water on the testicle, as it is popularly called. It is due to the same mechanical causes which lead to rupture, and the two conditions are sometimes found combined.

The Urine.—Urine is secreted by the kidneys at an early period of fœtal life, and the bladder is sometimes found to contain urine at birth. As a rule very little urine is passed by the new-born infant—2 oz. is quite a large quantity for the first twenty-four hours; at the end of the first week the amount may rise to 5 oz. A chemical examination of the urine of infants is seldom made, for the reason that it is generally regarded as a difficult matter to collect sufficient for this purpose. The usual method is to place some clean absorbent wool in the napkin, and to squeeze out any urine with which it has become saturated. This is a clumsy method: for the cotton wool a properly constructed infant's urinal should be substituted. These are made of india-rubber, and can be most conveniently applied.

The normal urine at birth is: Acid in reaction, dark in colour and generally cloudy; it has a specific gravity of about 1010, contains a large quantity of uric acid, a small quantity of urea and usually traces of albumin; within a few days the reaction becomes neutral, the colour lighter, and the specific gravity falls to about 1003: the albumin disappears and the urea increases in amount. The amount of uric acid during the whole period of infancy remains large as compared to the amount contained in the urine of adults.

The amount of urine passed during the twenty-four hours depends largely on the quantity of fluid taken and on the temperature of the atmosphere. On an average at one month the infant will pass 8 to 14 oz., at three months 8 to 18 oz., and at nine months 12 to 20 oz.

Bed-wetting.—A skilful and painstaking nurse will soon succeed in training an infant to pass his water into a chamber when held out. I have known instances of infants perfectly trained in this respect at the second month. The acquisition of a reflex act of this kind is generally easy, for the nervous system of an infant is such that automatic habits are very readily induced, in the same way that undesirable habits once acquired are only broken with difficulty. Some infants, especially degenerate infants, are difficult to train properly in all automatic functions. Their nervous systems are unstable, explosive in their actions, and almost incapable of performing co-ordinated regular functions.

Bed-wetting in later childhood is the result of unsuccessful training in early infancy, due either to neglect or to instability of the nervous centres. As already mentioned this condition is more liable to occur in degenerate children, and in boys with long tight foreskins. Acidity of the urine is also an exciting cause. Since bed-wetting is chiefly due to instability of the nervous centres which control the act of micturition, the following are rational expedients in the treatment:—

1. Try and induce regular and automatic habits by holding the infant out at regular periods during the day as well as during the night. The intervals during the day should be gradually lengthened, so as to accustom the infant to hold water in his bladder for considerable periods of time.
2. Give plenty of fluid during the day and restrict the amount during the evening and night.
3. Do not allow the child to sleep on his back. This causes congestion of the spinal cord, and renders the nervous centres more excitable and explosive in their actions.

4. Keep the child free from all form of excitement, such as visitors, parties, journeys, etc.
5. Keep his diet low and free from stimulating foods, such as meat or beef tea.
6. Give alkalies to reduce the acidity of the urine, and belladonna and bromide to allay the excitability of the nervous centres.

Masturbation.—The habit of masturbation is easily engendered in degenerate infants, especially in those who also wet their beds. The nervous centres which control micturition and the sexual act are closely associated in the spinal cord, and influences which act on one centre also act on the other. Masturbation in infants is often overlooked or not understood; the act generally takes place at night just before the infant or child goes to sleep, or just before he wakes up. It is generally accomplished by applying friction to the external genitals by rubbing the thighs together. The treatment is difficult, but should be conducted on the general lines recommended above for bed-wetting. In addition, however, a pillow or cushion should be tied between the knees, or the hands should be restrained from touching the parts by tapes or cords.

The Skin.—At birth the colour of the skin is usually a deep red, and it is covered more or less thickly with a greasy, cheesy material, the vernix caseosa, which consists partly of mascerated skin cells, the secretion from the sebaceous glands, and partly of substances deposited from the liquor amnii or water in which the fœtus floats. The red colour soon begins to fade, leaving the skin after the first few days of a pale pink and slightly yellowish shade. At a later date the cheeks sometimes assume a bright rosy colour.

This, as has before been stated, indicates dilatation of the superficial blood vessels, and is not a feature to be desired.

The sebaceous glands, as is shown by the presence of the vernix caseosa, are developed and active during uterine life, and abnormal activity of those glands at birth leads to the formation of greasy crusts on the scalp in which the hair becomes entangled. These crusts sometimes cause irritation and eczema ; for this reason they should be removed as rapidly as they are formed by the application of olive oil and by washing with soap and water. Great activity of the sebaceous glands is by some regarded as a sign of degeneracy or partial reversion to an ancestral condition when all the body was covered with hair, and the sebaceous glands had more important functions to perform. However, whether a sign of degeneracy or not, over-activity or excessive development of these glands is usually associated in infancy with other signs of want of vigour in the constitution, and later on in life, generally at the period of puberty, it leads to the production of acne spots or blackheads, or to sebaceous cysts, which are very common among insane persons and other degenerates.

The sweat glands, although present at the time of birth, do not as a rule become functionally active until towards the end of the first week. Profuse sweating must be regarded as a bad sign. It generally implies over-feeding and over-active combustion within the body and a physiological attempt to reduce the temperature and to get rid of imperfect products of combustion. It is

generally accompanied by other constitutional symptoms of rickets or malnutrition.

The skin of the infant is very sensitive to irritation, either from within or from without. Rashes, spots and eczema occur more readily than in adult individuals. Infants possessing excitable or unstable nervous systems, that is to say, those who are peculiarly sensitive to all forms of external impressions, irritants or stimuli, are more liable than others to all varieties of skin lesions. Their sensitiveness to irritation can be demonstrated by drawing the finger sharply across the skin when a red mark is immediately formed. This symptom is known as dermographia or skin writing. It is a very useful test of nervous instability. Dermographic effects are usually more easily produced in the offspring of gouty, rheumatic, nervous and neurasthenic parents.

The ordinary spots of infants, lichen urticatus, to which babies are particularly liable, are of the nature of a nettle rash. They commence usually as hard, white lumps about the size of a hemp seed, and gradually become red, vesicated, blistered or pustular. Spots of this kind have occasionally been mistaken for chicken-pox. They may be distinguished from the latter by appearing along the course of the superficial nerves, and presenting a characteristic linear grouping.

These spots often develop from apparently insignificant causes, especially so in infants of nervous temperaments. The reflex irritation of teething, the irritation of indigestible particles of food in the stomach or bowel, nerve shock, the irritation of flannel garments, certain drugs and conditions which lead to free perspiration, are all occasional

exciting causes; as a rule they require no special treatment, apart from removing the cause, if it can be discovered; however, a few grains of bicarbonate of soda, given two or three times a day, are sometimes of advantage. What is true of the ordinary nettle rash spots of infancy is also true of the more serious condition of eczema. The irritation to which the condition gives rise must be treated with appropriate local applications.

The Hair.—At birth the infant is generally covered more or less thickly with a fine down or lanugo. This fine hair, as a rule, rapidly atrophies and disappears, and is replaced by permanent hair, which, with the exception of that on the head, the brows and eyelids remains during infancy in an undeveloped condition. The condition of the hair in infancy may afford indications with regard to the general constitution, and the following points may be worth remembering: Red hair, for reasons not yet explained, is often associated with what, for want of a better expression, is generally called a rheumatic diathesis; that is to say, with a constitutional tendency to develop conditions of malnutrition in infancy, growing pains in childhood, and joint lesions at a later period. Red hair is not, therefore, prognostic of a robust constitution.

A copious development of straight, lank, dark hair on the scalp or eyelids, with a persistence of soft downy hair on the back, arms and other parts of the body, is a sign of degeneracy or scrofula, and should warn us of a delicate constitution and a difficult infancy, with a tendency to the development of enlarged or strumous glands.

The persistence of hair on the back is often

accompanied in later life by a badly formed chest, with projecting shoulder-blades, curvatures of the back, weak, flabby muscles and a tendency to consumption.

The number of hair roots on the head, as generally over the body, is predetermined before birth, but the size of the head to a certain extent depends on extra uterine conditions and on the way in which the infant is brought up. Since, therefore, the actual number of the hairs remain constant, and the size of the head differs according to circumstances, the closeness or thickness of the hair is a more or less reliable indication as to whether the head is larger or smaller than nature intended it to be. For instance, in rickets and hydrocephalus, in which conditions the head is usually greatly enlarged, the hair will apparently be scanty and the individual hairs widely separated. On the other hand, in small-headed children and in microcephalic children the hair usually appears very close. In nearly all rickety conditions with an enlarged head the hair appears scanty and correspondingly coarse. If this be the condition in infancy, the hair, as a rule, falls out early with premature baldness.

The Nails.—The appearance of the nails is, even in infancy, sometimes characteristic of the constitution. The finger-tips, and with them the nails, should be well rounded or pointed. Square or clubbed finger-tips are often associated with heart disease or with disease of the lungs, and are due to a certain extent to feeble circulation. Very thin and brittle nails are often noticeable in infants born of gouty or nervous parents.

Treatment.—With regard to the general treatment of the skin and hair little need be said, except that when the skin is very greasy soap may be more freely used than when it is dry, but the towel should always be employed freely to promote the circulation and improve the general condition of the integuments. Not only for the sake of his skin, but also for that of his general health, the infant should be gradually habituated to the application of cold water. The hardening of the skin by the application of cold water is the surest way to prevent colds and chills. By this process, as it were, the skin is trained to accommodate itself to changes of temperature. The skin which is always exposed to warm air and warm water is very liable to resent accidental exposure to any form of cold, and to cause a general disturbance of equilibrium or nervous shock. At birth the temperature of the bath should be about 98°, but when the infant is about three weeks old the temperature may be gradually reduced until, at the sixth week, it has been reduced to 80° in winter, or even lower in summer. A few spongefuls of nearly cold water may be squeezed over the shoulders and back as the infant leaves the bath with great benefit.

A healthy, vigorous growth of the hair is promoted by the free access of air to the head. The head should not be covered too warmly with hats, hoods or shawls. Unfortunately for the infant, his head is too often covered up with some monstrous form of bonnet with a view to preventing him catching cold. This close covering of the hair often leads to a profuse perspiration at the back of the head,

and this perspiration, by evaporation, is not infrequently the source of a chill. The best way to prevent colds due to sudden chill of the skin is to keep the temperature of the sleeping-room, as well as of the day nursery, at or below 64° F., to give baths of low temperature, and to have the clothes as light as possible, and to allow the access of plenty of fresh air to the head, hands and legs; the reverse of these methods is to produce a hothouse variety of baby, who takes a chill at once if he is exposed to any temperature lower than that of an incubator.

GENERAL DEVELOPMENT.

Height.—The average height of a male child at birth is 19¾ ins.; of a female, 19¼ ins. During the first year the child, whether male or female, should grow about 10 ins.

Chest Measurements.—At birth the chest should measure about 13 ins., namely, about the same as the head. At six months it should have increased to about 17¾ ins. and at one year to 19¾ ins. A large chest is a good sign.

The Abdomen.—During infancy the girth of the abdomen is relatively large, and as has already been mentioned, a small belly is of the greatest advantage not only throughout infancy but throughout life, and therefore measurements below the normal, combined with other indications of health, are excellent signs, for the reason that they imply that the liver, stomach, intestines and other abdominal organs are not enlarged or unduly distended. The belly at birth should not measure much more than 14 ins., at six months not more than 18 ins., and at one year not more than 19½ ins.

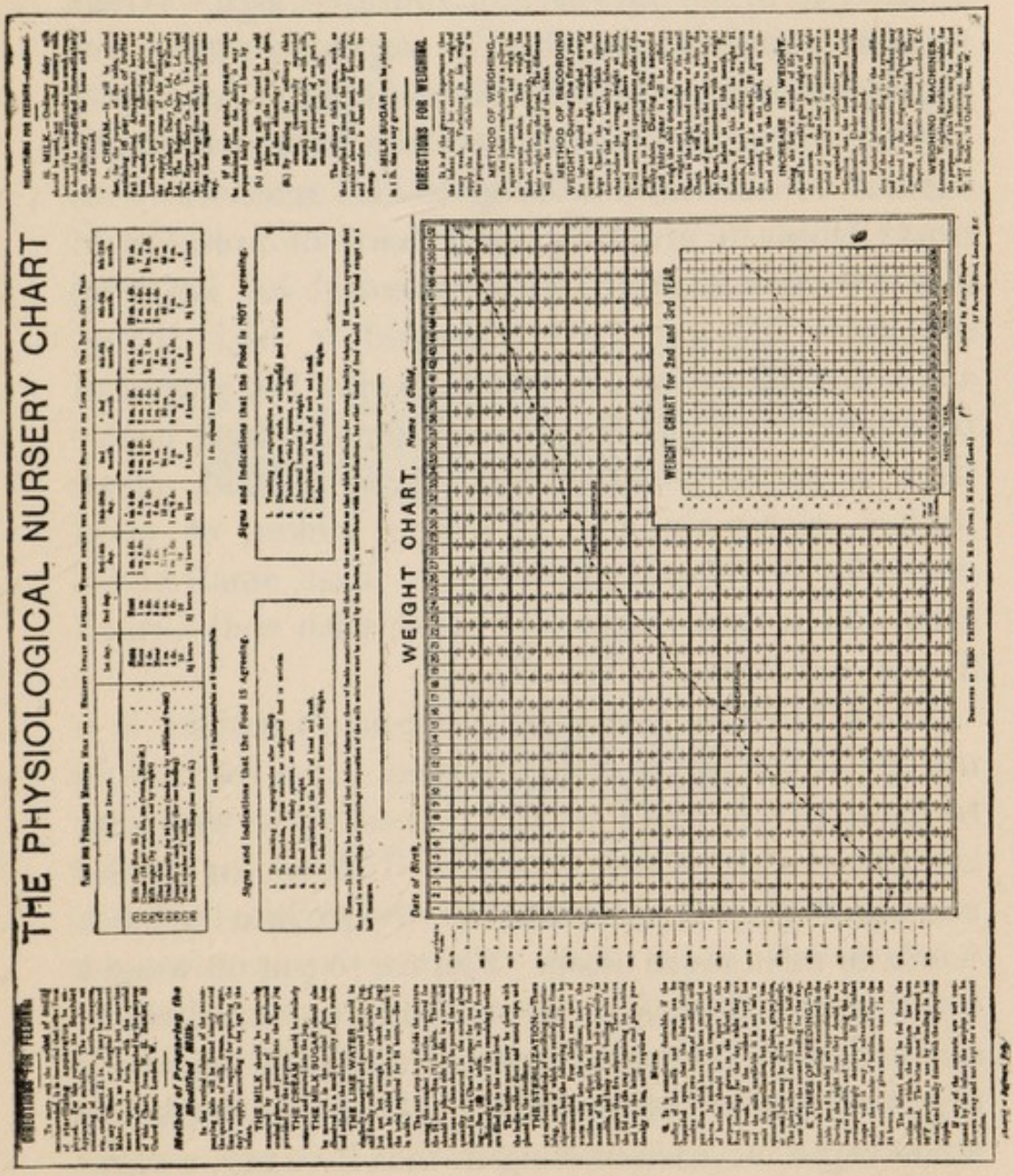

Fig. 3.—Author's Chart for Recording Weight.

Weight.—The weight of a healthy infant at birth should be between six and eight pounds. Unless all the measurements of height and chest are in proportion, any increase in weight over eight pounds is by no means a favourable sign. Great weight generally implies a superabundance of physiologically unsound tissue, rapidly developed during intra-uterine life under the influence of abnormal conditions obtaining in the mother. Fat, heavy children are frequently born of mothers of unsound constitution who have led an inactive, sedentary life, and have indulged in high living, alcoholic stimulants or drugs during the period of pregnancy. You cannot wish for anything better than a seven-pound infant, well formed, clean limbed, clean skinned, a strong kicker, of good muscular development, of large chest, small abdomen and a moderate-sized head, with well-formed fingers and toes.

From birth onwards the progress in weight is a matter of the greatest importance. It is impossible to insist too strongly on the necessity for weighing the infant at least once a week. Indeed, for special reasons it may be desirable to weigh him twice a week, or even more often. Failure to put on weight is often the first sign of malnutrition or disease, and attention is thereby drawn to a condition which might otherwise escape notice. On the other hand, a too rapid increase of weight, that is to say, a regular increase in weight of over eight or nine ounces per week, without a corresponding increase in muscular strength is as often as not an indication of abnormal nutrition.

A careful record should always be kept of the

weekly weighings. Such a record is of the greatest assistance to the doctor, who can thus see at a glance the sort of case he has to deal with. The record should be kept on a special chart, and for this purpose my physiological nursing chart has been designed. In a healthy infant during the first six months of life the increase in weight should be about 5 oz. per week. It is impossible to state more precisely what increase of weight should be regarded as satisfactory in any particular case, since the conditions of intra-uterine life

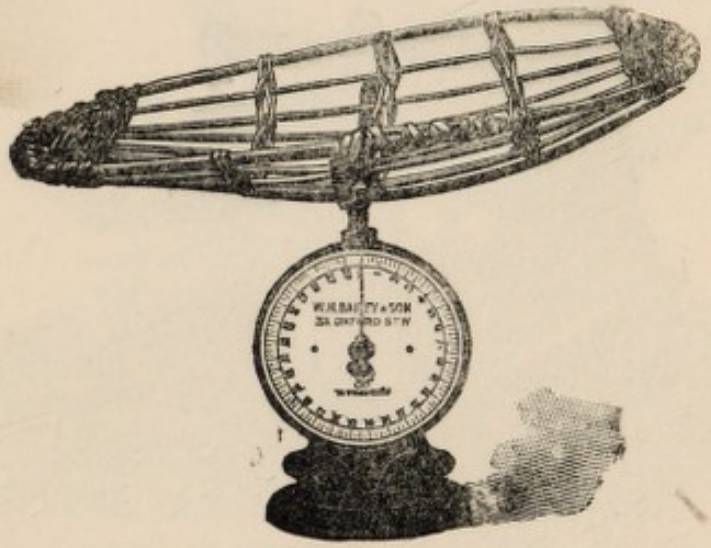

Fig. 4.—Patent Spring Balance.

and the hereditary constitution materially influence the subsequent progress, even when the general management is conducted on the very best lines. The same results are not to be expected in degenerate types of infants as in those of thoroughly sound constitution. As above stated, some degenerate infants put on an excessive amount of weight in spite of the most careful dieting. Increase of weight of this kind does not indicate the development of sound physiological tissue. On the other hand, no amount of food will enable other

varieties of unhealthy infants to put on a normal amount of weight. Our aim should be to recognise the sort of infant we have to deal with, and to secure the utmost regularity in the increments in weight rather than a rapid, irregular increase. There is often a temptation to increase the quantity of food in infants who are not putting on sufficient weight. As a matter of fact, if an infant of an average size and on an average dietary consistently shows a weekly increase of weight which is below the average, it is far better to accept the situation

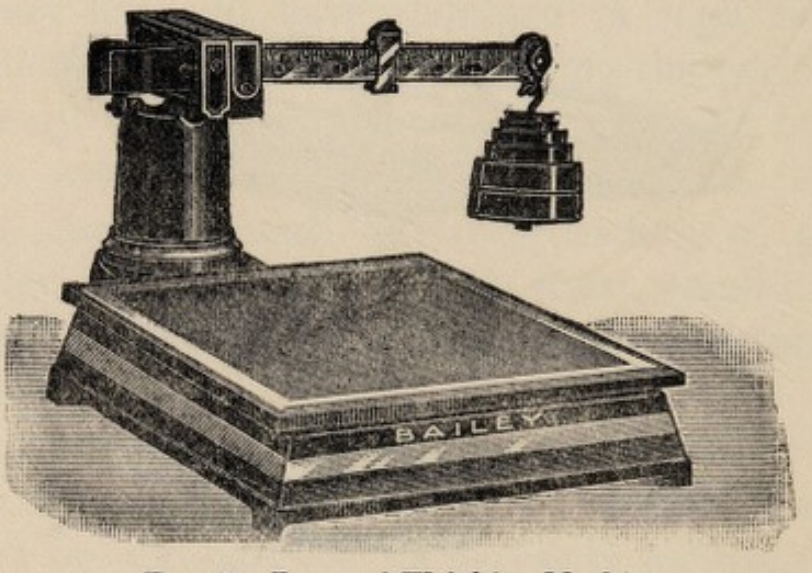

FIG. 5.—Personal Weighing Machine.

and to be content with a small increase provided that increase is perfectly regular.

The weighing of infants is a perfectly simple matter. The least complicated method is to use the patent spring balance, of which an illustration is given. The disadvantage of this machine is that no absolute reliance can be placed on its accuracy. On the other hand, with it there can be no excuse for not weighing at all on the ground of difficulty. The price of this balance is 28s.

A better machine is the "Personal Weighing

Machine," especially as it can be used for the weighing of children up to any age. In weighing infants they should be placed comfortably in a Japanese basket, and the latter placed on the footboard. Subsequently the basket pillows and the clothes in which the infant is dressed should be weighed, and this weight deducted from the weight of the previous weighing. The price of this weighing machine is 21s.

For the accurate weighing of infants, such as is

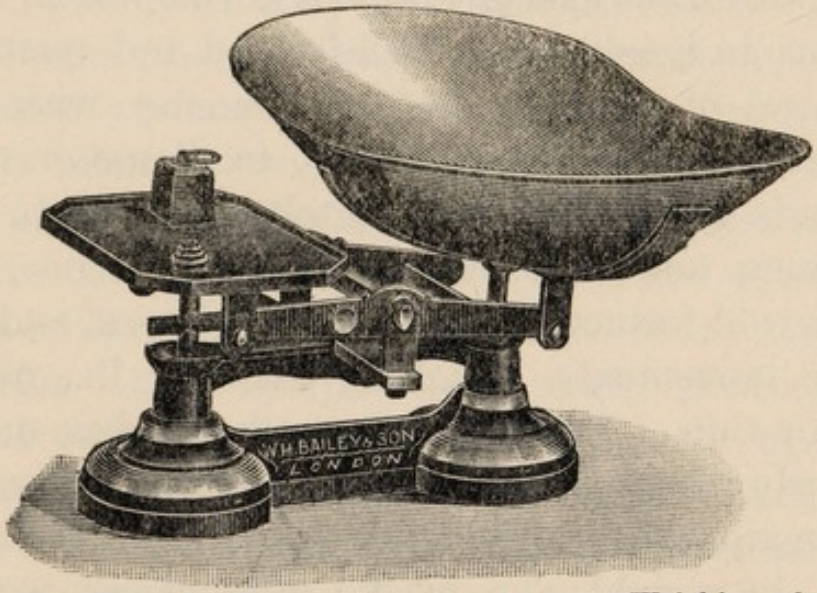

FIG. 6.—Author's Scales for the Accurate Weighing of Breast-fed Infants.

essential in breast feeding (see Chap. I.), neither the patent spring balance nor the personal weighing machine can be used. Scales for this purpose must weigh accurately to a quarter of an ounce. I have suggested a design for such scales,[1] and an illustration is here given. The pan is very large, roomy and convenient for the reception of the infant. The latter must be rolled tightly in a shawl, so that he cannot move about and set the scale oscillating.

[1] The scales may be procured from W. H. Bailey & Son, 38 Oxford Street, W.

THE IDEAL INFANT.

(1) Is an infant born of healthy parents under thirty years of age, free from taint of syphilis, gout, rheumatism and nervous disorders; of a mother who has lived a simple, healthy life during pregnancy, abstaining from alcohol and drugs; who has taken regular exercise, observed regular hours and regular times for meals. (2) Is an infant born at full time in natural labour, free from malformations or faults of development, about 19¾ ins. in height, with well-formed and symmetrical head of about 13 ins. in diameter, with well-formed chest of about 13 ins. in diameter which expands freely and immediately after birth, with abdomen not measuring more than 14 ins., with clean, well-formed limbs, fingers and toes, and with active movements, weighing about 7 lb., neither fat nor thin. (3) Is an infant who thrives on any properly adjusted dietary without sickness, diarrhœa or constipation, and who increases regularly about 6 oz. in weight per week; who sleeps well, is active during waking hours, with free muscular development and active movements, who does not cry out for food between the regular times of feeding, is satisfied with normal quantities, does not perspire about the head and appreciates his bath, who breathes freely through the nose, keeps his mouth firmly closed, has no spots about his body, cuts his teeth at the normal period, without symptoms, is able to stand and walk at the normal age, and shows normal, but not precocious intelligence. For the peace of mind of parents, I may here state that I have not yet met this baby.

HOW TO RECOGNISE DEGENERATE INFANTS.

In the foregoing pages frequent reference has been made of the signs and symptoms of degeneracy. As the significance of the term degeneracy is often imperfectly understood and regarded as a term of reproach, I take this opportunity of amplifying what has already been said on the subject. It is often of the greatest importance to be able, at an early period, to distinguish infants of this type from those who may be regarded as of normal constitution, because they do not conform to the processes of nutrition which apply in the case of infants of sound constitution.

Degenerate babies nearly always require special care in their up-bringing, for they are extremely liable to develop rickets, and other diseases of malnutrition under comparatively slight provocation, indeed often when they are surrounded by most favourable hygienic conditions. Such infants, even when they are breast fed, often become anæmic, nervous, scrofulous children, and under conditions of poverty and neglect help in later life to recruit the ranks of Hooliganism. They are the infants who develop into neurasthenic, rheumatic and consumptive adults ; they are often of precocious intellect, develop early and die young. They often fall victims to alcoholism and drug habits, and possess perverted instincts. They drift into prisons and lunatic asylums. These unhappy results can, to a certain extent, be obviated, or at least mitigated, if recognised at an early stage and treated by the application of sound dietetic and hygienic methods, and at later stages by judicious moral training.

As may be readily understood there are different degrees of degeneracy, from the superior degeneracy of precocious intelligence to complete idiocy. It is, however, only with the lesser degrees of superior degeneracy with which I propose to deal. At the commencement of the chapter on "Development," p. 15, I drew attention to the enormous influence of intra-uterine conditions on the health and development of the fœtus. This maternal influence need not again be referred to; it will be sufficient to reiterate that a history of unsatisfactory pre-natal conditions is a very important factor in the recognition or diagnosis of degeneracy in the infant after birth. Dr. Combey, in the *Revue Mensuelle des Maladies des Enfants* (1901), vol. xix., page 585, has written a lengthy though by no means complete account of the signs and symptoms of degeneracy in infancy. He describes two types of infants belonging to this category, the fat and the lean; both of these types I have referred to on page 172. The degenerate infant may be anæmic or full-blooded, with red lips and cheeks. There is often a tendency to infantilism or a tendency for infantile characteristics to persist later than they should, with stunted limbs and vacuous expression. The lymphatic tissues are liable to hypertrophy or enlargements; the tonsils may be of large size, and adenoid growths may develop early. The lymphatic glands in the neck enlarge, and, in fact, we find a condition which is described as lymphatism. As regards the circulatory system, there are frequent vaso-motor disturbances with liability to sudden flushing or paling, to dermographia, to fainting attacks, palpitation, irregularities of the pulse

and tachycardia. Among the symptoms which are due to disturbance of the respiratory system must be included tendency to catarrh of the nose, hay fever, asthma, bronchitis, laryngismus stridulus and croup. The digestive system presents a great variety of symptoms, such as perversions of appetite, capricious or ravenous feeding, periodic or cyclic vomiting without apparent cause, tendency to gastro-enteritis, constipation and diarrhœa. In the genito-urinary system, apart from actual malformations, there is a tendency to vaginitis in girls and overgrowth and tightness of the prepuce in boys, bed-wetting and dirty habits. The urine is generally highly acid, of high specific gravity, and contains a high percentage of uric acid. As regards the nervous system, degenerate infants generally sleep badly, are irritable and excitable, cry frequently, are liable to convulsions and fits, and present various degrees of precocious intelligence. The skin may give indications of extreme irritability by becoming unduly red on slight friction or trivial knocks (dermographia). Rashes, spots, excessive perspiration, excessive sebaceous secretion, eczema and nettle rash are common features, and there is frequently an excessive development of hair, especially noticeable on the back. Muscular development is often feeble, with a peculiar soft, inelastic feel of the muscles; the movements of the limbs, fingers and toes are often sluggish or clumsy, and the joints may become swollen with symptoms of acute inflammation. Another symptom peculiar to degenerate children is periodic attacks of fever or high temperature, without obvious cause, of a running type, which is not

unlike that of malarial fever. As already mentioned, asymmetry of development and actual anatomical malformations, such as hare lip, cleft palate, hermaphroditism, etc., are also occasional indications of a rather more advanced type of degeneracy.

APPENDIX.

RECIPES.

Barley Water.

Take two teaspoonfuls of washed pearl barley and boil in one pint of water slowly until it is reduced to two-thirds of a pint, then strain.

The percentage composition of barley water prepared in this way is :—

Proteids	0·09 per cent.
Fat	0·05 ,,
Starch	1·63 ,,

Barley water is a useful diluent of milk in place of ordinary water. As an examination of the above percentage composition will show, it cannot materially alter the percentage composition of any mixture to which it is added, except in so far that it increases the amount of carbohydrates to the extent of 1·65 per cent.

Beef-tea.

Take 1 lb. of lean beef, mince fine, mix thoroughly with 1½ pints cold water; allow it to stand for one hour, then stew until the quantity is reduced to 1 pint. Strain through muslin.

The percentage composition of beef-tea made in this way is :—

Proteids	1·0 per cent.
Fat	None.
Sugar	A trace.
Nitrogenous extractives . .	2 per cent.

Beef-tea, therefore, can hardly be regarded in the light of a food. It is, however, a powerful stimulant, and in combination with bread jelly, peptonised milk, or diluted milk, it is often of great value in the treatment of conditions of exhaustion, diarrhœa or atrophy.

It must be remembered that beef-tea, being a powerful stimulant, acting on the nervous system in certain respects like tea or coffee, should not be given as a routine practice to nervous infants.

Veal Broth.

Take 1 lb. of lean veal, cut small, with a few small pieces of shin bone or knuckle; add 1 pint of cold water, heat gently and allow to simmer for several hours. Cool down and remove fat.

Veal broth with the addition of milk sugar and emulsified butter, is particularly useful for new-born infants who cannot digest milk, see p. 87.

Bread Jelly.

Take a thick slice of bread (4 oz.) two or three days old, so as to be dry and sweet, place it in a basin of cold water and allow it to soak for eight hours. It is then to be taken out, and all the water squeezed out of it. The pulp is then placed in a pint of fresh water, and gently boiled for one and a half hours in a double saucepan; otherwise, it may be burned and spoiled. Rub through a fine hair sieve, and allow to jellify (Cheadle).

The composition of bread jelly made in this way is:—

Proteids	2·7 per cent.
Fat	0·5 ,,
Carbohydrates . . .	15·2 ,,

Practical experience proves that bread jelly diluted with water and supplemented with additional foods, such as raw beef juice and cream, makes a most satisfactory food for delicate infants, especially those suffering from chronic diarrhœa, sickness and atrophy. On theoretical grounds its

merits are not so clear, since it contains starch, which, as a rule, is an unsuitable form of carbohydrate for young infants. Further, it contains practically no fat and only a small proportion of proteid. For mixtures containing bread jelly, see p. 86.

White of Egg Water.

Measure 1 oz. of raw white of egg, cut in various directions with a clean pair of scissors, shake well in a bottle with 1 pint of water, and strain.

N.B.—Must not be boiled.

The percentage composition of this egg water is rather less than 1 per cent. of proteid.

It is, therefore, a very weak substitute for meat juice or other solutions of proteid.

It may be employed to advantage in combination with cream and milk sugar (see p. 84) for temporary use. The proteid of white of egg is non-stimulative, and is suitable for nervous cases, especially those of meningitis, convulsions, etc.

Raw Meat Juice.

Take 4 oz. prime rump steak, free from fat, and mince finely or pass through sausage machine; mix thoroughly with 1 oz. cold water, place between plates, and allow to stand for half an hour in a cold place, then squeeze through muslin.

N.B.—Must not be boiled.

The percentage composition of meat juice prepared in this way is:—

Proteids	5 per cent.
Fat and sugar	Traces.

For mixtures containing raw meat juice, see p. 83.

Raw meat juice is a valuable substitute for the casein of milk. Owing to its more stimulating properties it can be digested when other proteids cannot. It should not, however, be employed in routine practice if milk is being

properly digested, for, like beef-tea, it contains extractives which stimulate and excite the nervous system; hence to be avoided in the case of nervous, excitable infants.

Peptonised Milk.

To 1 pint of milk, warmed to blood temperature (98° F.), add one teaspoonful of liquor pancreaticus (Benger's) and 10 grs. of bicarbonate of soda, or the contents of one zymine peptonising tube (Fairchild). Place in a glass bottle and stand in a jug of water of the same temperature, *i.e.*, 98° F. Shake the bottle every two or three minutes.

To completely peptonise the process must be continued for about forty-five minutes. At the end of this time the milk should be boiled to prevent it turning too bitter.

The milk should be kept in a stoppered bottle until required for use.

Peptonised, or rather pancreatised, milk is extremely useful in cases in which ordinary modified milk cannot be digested. It must not be used exclusively for any prolonged length of time or scurvy will indubitably follow, and, further, if the infant has all his food digested for him he will not learn to digest for himself. For this reason, if peptonised milk be employed in emergencies, at the earliest possible moment the time of peptonisation should be reduced from forty-five minutes to ten minutes or less, and then discontinued.

For mixtures in which peptonisation is employed, see p. 83.

Whey.

To 1 pint of milk add a junket tablet, one teaspoonful of pepsencia (Fairchild), or about a dessertspoonful of rennet. Warm gently to blood-heat. When the curd has become quite solid beat up with a fork, and keep warm until the curds have shrunk considerably; then

strain off the whey through muslin or other strainer. Use the whey at once, keep on ice.

N.B.—Must not be boiled.

The percentage composition of whey thus prepared is :—

Proteids	·9 per cent.
Fat	·34 ,,
Sugar	5·6 ,,

As a food, therefore, whey is entirely inadequate unless supplemented with other proteids and fats. It may be used temporarily during conditions of fever or diarrhœa, in which a semi-starvation diet has advantages.

Whey, supplemented with meat juice and cream, answers well in cases in which the casein of milk is not well digested.

Sherry Whey.

To ½ pint of milk, while boiling in a saucepan, add one wineglassful of sherry. Strain.

Whey prepared in this way is of much the same percentage as above, only the percentage of proteid is still lower, and a certain proportion of alcohol is present.

Sherry whey is useful for temporary use in cases of diarrhœa, sickness and atrophy in which other forms of nourishment are rejected.

THE PERCENTAGE COMPOSITION OF VARIOUS FOODS AND FOOD PREPARATIONS.

Cow's Milk.

Throughout this book the composition of cow's milk has been assumed to be :—

Proteids	4·0 per cent.
Fat	3·5 ,,
Sugar	4·5 ,,

These figures represent a fair sample of milk such as is usually obtained from dairies where the milk of many different cows are mixed together.

The following tables, however, represent the accurate analyses of various milks obtained from different sources :—

	Kind of Cow.					
	Durham.	Ayrshire.	Holstein.	Jersey.	American Grade.	Common Native.
Proteids	4·17	4·01	3·99	3·99	4·06	4·09
Fat	4·04	3·89	2·88	5·21	4·01	3·69
Sugar	4·34	4·41	4·33	4·52	4·36	4·35
Ash	0·73	0·73	0·74	0·71	0·74	0·73
Water	86·72	86·96	88·06	85·57	86·83	84·14

PERCENTAGE COMPOSITION OF FORE MILK, MIDDLE MILK AND STRIPPINGS.

	Fore Milk.	Middle Milk.	Strippings.
Water	86·66	84·60	82·87
Solids	13·34	15·40	17·13
Fat	3·88	6·74	8·12
Ash	0·85	0·81	0·82

So-called nursery milk is frequently strippings. Since this variety of milk contains 8·12 per cent. of fat, that is to say, twice as much fat as ordinary milk, this fact must be remembered if such milk be employed. Strippings diluted with an equal amount of water constitutes a good mixture for an infant of about six months. Milk sugar should, however, be added to the extent of about two tablespoonfuls to the pint. At best, however, the use of food prepared from strippings is merely guess work as regards the percentage composition, and therefore is not to be commended.

Human Milk.

Throughout this book the composition of human milk has been assumed to be :—

Proteids	1·5 per cent.
Fat	4 ,,
Sugar	6·5 ,,

Human milk, however, differs even more than cow's milk in composition, not only during the different periods of lactation and in different women, but in the same women from day to day in accordance with their diet and mode of living.

ANALYSIS OF HUMAN MILK ACCORDING TO DIFFERENT AUTHORITIES (FROM JUDSON AND GITTING).

	Authority.							
	Pfeiffer.	Leeds.	Johannessen.	Richmond.	Lahmann.	Meigs.	Adrianee.	Schlossmann.
Proteids . .	1·94	1·99	1·10	1·97	1·7	1·05	1·30	1·56
Fat . . .	3·11	4·13	3·21	3·07	3·8	4·28	3·83	4·83
Sugar . .	6·3	6·93	4·67	6·59	6·0	7·4	6·56	6·95
Salts . .	0·19	0·20	...	0·26	0·20	0·10	0·20	...
Water . .	88·22	86·73	...	88·04	88·5	87·16	87·80	...
Solids . .	11·76	13·26	...	11·89	11·70	12·83	12·20	...

Ass's Milk.

The composition of ass's milk is as follows:—

Proteids	1·6
Fat	·9
Sugar	5·6

Except for the important fact that ass's milk contains only ·9 per cent. of fat, it closely resembles human milk in composition (see p. 84).

Goat's Milk.

Proteids	3·5
Fat	3·7
Sugar	4·7

As compared to human milk, goat's milk contains a higher percentage of proteids and a lower percentage of sugar.

A high percentage of proteids and a low one of sugar

is calculated to lead to the development of strong, healthy tissues, very resistant to disease. If, therefore, an infant's digestion can stand the high percentage of proteid which is present in goat's milk, there is much to be said in favour of this variety of milk.

Condensed Milks.

Sweetened.

	Brand of Milk.	
	Milk-maid.	Nestlé's.
Proteids .	8·54	7·90
Fat . .	10·82	10·62
Sugar .	54·02	53·09
Ash . .	2·13	1·84

Unsweetened.

Ideal Brand.	
Proteids .	7·36
Fat . .	10·10
Sugar .	11·03
Ash . .	1·85

These tables are taken from Dr. H. D. Chapin's book on *The Theory and Practice of Infant Feeding.*

An examination of the above tables shows that sweetened condensed milks contain far too large a percentage of sugar to enable them to be used for the feeding of infants with any degree of safety without considerable modification (see p. 83). Unsweetened condensed milk, such as the Ideal Brand, is a much better form for application in infant feeding, and may be employed confidently as a temporary substitute (see p. 83).

Creams.

The percentage compositions of creams differ very materially. Throughout this book it has been assumed that the percentage composition is as follows:—

Proteids	4·0
Fat	16·0
Sugar	4·5

For particulars of this cream, see p. 39.

Condensed Creams.

Dahl's gold medal cream :—

Proteids	.	3·00 approximately.
Fat	.	34·19
Sugar	.	4· per cent. approximately.

This is a good cream to use when fresh cream of standard percentage cannot be obtained.

Lahmann's Vegetable Milk.

The percentage composition of this condensed milk is as follows :—

Proteids	12·
Fat	34·72
Sugar	31·02

The value of this preparation is shown in cases in which animal fats are not well tolerated and cause symptoms of indigestion. This vegetable milk is prepared from nuts, almonds, etc., and contains, as above shown, a large percentage of fat and proteids. It may be used either in combination with milk or alone (see p. 85).

The smell and appearance of this milk are not inviting, but infants like it and thrive well on it. It is a preparation but little used in this country. I think it deserves a trial in difficult cases of malnutrition. There is no valid objection to the use of vegetable fats in place of animal fats. This milk may be obtained from the Lahmann Agency, 15 Fore Street, London, E.C.

Virol.

Virol is another preparation which contains a good percentage of fat, and should be employed in cases of malnutrition in which cream disagrees (see p. 85).

The percentage composition is as follows :—

Proteids and other nitrogenous matter	4·08 per cent.
Fats	12 ,,
Carbohydrates	59·30 ,,

The percentage of sugar or carbohydrates is high in relationship to the fats; but by using virol we may sometimes enable infants to absorb small quantities of fat when they are unable to assimilate it in any other form.

Patent Foods.

	Robinson's Patent Barley.	Ridge's Food.	Mellin's Food.	Savory & Moore's Food.	Nestlé's Food.	Horlick's Malted Milk.
Albuminoids .	5·13	9·24	10·07	9·63	11·00	15·83
Fats . .	0·97	0·63	0·18	0·40	4·25	5·30
Starch . .	77·76	77·96	—	36·36	36·86	5·57
Soluble Carbohydrates .	4·11	5·19	68·18	44·83	40·91	66·99
Ash . . .	1·93	0·60	3·75	0·89	1·70	3·13
Gum, Cellulose, etc. . .	1·33	—	5·45	0·44	0·28	—
Water . .	10·10	9·23	12·37	8·34	5·00	2·18

Taken from Dr. Thomson's book on the *Examination of Sick Children.*

Proprietary and patent foods are most undesirable preparations to use in infant feeding, unless they are used with the greatest caution and with a full knowledge of their percentage composition. They may be employed temporarily or as a substitute for milk sugar; indeed, the food value of many of them is little superior to milk sugar.

Gavage or Feeding by the Stomach Tube.

This method of forced feeding is useful in the following cases:—

1. When infants are unable to swallow from mechanical causes, such as exist in cleft palate, or in nervous cases, such as in paralysis, etc.
2. In cases of disturbed nervous co-ordination of the gastric movements, as in persistent nervous vomiting.

3. In all cases in which the infant refuses to swallow, and it is necessary to administer food by way of the mouth.

Method.—The necessary apparatus consists of a soft india-rubber catheter (No. 8 to No. 14), not less than 14 inches long; two feet of india-rubber tubing of the same size as the catheter; a short length of glass tubing (about 3 inches), to join the india-rubber tube and catheter together, and act as an "*inspection chamber*"; and a glass funnel fitted into the free end of the tube. A small metal spring clamp must be attached to the tubing to control the flow of fluid.

The infant should be held in a sitting posture on the lap of the nurse, with a shawl tightly wrapped round him to prevent any movements interfering with the operation. The operator stands in front, with the apparatus in his hands, and a glass measure containing the liquid to be poured into the infant's stomach ready at hand. He then pours some of the liquid into the funnel, and fills the tube and catheter by releasing the clamp; the clamp is then closed, and the catheter moistened on the outside with water or oil. The nurse then gently opens the baby's mouth, and depresses the tongue with her finger, while the operator passes the catheter rapidly and boldly to the back of the throat, whence it is carried into the stomach by the automatic contractions of the œsophagus. About 10 inches of catheter, as measured from the lips, should pass into the stomach. As soon as the catheter has reached the stomach, the clamp should be released and the fluid allowed to flow out of the funnel. The funnel should not be allowed to empty itself completely, but the clamp should again be applied while some of the fluid still remains in it. The catheter may then be withdrawn.

The Food.—The temperature, quantity and character of the food must be determined by general consideration.

The stomach may be washed out and food given at one and the same operation. It is also important to remember

that medicines can be conveniently administered by the same method.

Nasal Feeding

has been employed in cases of spasmodic contraction of the pylorus, and in cases of diseases of the throat in which the tube cannot well be passed through the mouth. The method is not so applicable in the case of infants as in that of older children.

The Method is practically the same as that described under gavage, only the tube must be sufficiently small to pass readily through the nostril, and great care must be exercised not to lacerate the mucous membrane of the nose.

Feeding by the Bowel.

This method of feeding is chiefly employed when, owing to constant vomiting, or gastric troubles, the infant is rapidly losing weight. It is seldom of use when bowel trouble complicates the condition.

Method.—If fluid injections are to be employed, a small soft, flexible female catheter answers the purpose well. It should be tied on to the nozzle of a small glass syringe holding about 1 oz.

The infant should be placed on the nurse's lap, on a bath towel or rubber sheet, and the nurse should hold the feet by the ankles in one hand, and flex them over the left shoulder, so as thoroughly to expose the buttocks; the other hand should be left free to assist the operator by holding in the catheter if necessary. The syringe and catheter should be completely filled with the fluid to be injected. The end of the catheter must be well lubricated with vaseline, and gently inserted through the anus. When the catheter has been inserted as far as it will go without force—generally about 2 inches—a small quantity of fluid must be injected, and the tube pushed on as the

injection flows out and opens up a way. In this way, without any force, it may be possible to insert 5 or 6 inches of the catheter. It is important to inject the fluid above the sigmoid flexure and not merely into the rectum, where it is not well retained, nor well absorbed. If the fluid passes above the sigmoid it is well tolerated in the colon, and generally well absorbed.

The amount of fluid which can safely be injected in the case of an infant is small, as a rule not more than one-half to two ounces.

The injection should be prepared of the following ingredients :—

Milk two ounces.
The yolk of one egg.
One teaspoonful of Benger's food.
Ten grains of carbonate of soda.
Ten grains of table salt.
Ten drops of Benger's liquor pancreaticus.
Ten drops of brandy.

The injection should be raised to a temperature or 98° F. before use.

If the bowel is sensitive and the injection returned, it may be desirable to add a small quantity of tincture of opium to the enema. This must, however, be done with caution, not more than one drop being given to an infant of six months, and proportionally smaller quantities for younger infants.

It is not now regarded as necessary to predigest the food before injection, indeed the pancreatic fluid itself is not absolutely essential; the addition of salt is, however, important, and must not be omitted.

The bowel should be washed out with sterilised water of a temperature of 98° about one hour before the nutrient enema is given : the quantity of water should be about three ounces or more. In performing this operation it is better to employ a glass funnel than a syringe.

The intervals between the injections of the nutrient enemata should be at least four hours.

Nutrient suppositories are sometimes used instead of fluid injections; they are much simpler to employ, but their value is correspondingly smaller. I do not recommend them for infants.

Subcutaneous Feeding.

When all other means of feeding fail, subcutaneous feeding may be a very valuable resource. For some reason or other there is an unjustifiable prejudice against this method. I have frequently employed it myself in the case of quite young infants, and I have never seen any bad effects. It is of course necessary to exercise the greatest care in seeing that the hypodermic syringe is properly sterilised, and that the fluids used are similarly sterilised. For infants the ordinary clinical hypodermic syringe answers perfectly well, and the fluid should be injected into a loose fold of skin in the axilla, the front of the thigh, or in the flank. The quantity of fluid injected should not be more than about one drachm, except in the case of plain sterilised water or normal saline solution, when as much as an ounce or more may be injected by means of a larger syringe.

The foods to be injected may consist of any of the following, either alone or in combination :—

Benger's peptone jelly.
Cod-liver oil.
Melted butter.
Solution of milk sugar.

In the case of adults considerable quantities of food have been introduced into the system by the method of hypodermic injection, and it is possible that much larger quantities than those stated above may be found to be safe in the case of infants; but if the quantities be increased beyond those stated above, it would be advisable to make the increases gradually and with caution.

In the case of adults the following foods have been employed, and there is no logical reason why they should not answer equally well in the case of infants :—

Cow's milk, syrup, yolk of egg, defibrinated blood, blood serum and olive oil.

The Inunction of Fats.

A small quantity of fat can be introduced into the system by inunction. It is therefore sometimes of advantage, when food cannot be introduced by the natural passages, to rub the body well with olive oil, cod-liver oil or melted butter.

The Feeding of Premature Infants.

The feeding of premature infants requires skill and experience. A good account of the artificial feeding with modified milk is to be found in Rotch's *Pediatrics*.

Breast feeding should not be attempted by the mother if the infant is more than six weeks short of full time. A wet nurse whose own baby is about one month old may be tried, or her milk may be drawn off with a breast pump, diluted if thought desirable, and given to the infant by means of a glass syringe provided with an india-rubber nipple.

The amount of food to be given to the premature infant cannot be stated precisely. It is always necessary to commence with very small quantities, and gradually to increase the amount as the capacity of the stomach and the digestive functions permit.

The following prescriptions, which are taken from Rotch's *Pediatrics*, may serve as a guide for the quantities and percentage composition to be tried in the case of premature infants of different stages of development.

I. For infant born at the twenty-eighth week.

To be fed every hour, with one teaspoonful of food of following percentage composition :—

Fat	1 per cent.
Sugar	3 ,,
Proteid	·5 ,,

Directions for preparing modified milk of this percentage composition.

Whey (see page 185) . .	4 drachms
Cream (16 per cent.) . .	20 drops

Water to make one ounce.

It is, in my opinion, open to question whether it is not better to start an infant of this age on a prepared food, such as the Allenbury No. 1. A suitable mixture may be prepared by mixing half a teaspoonful with one ounce of water. If this agrees, cream may be added very gradually, commencing with five drops to the ounce and increasing the amount by one drop daily.

II. If the infant is born at the twenty-ninth week, he should be fed every hour, and the quantity for one feeding should be two teaspoonfuls.

The percentage composition should be :—

Fat	1·5 per cent.
Sugar	4·0 ,,
Proteids	·5 ,,

To prepare modified milk of this percentage composition take—

Whey	4 drachms
Cream (16 per cent.) . .	30 drops
Sugar	8 grains

Water to one ounce.

If to begin with Allenbury food No. 1 is preferred, three-quarters of a teaspoonful (40 grains) to the ounce of water should be employed, and cream gradually added as above described.

III. If the infant is born at the thirty-second week, he should be fed every hour, and the quantity at each feeding should be three teaspoonfuls.

The percentage composition should be as follows :—

Fat	1·5 per cent.
Sugar	5 ,,
Proteid	·75 ,,

To prepare modified milk of this percentage take—

Whey	7 drachms
Cream (16 per cent.) . .	40 drops

Water to one ounce.

Or again, if Allenbury food is employed, one teaspoonful of the food must be added to each ounce of water, and cream gradually added as described above.

IV. If the infant is born at the thirty-sixth week, or later, he should be fed every hour, and the amount of each feeding should be half an ounce.

The percentage composition of the modified milk should be—

Fat	2 per cent.
Sugar	5·5 „
Proteid	1 „

To prepare one ounce of this mixture take—

Milk	1½ teaspoonfuls
Cream (16 per cent.) . .	1 teaspoonful
Sugar	24 grains

Water to one ounce.

Or to prepare a corresponding mixture with Allenbury food, take one teaspoonful of Allenbury food No. 1, and twenty-five drops of cream, and add water to make one ounce.

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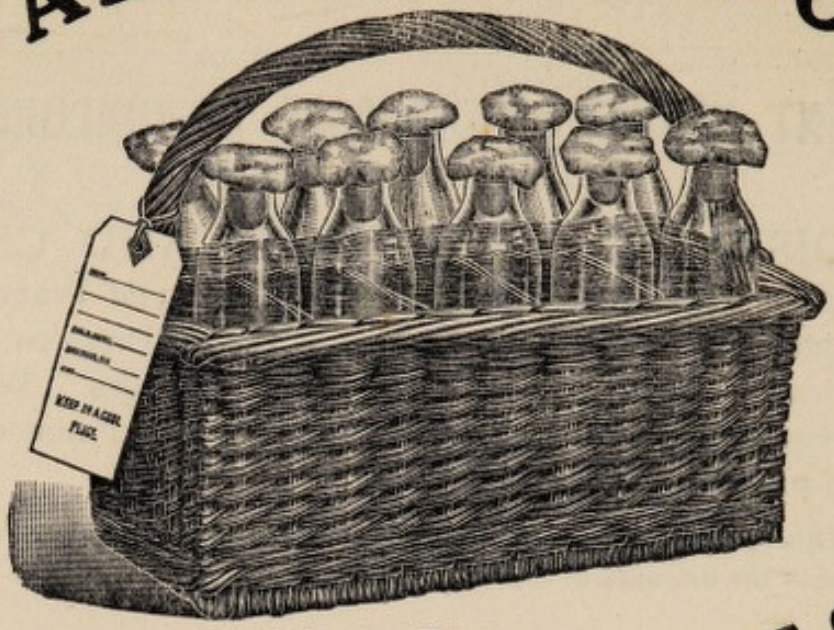

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