THE DISEASES OF INFANCY AND CHILDHOOD

FOR THE USE OF STUDENTS
AND PRACTITIONERS OF MEDICINE

BY

L. EMMETT HOLT, A. M., M. D.

PROFESSOR OF DISEASES OF CHILDREN IN THE NEW YORK POLYCLINIC; ATTENDING PHYSICIAN TO THE NURSERY AND CHILD'S AND THE BABIES' HOSPITALS, NEW YORK; CONSULTING PHYSICIAN TO THE NEW YORK INFANT ASYLUM, AND TO THE HOSPITAL FOR THE RUPTURED AND CRIPPLED

WITH TWO HUNDRED AND FOUR ILLUSTRATIONS
INCLUDING SEVEN COLOURED PLATES

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TO

VIRGIL P. GIBNEY, M. D.,

CLINICAL PROFESSOR OF ORTHOPÆDIC SURGERY IN THE COLLEGE OF PHYSICIANS AND SURGEONS (COLUMBIA UNIVERSITY), NEW YORK; SURGEON-IN-CHIEF TO THE HOSPITAL FOR THE RUPTURED AND CRIPPLED,

THIS VOLUME IS INSCRIBED

AS A TRIBUTE TO HIS PERSONAL WORTH AND HIGH PROFESSIONAL ATTAINMENTS,

AND IN GRATEFUL REMEMBRANCE OF MANY ACTS OF KINDNESS,

BY THE AUTHOR.

PREFACE.

THE rapid advance made during the past few years in this department of medicine is a sufficient justification, if one were needed, for another general work on the Diseases of Infancy and Childhood. It is not claimed that the present work is a complete one, for completeness in so broad a subject in a single volume is impossible. However, by omitting much material which does not strictly pertain to children, I have endeavoured to give a somewhat full discussion of matters which are peculiar to early life, the space allotted to each subject being in some degree commensurate with its practical importance to the physician and student. I have intentionally avoided entering into a discussion of many questions which belong to general medicine and which are fully treated in works upon that subject.

The pathology and symptomatology of disease in children who have passed their seventh or eighth year, really differ little from those of adolescents and young adults. It is in infancy and early childhood only that the peculiar conditions exist which separate pædiatrics from general medicine and entitle it to be ranked as a special department. These pages therefore are chiefly devoted to a consideration of the subjects of the nutrition and the diseases of infants and young children.

The discussion of questions relating to operative surgery has been purposely omitted. What is said regarding surgical diseases has been from the standpoint of the physician, not that of the surgeon, and relates chiefly to symptoms and early diagnosis.

Rather more space than is usual in a clinical work has been given to pathology and the description of lesions, my reasons for this being, first, that most of the processes which are peculiar to very early life have received but scant attention in works on pathology; secondly, such knowledge is absolutely indispensable to the correct understanding of these diseases clinically; and, thirdly, because I have been fortunate in having rather exceptional opportunities for post-mortem study in connection with my clinical work. It is hoped that the drawings and photographs of pathological conditions which have been inserted will render this part of the work of interest to the general practitioner, and be of some assistance and value to those whose opportunities for the study of disease in

children are limited to the bedside. These illustrations have been selected with reference to their bearing on the symptomatology of disease and for the benefit of the practitioner, not the pathologist. In this as in all parts of the book I have tried to keep constantly in mind the every-day needs of the physician who practises among children and of the student who expects to do so.

The material has been gathered from eleven years' continuous hospital service among young children, and much of the statistical matter which has been introduced, relates to cases which have been under my own observation.

While as a whole the book is very largely a record of personal experience, I must express my great indebtedness to the rapidly increasing number of active workers in pædiatrics both in America and in Europe.

The arrangement of the book differs somewhat from that of other works on the subject. The space given to nutrition, to its derangements, and to the diseases resulting therefrom, is, I think, not out of proportion to their importance. There can be little question regarding the propriety of placing rickets and scurvy in this class. It is hoped that the plan of grouping in a single chapter the various therapeutic measures useful in early life may aid the reader who wishes to consult the book on these points. In the parts relating to treatment, great, but I think not undue, stress has been laid upon diet and hygienic measures, since in them rather than in drug-giving lies the secret of success, certainly in all disorders of digestion and nutrition.

The illustrations are for the greater part original, being either from photographs or drawings of my own cases. Most of the drawings are by Dr. Henry Macdonald. For all borrowed illustrations credit has been given. For some of the latter I wish to thank Messrs. William Wood & Co. and the J. B. Lippincott Company, who have allowed the use of cuts from their publications.

I wish to express my obligations to Prof. James W. McLane, who kindly placed at my disposal the valuable records of the Sloane Maternity Hospital, from which the statistics relating to the newly-born child have been largely drawn.

I am also deeply indebted to Drs. Charles G. Kerley and Martha Wollstein for the tabulation of cases from hospital records and for other valuable assistance; to Dr. Thomas S. Southworth for suggestions in the chapter on Diseases of the Blood and for the preparation of the index; to my brother, Dr. N. Curtice Holt, for the revision of the proof sheets of the entire book; and, finally, to my publishers for their uniform courtesy and hearty co-operation at every stage of the work.

L. Emmett Holt.

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THE DISEASES OF INFANCY AND CHILDHOOD.

PART I.

CHAPTER I.

HYGIENE AND GENERAL CARE OF INFANTS AND YOUNG CHILDREN.

The physical development of the child is essentially the product of the three factors—inheritance, surroundings, and food. The first of these it is beyond the physician's power to alter; the second is largely and the third almost entirely within his control, at least in the more intelligent classes of society. These two subjects, infant hygiene and infant feeding, are the most important departments of pediatrics.

The Care of the Newly-Born Child.—After the ligature of the cord the child should be wrapped in a thick blanket and placed in a warm room. In hospital practice the eyes should be cleansed with absorbent cotton and water which has been boiled, and then two or three drops of a two-per-cent solution of nitrate of silver, after Credé's method, instilled into each eye by means of a glass rod or eye-dropper. In private practice a saturated solution of boric acid may be substituted, unless the mother has had a purulent vaginal discharge, in which case the silver solution should always be used. The bath should now be given in a warm room; the body being first oiled thoroughly in order to remove the vernix caseosa and then washed in water at a temperature of 100° F. The mouth should be cleansed with plain tepid water and a soft cloth, and no violence employed. The cord may be covered with salicylic acid one part and starch nineteen parts, or simply with subnitrate of bismuth, and wrapped in absorbent cotton or surgeon's lint. The abdomen should now be enveloped in a flannel band, eight or ten inches wide, and pinned rather snugly. Before dressing is completed, the child should be submitted to a thorough examination for injuries received during delivery, congenital deformities, also as to the condition of the respiration, circulation, etc.

After dressing, the child should be placed in its crib and covered with blankets, and if the feet are cold, or the fingers and lips a little blue, it

should be surrounded by hot-water bottles covered with flannels, and placed near, but not in contact with, the body. The crib should be placed in a quiet, darkened room. The young infant should not occupy the same bed as the mother, unless it greatly needs the warmth of her body, other means of artificial heat not being at hand.

The cord should be kept dry and disturbed as little as possible until it falls off. Under ordinary circumstances the cord separates from the fourth to the seventh day, the average being the fifth day. The stump should then be covered with the salicylic acid and starch powder, and a pad of muslin about one fourth of an inch thick and two inches square applied and secured in position by means of the abdominal band. The purpose of this is to prevent umbilical hernia. The pad should be continued for the first month. The use of stronger antiseptic dressings than that recommended is somewhat objectionable, since it preserves the cord too long and delays separation. The full bath should not be given until the cord has separated.

The physician should always see to it that the infant cries enough to keep the lungs properly expanded.

The question of food for the newly-born infant is considered in the chapter upon infant feeding.

Bathing.—For the first few months the bath should be given at 98° F. The room should be warm, preferably there should be an open fire. The bath should be short and the body dried quickly, without too vigorous rubbing. The addition of salt to the bath is an advantage where the skin is unusually delicate or excoriations are present. One large handful should be used to a gallon of water. By the sixth month the temperature of the bath for healthy infants may be lowered to 95° F., and by the end of the first year to 90° F. Older children who are healthy should be sponged or douched for a moment at the close of the tepid bath with water at 65° or 70° F. During childhood the warm bath is preferably given at night. In the morning a cold sponge bath is desirable. This should be given in a warm room and while the child stands in a tub partly filled with warm water. This cold sponge should last but half a minute, and be followed by a brisk rubbing of the entire body.

In some young infants and even older children there is no proper reaction after the bath, even when given at the temperatures mentioned; children being pale, slightly blue about the lips and under the eyes. All tub bathing, and especially all cold bathing, should then be stopped, since a continuance can only be a drain upon the child's vitality.

Clothing.—The clothing of infants should be light, warm, non-irritating to the skin, and loose enough to allow free motion of the extremities; nor should bands be pinned so tightly about the trunk as to embarrass the movements either of the chest or of the abdomen. The chest should be covered with a woollen shirt, high in the neck and with long

sleeves. All petticoats should be supported from the shoulders and not from waistbands. Canton flannel and stockinet are both superior as absorbents to the more commonly used linen diapers. Stockinet has the advantage of being very soft and pliable. Care should be given that in infants the feet be kept warm. If the circulation is very poor, a bag of hot water should always be in the crib. Cold feet are responsible for many attacks of colic and indigestion.

The abdominal band is usually worn during infancy. It cannot be considered in any sense a necessity after the first few months, excepting in cases of very thin infants whose supply of fat in the abdominal walls is an insufficient protection to the viscera. For the first few weeks a band of plain flannel is to be preferred; later, a knitted band with shoulder-straps. The fashion of low neck and short sleeves for infants and very young children has fortunately passed away—let us hope, never to return.

During the summer the outer clothing should be light and the under clothing of the thinnest flannel or gauze. The changes in the temperature of morning and evening may be met by extra wraps. The custom of allowing young children to go with legs bare has many enthusiastic advocates; while it may not be objectionable during the heat of summer, its advantages at any season are very questionable in a changeable climate like that of New York or the Atlantic coast. Many delicate children are certainly injured by such ill-advised attempts at hardening.

The night clothing of infants should be similar to that worn during the day, but should be loose, the material being of the lightest flannel. The night clothing for older children should consist of a thin woollen shirt and a union suit with waist and trousers, and in some cases with feet, if there is a tendency to get outside the coverings. The common mistake is to overload all children, but especially infants, with covering at night. This is an explanation of much of the restless sleep which is seen particularly in delicate children.

Care of the Eyes.—During the first few days at the daily bath, the eyes should be cleansed with a saturated solution of boric acid. They should be carefully protected from too strong light during early infancy. It is desirable that a child should always sleep in a darkened room.

Care of the Mouth and Teeth.—The mouth of the newly-born infant should be gently cleansed at each morning bath with boiled water and a soft cloth. On the first appearance of thrush the mouth should be washed after every feeding with a solution of bicarbonate of soda or borax (twenty grains to the ounce). Harm is often done by the use of too much force in cleansing the mouth of a young infant.

The primary teeth as well as those of the permanent set should receive daily attention. Too often they are neglected altogether. Dirty teeth are likely sooner or later to become carious; and carious teeth, besides being a cause of bad breath and neuralgia, are a constant menace to the

health of the child, since they may harbour infectious germs of all varieties. Such teeth should either be filled or removed.

Care of the Skin.—The skin of a young infant is exceedingly delicate, and excoriations, intertrigo, and eczema are of very common occurrence. These conditions are much easier of prevention than of cure. The first essential in the care of the skin is cleanliness, and this must be secured without the use of strong soaps or too much rubbing. Napkins must be removed as soon as soiled or wet. Some bland absorbent powder, like starch, talcum, or the stearate of zinc, should be used in all the folds of the skin, in the neck, in the axillæ, groins, and about the genitals, and in the folds of the thighs, particularly in very fat infants. If plain water produces an undue amount of irritation, the salt or bran bath should be employed.

Care of the Genital Organs.—The female genitals need but little attention in young children, excepting as to cleanliness. This is more often neglected in older children than in infants. Vulvo-vaginitis is very common among the children of the poorer classes where cleanliness is neglected.

In males the prepuce should receive attention during the first few weeks of life. If the foreskin is long and the preputial orifice small, circumcision should invariably be done. If it is not long, but is only adherent, these adhesions should be broken up, the parts thoroughly cleansed and the foreskin retracted daily until there is no disposition to a recurrence of the adhesions. These operations will be discussed more at length in a subsequent chapter. The only thing to be emphasised in the present connection is that the prepuce should receive proper attention in early infancy, since this can now be done with less pain and discomfort to the child, and at the same time better results are obtained. If this matter is neglected during infancy, it is apt to be overlooked until harm has been produced by local or reflex irritation which phimosis or adherent prepuce may have excited.

Vaccination.—This, although considered elsewhere, should be mentioned in this connection as among the things requiring the physician's attention during the first months of life.

Training to Proper Control of Rectum and Bladder.—It is surprising to see what can be accomplished by intelligent efforts at training in these particulars. An infant can often be trained at three months to have its movements from the bowels when placed upon a small chamber. This not only saves a great amount of washing of napkins, but there is soon formed a habit of having the bowels move at a regular time or times each day. The infant must be put upon the chamber soon after its feeding. The importance of training young children to regular habits regarding evacuations from the bowels can hardly be overestimated. It should be impressed upon every mother and nurse by the physician, and

especially the necessity of beginning training during infancy. Much of course will depend upon the food and the digestion; but habit is a very large factor in the case.

The training of the bladder is not quite so important, but the proper education of this organ adds much to the comfort of the child and the ease with which it is cared for. Before the end of the first year most intelligent children can be trained to indicate a desire to empty the bladder. Many mothers and nurses succeed in training children so well that by the tenth or eleventh month napkins are dispensed with during the day. On the other hand, it is very common to see children of two and even two and a half years still wearing napkins because of the lack of proper training. Before it has reached the latter age a healthy child should go from 10 P. M. until morning without emptying the bladder. The annoyance and discomfort from the neglect of early training in this particular are very great. Night feeding is responsible for much of the difficulty experienced in training children to hold the water during the night.

General Hygiene of the Nervous System.—Great injury is done to the nervous system of children by the influences with which they are surrounded during infancy, especially during the first year. The brain grows more during the first two years than in all the rest of life. Normal healthy development of the nervous centres demands quiet, rest, peaceful surroundings, and freedom from everything which causes excitement or undue stimulation.

The steadily increasing frequency of functional nervous diseases among young children is one of the most powerful arguments for greater attention by physicians to the subject of the hygiene of the nervous system during infancy. Most parents err through ignorance. Playing with young children, stimulating to laughter and exciting them by sights, sounds, or movements until they shriek with apparent delight, may be a source of amusement to fond parents and admiring spectators, but it is almost invariably an injury to the child. This is especially harmful when done in the evening. It is the plain duty of the physician to enlighten parents upon this point, and insist that the infant shall be kept quiet, and that all such playing and romping as has been referred to shall, during the first year at least, be absolutely prohibited.

Sleep.—The sleep of the newly-born infant is profound for the first two or three days and under normal conditions almost continuous. In the case of prolonged or tedious labor, or where from any cause undue compression has been exerted upon the head, it may approach the condition of semi-coma for twenty-four or forty-eight hours. This may be so deep as to excite apprehensions of serious brain lesions. If, however, there are associated with it no convulsions and no rigidity, this early stupor usually passes away on the second or third day.

The sleep of early infancy is quiet and peaceful, but not very deep after

the first month. After the third year the heavy sleep of childhood is commonly seen. A healthy infant during the first few weeks sleeps from twenty to twenty-two hours out of the twenty-four, waking only from hunger, discomfort, or pain. During the first six months a healthy infant will usually sleep from sixteen to eighteen hours a day, the waking periods being only from half an hour to two hours long. At the age of one year most infants sleep from fourteen to fifteen hours, viz., from eleven to twelve hours at night, and two or three hours during the day, usually in two naps. When two years old usually thirteen to fourteen hours' sleep are taken; eleven or twelve hours at night and one or two hours during the day, generally in a single nap. At the age of four years children require from eleven to twelve hours' sleep. It is always desirable, and in most cases with regularity it is possible, to keep up the daily nap until children are four years old. From six to ten years the amount of sleep required is ten or eleven hours, and from ten to sixteen years nine hours should be the minimum.

Training in proper habits of sleep should be begun at birth. From the outset an infant should be accustomed to being put into its crib while awake and to go to sleep of its own accord. Rocking and all other habits of this sort are useless and may even be harmful. An infant should not be allowed to sleep on the breast of the nurse, nor with the nipple of the bottle in its mouth. Other devices for putting infants to sleep, such as allowing the child to suck a rubber nipple or anything else, are positively injurious. If such means of inducing sleep are resorted to the infant soon acquires the habit of not sleeping without them. I have known of one instance where the habit of rocking during sleep was continued until the child was two years old; the moment the rocking was stopped the infant would wake, and in consequence this practice was continued by the devoted but misguided parents. A quiet, darkened room, a warm and comfortable bed, an appetite satisfied, and dry napkins are all that are needed to induce sleep in a healthy child.

The periods of sleep in young infants are usually from two to three hours long, with the exception of once or twice in the twenty-four hours, when a long sleep of five or six hours occurs. The purpose of training is to have the child take this long sleep at night. The habit of regular sleep is best established by wakening the infant regularly every two or two and a half hours during the day for feeding, and allowing it to sleep as long as possible during the night. This training goes hand-in-hand with regular habits of feeding. Such habits are easily formed if the plan be systematically followed from the outset.

By the fifth month all feeding between 10 P. M. and 7 A. M. should be discontinued. If this is done most infants can be trained by this time to sleep all night. If the room is lighted, and the child taken from the crib or rocked or fed as soon as it wakens at night, there is no such thing as

the formation of good habits of sleep. Regularity in sleep and feeding not only make the care of young infants very much easier, but they are of a good deal of importance for the health of the child.

The causes of disturbed or irregular sleep in young infants are mainly two—hunger and indigestion. In nursing infants it is usually the former; in those artificially fed usually the latter. Sleeplessness from hunger is often seen in children who are nursed thirty or forty minutes and then fall asleep, but wake in fifteen or twenty minutes crying and fretful. After being quieted they may fall asleep again for half an hour, but wake at short intervals. The peaceful sleep of two or three hours which should follow a proper feeding is never seen. With this restlessness other signs of indigestion are usually present, such as bad stools, stationary weight, etc. The disturbed sleep due to overfeeding shows itself by much the same symptoms, excepting that the first sleep after the meal is usually longer.

Exercise.—This is no less important in infancy than in later childhood. An infant gets its exercise in the lusty cry which follows the cool sponge of the bath, in kicking its legs about, waving its arms, etc. By these means pulmonary expansion and muscular development are increased and the general nutrition promoted. An infant's clothing should be such as not to interfere with its exercise. Confinement of the legs should not be permitted. In hospital practice I have often had a chance to observe the bad results which follow when very young infants are allowed to lie in the cribs nearly all the time. Little by little the vital processes flag, the cry becomes feeble, the weight is first stationary, then there is a steady loss. The appetite fails so that food is at first taken without relish, then at times altogether refused; later, vomiting ensues and other symptoms of indigestion. This, in many cases, is the beginning of a steady downward course which goes on until a condition of hopeless marasmus is reached. Such infants must be taken up every few hours and carried about the wards; the position should be frequently changed, and general friction of the entire body employed at least twice a day. Every means must be made use of to stimulate the vital activity. The value of systematic attention to these matters cannot be overestimated in hospitals for infants. Infants who are old enough to creep or stand usually take sufficient exercise unless they are restrained. At this age they should be allowed to do what they are eager to do. Every facility should be afforded for using their muscles. Exercise may be encouraged by placing upon the floor in a warm room a mattress or a thick "comfortable," and allowing the infant to roll and tumble upon it at will. A large bed may answer the same purpose.

In older children every form of out-of-door exercise should be encouraged—ball, tennis, and all running games, horseback riding, the bicycle, tricycle, swimming, coasting, and skating. Up to the eleventh year no

difference need be made in the exercise of the two sexes. Companionship is a necessity. Children brought up alone are at a great disadvantage in this respect, and are not likely to get as much exercise as they require. The amount of exercise allowed delicate children should be regulated with some degree of care. It may be carried to the point of moderate muscular fatigue, but never to muscular exhaustion. The latter is particularly likely to be the case in competitive games.

Exercise should have reference to the symmetrical development of the whole body. In prescribing it the specific needs of the individual child should be considered. By carefully regulated exercises very much may be done to check such deformities as round shoulders and slight lateral curvature of the spine, and also to develop narrow chests and feeble thoracic muscles. For purposes like these, gymnastics are exceedingly valuable to supplement out-of-door exercise, but they can never take their place.

There are two important points with reference to exercise indoors: First, the playroom should be cool—from 60° to 65° F.; never above this point. Secondly, during all active exercise the clothing should be loose and light, so as to allow the freest possible motion of the body.

Airing.—In summer there can be no possible objection to a young infant being allowed out of doors at the end of the first week. It should be kept in the open air as much as possible during the day. In the fall and spring this should not be permitted until the child is at least a month old, and then only when the out-of-door temperature is above 60° F. During its outing the head should be protected from the wind and the eyes from the sun. The duration of the outing at first should be only fifteen or twenty minutes, the time being gradually lengthened to two or three hours. The child should be gradually accustomed to changes of temperature in the room by opening wide the windows for a few minutes each day even before it is taken out of doors, the child being dressed meanwhile as for an outing. In the case of children born late in the fall or in the winter this means of giving fresh air may be advantageously begun at one month and followed throughout the first winter. It is only necessary in all such cases that the changes be made very gradually both as to the length of the airing and to the temperature. The great advantage of this plan over that more commonly followed of keeping young infants closely housed for the first six months in case they are born in the fall or early winter, I can positively affirm from quite a wide observation of both methods. It is a matter of very serious importance that every infant be furnished an abundance of pure fresh air in winter as well as in summer. When the plan above outlined is carefully and judiciously followed, the tendency to catarrhal affections instead of being increased is thereby greatly lessened.

When four or five months old, there is no reason why a healthy child should not go out of doors on pleasant days if the temperature is not

below 20° F. While there is a prejudice on the part of many mothers and some physicians against a child's sleeping out of doors in cold weather, it is a practice which I have always urged upon mothers, and have never seen followed by any but the most beneficial results. The days of all others when infants and very young children should not be out of doors are when there are high winds, especially those from the northeast, an atmosphere of melting snow, and during severe storms. Delicate infants must of course be more carefully guarded during the cold season. With most of these the plan of house-airing is all that should be attempted.

Nursery.—This should be the sunniest and best-ventilated room in the house. It is the physician's duty to see that proper attention is paid to the hygiene of the room in which the child spends at least four fifths of its time during the first year, and two thirds of its time during the first two or three years of life. Sunlight is absolutely indispensable. Sunny rooms always contain less organic matter and less humidity, and hence a room upon the north side of the house should always be avoided, preferably one in the second story should be chosen. Nothing which can in any way contaminate the air of the room should be allowed. There should be no drying of clothes or of napkins, and no plumbing. No food should be allowed to stand about the room. The gas should not be allowed to burn at night; a small wax night-light furnishes all that is needed in the nursery. If possible the heat should be from an open fire; the next best thing is the Franklin radiator. Nothing in the room is worse than steam heat from a radiator unless it be a gas stove which under no circumstances should be allowed, excepting possibly for a few minutes each morning during the bath.

The temperature of the room during the day should be 70° F., but better 68° than 72° F. It is important that every nursery should have a thermometer, and that this and not the sensations of the nurse should be the guide. It is almost invariably true that the nursery is overheated. Often no other explanation can be found for chronic indigestion and failing weight excepting a nursery whose habitual temperature ranges from 75° to 80° F. At night for the first few months the temperature should not be allowed to fall below 65° F. After the first year the night temperature may fall to 60° or even 55° F.

Free ventilation without draughts is an absolute necessity. This is best accomplished by ventilators in the windows, of which there are many excellent devices sold in the shops. While the child is absent from the room the windows should be widely opened and free airing of the nursery accomplished. The room should always be thoroughly aired at night before the child is put to bed. The window may be kept open even in the first year, unless the temperature out of doors is below 40° F. After the first year the window may be open, unless the outside temperature is as low as

20° F. If the window is open the door of the nursery should be closed, that currents of air may be avoided. The ventilation by means of an open fire is the most efficient.

The furniture of the nursery should be as simple as possible, heavy hangings should be positively forbidden, and upholstered furniture used only to a small extent. Floors covered by large rugs are much more cleanly than carpets, and hence are to be preferred.

The child, whenever it is possible, should have a separate bed; and so should the newly-born infant, in order to prevent the danger of overlying by the mother, which among the lower classes is a frequent cause of death, and also to avoid the danger of too frequent night nursing, which is injurious alike to mother and child. Separate beds for older children will prevent the spread of many forms of infection from the diseased child to the healthy. The cradle for infants should be one which does not rock, in order that this unnecessary and vicious practice should not be carried on. The mattress should be of hair and quite firm. The pillow should be small; in the summer, hair pillows are an advantage but not a necessity. The position of the child during sleep should be changed from time to time from one side to the other and then to the back. Attention to all these details should not be beneath the physician's notice, since the violation of these plain rules of hygiene is at the bottom of many of the milder disorders and even of some of the more serious diseases seen in infancy.

The Nurse.—The nurse of a young child should be healthy, young or in middle life, free from tuberculous or syphilitic taint, and from catarrhal affections of the nose and throat. She should be neat in habit, of quiet disposition, and, most of all, she should be a person of intelligence.

The Amount of Air Space required by Infants.—The nursery should always be as large a room as possible. One of the reasons why young infants do so badly in institutions is because of overcrowding. In a well-ventilated ward there should be allowed to each infant at least 1,000 cubic feet for the best results. Children over two years old are not so sensitive to their surroundings, and may thrive in wards where only 700 or 800 cubic feet are allowed to each child.

THE CARE OF PREMATURE AND DELICATE INFANTS.

Infants born before term, and some exceedingly delicate ones which are born at full term, require very special and particular care. The vitality is so feeble in these children that if they are handled in the ordinary way they survive at most but a few weeks. The symptom which indicates that such special care is necessary is most of all the weight of the child. Either congenital feebleness or prematurity may be assumed in most of the chil-

dren weighing less than four pounds. This is certainly true of those weighing less than three pounds; also if the length of the body is less than nineteen inches. In these children all the organs are likely to be imperfectly developed and they are not ready for their work. Especially is this true of the lungs and of the organs of digestion.

The clinical picture presented by these cases is quite characteristic. The body is limp; the skin very soft and delicate and almost transparent; the cry, a low feeble whine not unlike the mew of a kitten; the respiratory movements, extremely irregular, sometimes scarcely perceptible for several seconds; the movements of the extremities infrequent and never vigorous. The general appearance is one of torpor. The muscles of the mouth and cheek and tongue may lack the requisite force for sucking, so that this is practically impossible, and even deglutition is slow, difficult, and prolonged. Unless very carefully protected the temperature of the body quickly falls to a subnormal point, and it is difficult to maintain the normal body heat. These symptoms vary much in degree according as the infants are born at six and a half, seven months, or only shortly before term.

In the management of these cases there are two problems to be solved: the first to maintain the animal heat, the second to nourish the infant. Difficult as it always is to rear a premature infant, these difficulties are much increased in cases where proper means are not adopted immediately after birth. The loss which these children sustain during the first few days is in very many cases so great that subsequent measures, however well carried out, are futile. The heat-producing power is so feeble that the body temperature quickly falls below normal unless artificial heat is constantly used. The effect of cold upon these delicate infants is very serious, and not only growth but even life depends upon maintaining the body temperature steadily and uniformly. Their extreme susceptibility is something which it is difficult for one to appreciate who has not had experience in these cases.

One of the simplest means of maintaining the temperature is to oil the skin and then roll the entire body in cotton batting, no clothing excepting the diaper being used. The body should then be wrapped in two or three blankets and surrounded by bottles or rubber bags containing hot water. These means are usually sufficient in infants of three and a half pounds or over, but in those much under this weight this is not enough. Where cotton is used it should be changed only once in two or three days, excepting about the buttocks. If absorbent cotton be used in this region instead of cotton batting, the napkin may be dispensed with altogether. This cotton may be changed as often as it is soiled by the discharges. These children should not be bathed, but the skin should be kept in a healthy condition by rubbing with sweet oil once in two or three days.

Incubators.—In the case of infants born in the seventh month, and in some even later than this, the animal heat which can be maintained by the means described is inadequate to the child's needs. For such cases an incubator must be employed. The following statistics are published by Tarnier, showing the results obtained in his hospital in Paris during five years with the incubator and for the five years before its introduction:

Age.	Percentage saved with incubator.	Percentage saved without incubator.
Infants born at 6 months	16·0	....
" " " 6½ "	36·6	21·5
" " " 7 "	49·8	39·0
" " " 7½ "	77·0	54·0
" " " 8 "	88·8	78·0
" " " 8½ "	96·0	88·0

The essential thing to be secured in an incubator is a uniform temperature, which in the most delicate infants should be maintained at 96° to 98° F. In those a little more robust, from 80° to 95°. The air must at the same time be moistened, and there must be sufficient ventilation to keep it pure.

A modification of Tarnier's incubator is shown in the accompanying illustrations. (Figs. 1 and 2). This consists of a wooden box thirty

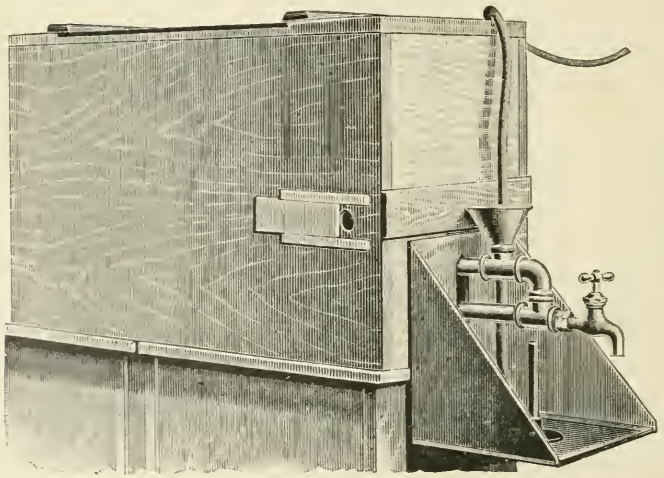

Fig. 1.—Incubator.

inches long, fifteen inches wide, and twenty inches high. It is composed of an outer and inner box, each one half inch in thickness, with an air chamber one fourth of an inch in thickness separating them, excepting

at the bottom, which is solid. It may be made solid throughout. The temperature is maintained by a large tank of warm water four inches in height which completely fills the bottom of the incubator. This is so arranged that it can be emptied and filled without opening the box. Connected with one end of the tank is a loop of brass pipe. To this is attached a funnel for filling and a faucet for emptying the tank. Beneath this pipe the heat is applied. The tank, which holds five or six gallons, is filled with hot water, and the heat is then maintained by the flame of a Bunsen burner or an alcohol lamp. The lamp stands upon a hanging shelf made of tin. Fresh air is admitted at four openings, three inches in diameter, two being on each side. A slide is so arranged that one or all of these can be opened as desired. The air passes over the upper surface of the tank, is moistened by a wet sponge, and finds its exit at the top. A thermometer is placed on the inside of the box just over the bed, so that the exact temperature can be seen. A portion of the cover consists of a sliding plate of glass, through which the child can be observed, and by partly opening which it can be fed. The infant lies upon a bed of cotton, in some cases naked, in others enveloped in the cotton. The discharges are received in the cotton upon which it lies. The infant is kept clean by the use of oil and cotton. It is not to be removed for feeding, since the food is usually given by gavage, and this can be done by sliding the cover. Every day the child should be taken out long enough to allow thorough cleansing and airing of the incubator, introduction of fresh cotton, etc.

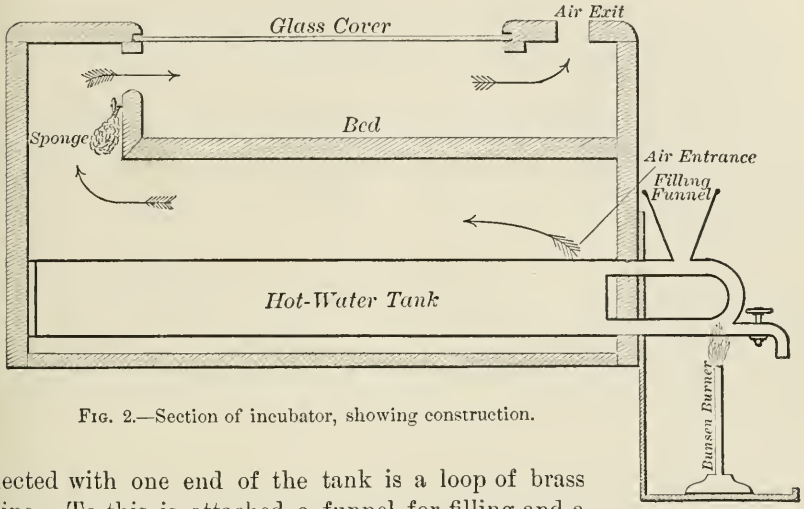

FIG. 2.—Section of incubator, showing construction.

This apparatus, which was devised by Dr. E. J. Sherow and myself, can be made by any carpenter and tinsmith at a very moderate expense. The only difficulty is with the ventilation. This is quite easy provided the temperature of the room in which the incubator stands is not over

65° or 68° F., but much more difficult when it is at 75° or over, as in warm weather. At such times all the doors for the entrance of air should be opened to the full extent and the glass cover opened from one half to two inches.

Rotch,* of Boston, has devised a very elaborate incubator which contains a very perfect heating and ventilating apparatus and also scales, so that the weight of the infant can be ascertained every day without removing it. This apparatus, which is without doubt the best that has been devised, is made of metal, principally of copper. The only objection is its cost. The apparatus which I have described above is one with which excellent results can be obtained, but it requires a little more care and attention. The essential thing in all cases is a constant temperature and free ventilation.

The child is kept in the incubator until it is nearly full term, or has become, judging by its activity, sufficiently strong to withstand the variations in temperature of an ordinary room. Before it is taken out permanently the temperature of the incubator should be gradually lowered by opening the cover more and more until it is only a little higher than the temperature of the room, clothing being of course added at the same time.

The feeding of the premature infant is not less important than the use of the incubator. Very few infants before eight months can be depended upon to take a proper amount of food from the breast or bottle. Forced feeding by means of gavage is indispensable in order to save these very young and very delicate children. This method of feeding is described elsewhere. The amount of food will depend upon the age of the child. At seven months one half ounce may be given every hour and a half, and at eight months three fourths of an ounce at the same interval. The food employed should if possible be breast milk. If artificially fed the feeding should be carried on as described in the chapter on the feeding of delicate children during the first year. With careful attention to details and intelligent co-operation on the part of a good nurse very many of these cases may be saved that otherwise would be absolutely hopeless.

The incubator thus far has not been so much employed in America as in Europe, where the most gratifying results have followed its use, particularly in Paris, St. Petersburg, and Moscow.

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* Archives of Pediatrics, August, 1893.

CHAPTER II.

GROWTH AND DEVELOPMENT OF THE BODY.

Observations upon growth and development are of the utmost importance during infancy and childhood. Only by this means are very many diseases detected in their incipiency. Early recognition carries with it in most cases the possibility of checking such pathological processes, as, if allowed to go on, may affect the health not only in infancy but even throughout life.

By familiarity with what is normal, detection of the abnormal soon becomes easy. Investigation in regard to these subjects should be made a part of the physical examination of every child.

WEIGHT.

The weight of the infant is the best means we have to measure its nutrition. It is as valuable a guide to the physician in infant feeding as is the temperature in a case of continued fever. Although the weight is not to be taken as the only guide to the child's condition, it is of such

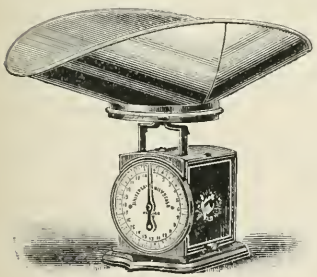

Fig. 3.

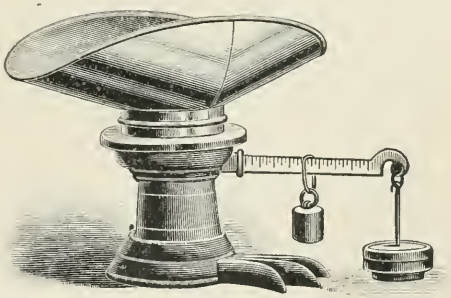

Fig. 4.

importance that we cannot afford to dispense with it during the first two years. It is a great advantage to keep up regular observations during childhood.

Weekly weighings should be made for the first six months, bi-weekly for the rest of the first year, and monthly during the second year. Delicate children should be weighed even more frequently. Satisfactory scales of moderate price for domestic use are those known in the shops as the "Universal Family Scales." (Fig. 3). These weigh up to twenty-four

pounds and indicate ounces. For hospital use and for very fine observations more accurate scales are needed. In Fig. 4 are shown the scales I employ; they weigh up to sixty-one pounds and indicate half ounces.*

Weight at Birth.—The following figures are taken consecutively in nearly equal proportion from the records of the Nursery and Child's Hospital, the Sloane Maternity, and the New York Infant Asylum, and include only full-term children:

Average weight of 568 females	7·16 lbs.	(3,260 grammes).
" " 590 males	7·55 "	(3,400 ").
" " 1,158 infants	7·35 "	(3,330 ").

Weight Curve during the First Few Weeks.—The accompanying chart represents the variations in weight for the first twenty days. These observations were made upon one hundred healthy, nursing infants, fifty males and fifty females, at the Nursery and Child's Hospital. The children were weighed daily during the period of observation. The average weight at birth was 7·1 pounds. The curve shows a very marked loss of weight on the first day and a slight loss on the second day, the lowest point being touched at the beginning of the third day; but from this time there was a steady gain. The average initial loss in these cases was ten ounces, being in each sex exactly eleven per cent of the body weight. In eight hundred and thirty-five cases, however, including those above mentioned, the average loss was nine and a half ounces. The loss of the first days is chiefly due to the discharge of the meconium and urine, but is in part from the excess of tissue waste over the nutriment derived from the breasts. After the third day, coincident with an abundant secretion

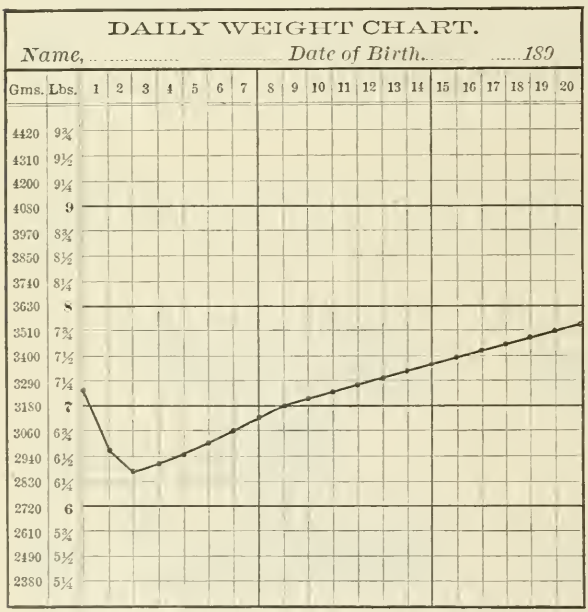

FIG. 5.—Weight curve of the first twenty days.

* These are made by the Howe Scale Company.

of milk, there is a steady, daily increase in weight. If the milk is very scanty or is wanting altogether, the loss in weight continues.

The birth-weight of nursing children who thrive normally is regained on the average on the tenth day. The most frequent deviation from the normal curve consists in a continued loss or stationary weight after the third day. This may be due to acute illness, such as bronchitis, diarrhœa, pyæmia, or hæmorrhage, but in the majority of cases there is a disturbance of nutrition from improper or insufficient food. This is quite as likely to be the case in nursing infants as in those who are artificially fed. Under these circumstances the loss may continue indefinitely, and it may be slow or rapid according to the character of the nursing or feeding.

The weight curve in strong infants who are artificially fed in the proper way from the beginning, follows in some cases the same course as in nursing infants. There are many infants who, though properly fed, gain very little or not at all for two or three weeks, often not regaining the birth-weight until the end of the third or fourth week. Such infants should be closely watched and weighed twice a week, and if the weight is stationary, one should not be too ready to make a change in the food. A continued loss in weight, however, is an invariable indication that this should be done. It should be expected that most artificially fed infants will be slower in getting started, but in my experience their subsequent gain under favourable circumstances has been quite as regular and as rapid as that of average, breast-fed children.

There are cases in which an excessive loss of weight during the first three or four days is associated with an elevation of temperature, but without any other evident signs of disease. Both the fever and the rapid loss in weight are to be looked upon as due to the same cause—inanition. This will be more fully considered in the chapter devoted to that subject.

Excessive loss in weight during the first few days from any cause whatsoever, seriously handicaps an infant during the first weeks of its life. The great importance of this has not been sufficiently appreciated. Loss in weight after the second day is an indication for food in addition to that derived from the breast.

Weight Curve of the First Year.—The curve of the accompanying chart is made up from complete weight charts of one hundred healthy nursing infants who were thriving and weighed every week, and the incomplete charts of about three hundred others. There are represented in round numbers about ten thousand observations on children under one year. The period of most rapid increase is during the first three months. It is slowest from the sixth to the ninth month. This curve is not to be regarded as a normal line, like the normal line of the temperature chart, but as an average line. An infant who is at birth a pound above the average may keep this distance above the line for the whole

year; another weighing one pound less than the average may be as far below it. Girls throughout the year are on the average half a pound lighter than boys. No single child exactly follows the line all the way, but it is surprising to see how close to it a very large number of the cases come.

In artificially-fed infants—provided the feeding is properly done—the curve does not differ essentially from that of breast-fed infants, excepting

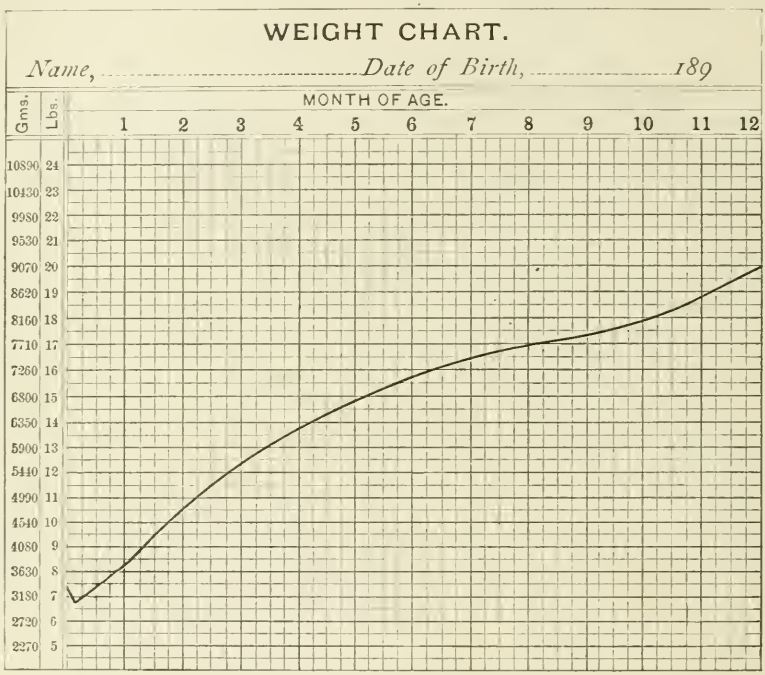

Fig. 6.—The weight curve of the first year.

in the slower gain of the first one or two months, although this difference is usually made up before the sixth month is reached.

At the end of the first year the average child weighs nearly three times as much as at birth. Perfect health during the first year is consistent only with a steady gain in weight. A child may not always gain rapidly, but it should gain steadily, and if it does not, something is wrong. All the conditions surrounding the infant should be investigated, but especially the food. One should not be satisfied unless the average weekly gain during the first six months is at least four ounces. In the second six months it may be slightly less. It may be taken as a rule that a child who gains regularly in weight is thriving; an exception must, however, be made in the case of some infants who are fed chiefly upon carbohydrate foods.

Weight from the Second to the Fifth Year.—Comparatively few observations have been published upon the weight during this period. From three hundred and seventy-two personal observations it appears that the gain is about six pounds during the second year, about four and a half during the third year, and about four pounds during the fourth year: the actual weights are given in the large table (page 20). During this period the gain is rarely steady even in the second year. With most children it is slowest or the weight is stationary in the summer months, while the most rapid increase is usually seen in autumn. Throughout this period the girls gain in about the same ratio as boys, but remain on the average nearly one pound lighter. During almost every illness, no matter of what character, the gain in weight ceases, and usually there is a loss, the rapidity and extent of which are somewhat proportionate to the severity of the attack; but it is always much more rapid in diseases of the digestive tract than in any other form of illness.

Weight of Older Children.—The weights given in the table of children from five to fourteen years are from Bowditch. Observations were made upon children of American parentage in the public schools of Boston—upon 4,327 boys and 3,681 girls.* It is to be remembered that these weights include the ordinary clothing, while those below five years are without clothing.†

The slowest gain is from the fifth to the eighth year, when it is about four pounds a year. From the eighth to the eleventh year it rises to about six pounds a year. Up to the eleventh year the two sexes gain in about the same ratio. From the eleventh to the thirteenth year the girls gain

* W. T. Porter has published (1894) observations made upon 14,744 children of American parentage in the public schools of St. Louis. His figures show quite a variation from those of Bowditch, and are as follows:

Age.	Boys' weight.		Girls' weight.	
	Kilos.	Pounds.	Kilos.	Pounds.
6 years	19·66	43·2	18·76	41·3
7 "	21·67	47·7	20·82	45·8
8 "	23·91	52·6	22·71	50·0
9 "	26·08	57·4	25·07	55·1
10 "	28·49	62·7	27·43	60·3
11 "	31·26	68·8	29·93	65·8
12 "	33·45	73·6	33·17	73·0
13 "	35·96	79·1	38·29	84·2
14 "	40·34	88·7	43·12	94·9
15 "	47·25	103·9	46·90	103·2
16 "	52·10	114·6	50·06	110·1

† The average weight of the ordinary house clothing of school children, according to Bowditch, is at five years 2·8 pounds for both sexes; at seven years, 3·5 for both sexes; at ten years, 5·7 pounds for boys and 4·5 pounds for girls; at thirteen years, 7·4 pounds for boys and 5·6 pounds for girls; at sixteen years, 9·7 pounds for boys and 8·1 pounds for girls. This must be deducted from weights given to obtain the net weight.

much more rapidly, passing the boys for the first time and maintaining this lead until the fifteenth year, when again the boys pass them.

*Table showing Weight, Height, and Circumference of the Head and Chest from Birth to the Sixteenth Year.**

Age.	Sex.	Weight.		Height.		Chest.		Head.	
		Pounds.	Kilos.	Inches.	Cm.	Inches.	Cm.	Inches.	Cm.
Birth.....	Boys.	7·55	3·43	20·6	52·5	13.4	34.2	13·9	35·5
	Girls.	7·16	3 26	20·5	52·2	13·0	33·2	13·5	34·5
6 months....	Boys.	16·0	7·26	25·4	64·8	16·5	42·0	17·0	43·5
	Girls.	15·5	7·03	25·0	63·6	16·1	41·0	16·6	42·2
12 months....	Boys.	20·5	9·29	29·0	73·8	18·0	45·9	18·0	45·9
	Girls.	19·8	8·84	28·7	73·2	17·4	44·4	17·6	44·6
18 months....	Boys.	22·8	10·35	30·0	76·3	18·5	47·1	18·5	47·1
	Girls.	22·0	9·98	29·7	75·6	18·0	45·9	18·0	45·9
2 years.....	Boys.	26·5	12·02	32·5	82·8	19·0	48·4	18·9	48·2
	Girls.	25·5	11·56	32·5	82·8	18·5	47·0	18·6	47·2
3 years.....	Boys.	31·2	14·14	35·0	89·1	20·1	51·1	19·3	49·0
	Girls.	30·0	13·60	35·0	89·1	19·8	50·5	19·0	48.4
4 years.....	Boys.	35·0	15·87	38·0	96·7	20·7	52·8	19·7	50.3
	Girls.	34·0	15·41	38·0	96·7	20·5	52·2	19·5	49.6
5 years.....	Boys.	41·2	18·71	41·7	106·0	21·5	54·8	20·5	52.2
	Girls.	39·8	18·06	41·4	105·3	21·0	53·5	20·2	51.3
6 years.....	Boys.	45·1	20·48	44·1	112·0	23·2	59·1	.....	.....
	Girls.	43·8	19·87	43·6	110 9	22·8	58·3	.....	.....
7 years.....	Boys.	49·5	22·44	46·2	117·4	23·7	60·6	.....	.....
	Girls.	48·0	21·78	45·9	116·7	23·3	59·5	.....	.....
8 years.....	Boys.	54·5	24·70	48·2	122·3	24 4	62·2	.....	.....
	Girls.	52·9	24·01	48·0	122·1	23·8	60·8	.....	.....
9 years.....	Boys.	60·0	26·58	50·1	127·2	25·1	63·9	.....	.....
	Girls.	57·5	26·10	49·6	126·0	24·5	62·5	.....	.....
10 years.....	Boys.	66·6	30·22	52·2	132·6	25·8	65·6	21·0	53·5
	Girls.	64·1	29·07	51·8	131·5	24·7	63·0	20·7	52·8
11 years.....	Boys.	72·4	32·83	54·0	137·2	26·4	67·2	.....	.....
	Girls.	70·3	31·87	53·8	136·6	25·8	65·8	.....	.....
12 years.....	Boys.	79·8	36·21	55·8	141·7	27·0	68·8	.....	.....
	Girls.	81·4	36·90	57·1	145·2	26·8	68·3	.....	.....
13 years.....	Boys.	88·3	40·04	58·2	147·7	27·7	70·6	.....	.....
	Girls.	91·2	41·36	58·7	149·2	28·0	71·3	.....	.....
14 years.....	Boys.	99·3	45·03	61·0	155·1	28·8	73·3	.....	.....
	Girls.	100·3	45·50	60·3	153·2	29·2	74·1	.....	.....
15 years.....	Boys.	110·8	50·26	63·0	159·9	30·0	76·6	21·8	55·5
	Girls.	108·4	49·17	61·4	155·9	30·3	76·8	21·5	54·8
16 years.....	Boys.	123·7	56·09	65·6	166·5	31·2	79·2	.....	.....
	Girls.	113·0	51·24	61·7	156·7	30·8	78·8	.....	....

* The recently published observations of Boas (Science, April 12, 1895) upon 4,319 children over six years old show that first born exceed later children both in height and weight.

HEIGHT.

The figures showing the height at different ages are given in the foregoing table. The measurements of infants at birth are taken in about equal numbers from the records of the New York Infant Asylum and the Sloane Maternity Hospital. They were made upon full-term infants.

Average length of	231	males	20·61 inches (52·5 cm.);
" "	211	females	20·47 " (52·2 ");
" "	442	infants	20·54 " (52·35 ").

The most rapid gain in length is in the first year. During this period the child grows on an average a little over eight inches (21 cm.). This gain is usually, but not always, proportionate to the increase in weight. During the second year the average increase is three and a half inches (9 cm.). From this time on the rate of increase is quite uniform in both sexes until the eleventh year, it being between two and three inches a year.

After the eleventh year in girls and the twelfth in boys the growth is much more rapid. In height the girls exceed the boys at the twelfth and thirteenth years for the only time in their growth.

In the figures given in the preceding table those of five years and over are taken from Bowditch,* the observations being made upon the same children as those whose weights were taken. The observations from six months to four years inclusive are from original sources, and are drawn from about five hundred cases. The height much more than the weight of children is modified by hereditary influences.

Rachitic children during infancy and early childhood are, as a rule, shorter than others. I have frequently measured such children during the third year who were six inches below the average for that age. The effect of malnutrition upon the length of the body is much less than on the weight.

GROWTH OF THE EXTREMITIES AS COMPARED WITH THE TRUNK.

At birth the trunk is relatively long and the extremities short. Subsequently the growth of the extremities is much more rapid than that of the trunk. Thus I have found at birth the length of the lower extremities (measuring from the anterior superior spine of the ilium to the sole of the foot) to be forty-three per cent of the length of the body; at five years, fifty-four per cent, and at sixteen years sixty per cent. The above figures are from one hundred and fifty observations, which, although not numerous enough for exact percentages, are still sufficient to give a

* According to the observations of Porter, the St. Louis children reach a given height on the average about one year later than Boston school children.

very good idea of the general relation of the length of the extremities to that of the body as a whole.

THE HEAD.

Circumference.—The average circumference of the head at birth in four hundred and forty-six full-term infants taken in about equal numbers from the Sloane Maternity Hospital and New York Infant Asylum was as follows:

Average circumference of the head,	231 males..	13·90 inches	(35·5 cm.);
" " " "	215 females.	13·52 "	(34·5 ");
Total.....	446 infants.	13·71 "	(35·0 ").

The occipito-frontal measurement has been the one taken.

The growth of the head is most rapid during the first year, the increase being about four inches (10 cm.). During the second year the increase is about one inch (2·5 cm.). From the second to the fifth year the growth is slower, being only about one and a half inches (4 cm.) for the three years. After the fifth year the increase in the circumference of the head is very slow, as shown by the preceding table.

Closure of the Sutures.—The main sutures of the cranium are not commonly ossified before the end of the sixth month, and very frequently some mobility may be detected at the end of the ninth month. Distinct separation of the cranial bones after birth is abnormal. It is most frequently seen in premature and in syphilitic infants, but rarely in this country as the result of congenital rickets.

Closure of the Fontanels.—The posterior fontanel is usually obliterated by the end of the second month. The anterior fontanel under normal conditions closes on an average at about the eighteenth month. The usual variations are between the fourteenth and the twenty-second months. At the end of the first year the fontanel should be about one inch in diameter. An open fontanel at the end of the second year may always be considered abnormal. Rickets is the usual explanation.

The closure of the fontanel is not always early in well-nourished children, nor is it always delayed in those suffering from malnutrition. It often happens that in a child with marked evidences of malnutrition the fontanel at ten or twelve months is nearly or quite closed and the sutures firmly ossified. In such children the head is usually small, and the early closure is partly due to the slow growth of the brain. On the other hand, it is sometimes the case that in stout, well-nourished children the fontanel may remain open until nearly the end of the second year, although the child presents every evidence of perfect nutrition and no signs of rickets. This may be due to the fact that the brain has grown with more than usual rapidity. When, however, there is any great disproportion between the size of the head and the development of the rest of the body, or when

the circumference of the head exceeds very much the figures given in the table above, either rickets or hydrocephalus should be suspected.

Shape of the Head.—The deformity which results from compression during labour usually disappears by the end of the first month. During the first year the head often becomes flattened at the occiput in consequence of the child's lying too much upon the back. This is easily remedied by changing its position. A slight obliquity of the head may

Fig. 7.—Premature ossification of the sagittal suture. Death at six weeks.

be produced by the child's being habitually held in one position, as in some cases where it is nursed only at one breast, or where it is always laid upon the same side during sleep.

The other abnormities in the shape of the head are chiefly due to rickets and hydrocephalus, more rarely to congenital malformations of the brain. They will be considered in the chapter devoted to these topics.

Premature ossification of the sutures of the cranium occasionally gives rise to a very striking deformity of the head. I have recently seen two cases of such deformity from premature ossification of the sagittal suture. The heads in both cases were very narrow and long in the antero-posterior diameter. The forehead was narrow, prominent, and slightly pro-

jecting. The accompanying illustration shows the skull of one of these cases. There is a complete obliteration of the sagittal suture. In this case there was a wide separation of the sutures at the junction of the parietal and temporal bones. (See Fig. 7.)

THE CHEST.

The figures showing the circumference of the chest at the different periods of childhood are given on page 20. The measurements up to and including five years are from original sources, those from the sixth to the sixteenth are taken from Porter, and are drawn from observations on 31,371 school children. The measurement of the chest is that taken midway between full inspiration and expiration, and at the level of the nipples.

In the newly-born child the antero-posterior and the transverse diameters of the chest are nearly the same. As age advances, the transverse diameter increases very much more rapidly, so that the outline of the chest gradually assumes an elliptical shape, which it maintains during childhood.

At birth, the circumference of the chest is about one half inch less than that of the head, but throughout infancy the two measurements are nearly the same. It is not until the third year that the circumference of the chest exceeds that of the head. According to Uffelmann, the circumference of the head and the chest are the same until the twenty-first month in a robust child, and until two and a half years in an average child. If at three years the chest continues smaller than the head, the child is likely to be a weak one. If the chest is below the average at birth, it is likely to remain so throughout infancy. The chest measurement in infants is always much modified by the amount of fat; but, after making due allowance for this, a large chest always indicates a robust child and a small chest a delicate one. If at any age the circumference of the child's chest is found to be below the average, measures should be taken, by gymnastics and otherwise, to develop it.

Deformities of the thorax result chiefly from rickets, sometimes from empyema, emphysema, and cardiac disease; in older children, from lateral curvature of the spine, or from Pott's disease.

THE ABDOMEN.

Throughout infancy the circumference of the abdomen is, as a rule, about the same as that of the chest. At the end of the second year the measurements of the head, chest, and abdomen are very often identical; after this time the chest measurement increases much more rapidly than the other two. Marked enlargement of the abdomen is seen in

many varieties of chronic intestinal disorders. It is, however, most marked in the tympanites which so constantly accompanies rickets.

MUSCULAR DEVELOPMENT.

The first voluntary movements are usually in the fourth month, when the infant deliberately attempts to grasp some object placed before it. During the fourth month, as a rule, the head can be held erect when the trunk is supported. In many infants this is possible in the early part of the third month. At seven months a healthy child is usually able to sit erect and support the trunk for several minutes.

In the ninth or tenth month are usually seen the first attempts to bear the weight upon the feet. At ten or eleven months a child stands with slight assistance. The first attempts at walking are commonly seen in the twelfth or thirteenth month. The average age at which children walk freely alone has been, in my experience, the fourteenth or fifteenth month. Quite wide variations are seen in healthy children. Very much depends upon the surroundings. I have known infants to walk at ten months and many others not until seventeen or eighteen months, although showing no evidences of disease, and although their development had not been retarded by previous illness. A very marked difference is seen in different families of children with respect to the time of walking.

The physician is often consulted because of backward muscular development, most frequently because the child is late in walking. General malnutrition, or any other severe or prolonged illness, may postpone for several months this or any of the other functions mentioned. When there is no such explanation of the backwardness, a child who does not hold up its head, sit alone, or make efforts to stand or walk at the proper time, should be submitted to a careful examination for a cerebral or spinal paralysis, but especially for rickets which is the most frequent explanation of the symptoms.

Contrivances for teaching infants to walk are unnecessary, and their effect may even be injurious. An infant should be allowed the greatest possible freedom in the use of its limbs. It should not be restrained from walking when inclined to do so, nor continually urged to walk when no voluntary attempts are made. Nothing short of mechanical restraint will prevent a healthy child from walking or standing when it is strong enough to do so.

DEVELOPMENT OF THE SPECIAL SENSES.*

Sight.—The newly-born infant avoids the light. Its pupils contract in a light room, and if a bright light is brought before the eyes they

* For many of the facts in this paragraph I am indebted to Preyer's The Senses and the Will, American edition, 1888, D. Appleton & Co.

close. During the first few weeks the infant indicates by every sign that excessive light is unpleasant. As early as the sixth day the eyes will sometimes follow a light in the room, and the child may even turn the head for this purpose. The muscles of the eyes of the newly-born infant act irregularly and not in harmony. Co-ordinate action for general purposes is not established until about the end of the third month. Even after this time inco-ordinate action is occasionally seen. The eyelids also move irregularly, and are often partly separated during sleep. The cornea is but slightly sensitive during the first weeks. In Preyer's child it was not until the third month that the lids closed when the water in the bath touched the lashes or the cornea. The recognition of objects seen is usually evident in the sixth month.

It is important that the room in which the newly-born child is placed should be darkened, and that for the first few weeks the eyes should be protected against strong light.

Hearing.—For the first twenty-four hours after birth infants are deaf. This deafness sometimes persists for several days. It is believed to be due to absence of air from the middle ear and to swelling of the mucous membrane which lines the tympanum. With the movements of respiration, air gradually finds its way into the middle ear, and the swelling subsides during the first few days. After this the hearing gradually improves, and during the early months of life it is very acute. The child starts at the slamming of a door, and even moderately loud noises will waken it from sleep. By the end of the second month it will sometimes turn its head in the direction from which the sound comes, and by the end of the third month this will usually be done. Demme found, in observations upon one hundred and fifty infants, that the voices of parents were recognised on an average at three and a half months.

Not only are the ears unusually sensitive to sound in infancy, but the impression produced upon the brain is often marked—very loud sounds causing great fright, and sometimes even, it is reported, convulsions.

Touch.—Tactile sensibility is present at birth, but is not highly developed except in the lips and tongue, where it is very acute for the obvious necessity of sucking. After the third month it is fairly acute over the surface of the body generally. Two especially sensitive areas, according to Preyer, are the forehead and external auditory meatus.

Sensibility to painful impressions is present in early infancy, but very dull as compared with later childhood.

Temperature is also distinguished. This recognition is especially acute in the tongue. A young infant is often seen to refuse to take the bottle because the milk is only a few degrees too cold or too warm.

The localization of sensory impressions comes later, probably not much

before the middle of the sixth month, and is very imperfect throughout the first year.

Taste.—This is highly developed, even from birth. According to the experiments of Kussmaul, the ability to distinguish sweet, sour and bitter, exists in the newly-born child—sweet exciting sucking movements, and bitter, grimaces. A young infant detects with surprising accuracy the slightest variation in the taste of its food, and the smallest difference is often enough to cause it to refuse its bottle altogether. Sweet substances are always easily administered, and in combination with sirups even very bitter substances can be given; but to aromatic powders and elixirs it usually objects.

Smell.—Observations upon the sense of smell in newly-born infants are few and not altogether conclusive. Kroner's experiments appear to show that smell is present in the newly born. It has been noted to be especially acute in infants born blind. The sense of smell is developed much later than the other senses. Detection of fine differences in odours is not acquired until quite late in childhood.

SPEECH.

There is a very wide variation in children with reference to the time of development of the function of speech. Girls, as a rule, talk from two to four months earlier than boys. Towards the end of the first year the average child begins with the words "papa," "mamma." By the end of the second year it is able to put words together in short sentences of two or three words. Progress in speech from this time is very rapid, each month showing great improvement. Names of persons are commonly first acquired, then the names of objects. Next to this the verbs are learned, and then adverbs and adjectives. Conjunctions, prepositions, and articles follow in order, and last of all the personal pronouns.

If a child of two years makes no attempt to speak, some mental defect may usually be inferred.

DENTITION.

The teeth are enclosed at birth in dental sacs which are situated in the gums. Above, they are covered by the submucous connective tissue and the mucous membrane; below, the dental sacs rest in depressions in the alveolar process of the jaw. The tooth grows in length mainly as the result of the calcification of its roots, and being thus fixed below, it pushes upward towards the mucous membrane. This growth undoubtedly goes on steadily from birth until the tooth pierces the gum.

The deciduous or milk teeth are twenty in number. The time at which they appear is subject to considerable variation even under normal conditions. The following is the order and the average time of appearance of the different teeth:

(1) Two lower central incisors	6 to	9	months.
(2) Four upper incisors	8 "	12	"
(3) Two lower lateral incisors and four anterior molars.	12 "	15	"
(4) Four canines	18 "	24	"
(5) Four posterior molars	24 "	30	"
At 1 year a child should have		6	teeth.
At 1½ " " " "		12	"
At 2 years " " "		16	"
At 2½ " " " "		20	"

Quite wide variations on both sides of the average are common, and are not always easy of explanation. In many cases it seems to be a family idiosyncrasy, since in the different members of a family the teeth are apt to appear at about the same time. I know one family in which no less than three members of three successive generations were born with teeth, and in most of the other members the first teeth appeared in the third or fourth month. The order in which the teeth appear is much more regular than the time of their appearance. The order given above corresponds with that stated by most observers, although some writers have made different statements, placing the lower before the upper lateral incisors.

The teeth may pierce the gum without any local manifestations. Very frequently, however, just before a tooth comes through there is noticed a moderate swelling and redness of the mucous membrane of the gum overlying it, and to a slight degree this may affect the general mucous membrane of the mouth. This condition may be accompanied by a little fretfulness and increased salivation, or both of these may be entirely wanting. These symptoms usually disappear when the tooth has pierced the gum. The symptoms of difficult dentition will be discussed in connection with Diseases of the Mouth.

Infants may be born with teeth; this is, however, an exceedingly rare occurrence. It is almost invariably one of the lower central incisors that is present. In case this interferes with nursing, or if it is very loosely attached to the gum, it should be extracted, but under other circumstances it should be allowed to remain, since, if it is removed, a second tooth is not likely to appear in its place in the first set. It is not at all uncommon for the first teeth to appear in the fourth month. Such teeth, in my experience, do not usually differ in character from those appearing later, unless they are in children who are syphilitic. Syphilitic children are rather prone to early dentition, and under such circumstances rapid and early decay is likely to take place. Nursing infants are, as a rule, a little earlier in their dentition than those artificially fed.

Delayed dentition is much more frequently due to rickets than to all other causes combined. It is to be remembered, however, that the first teeth may not appear until the tenth month in healthy, well-nourished children and in those who present no signs whatever of rickets. On the

other hand, it is by no means invariable that dentition is late in rachitic children. The latest dentition is seen in cases of cretinism. In such children it is not rare for the first teeth to appear as late as the eighteenth month. I have seen one child two years old with but two teeth. As a rule, dentition and ossification of the bones of the head go on in a corresponding manner; where one is early the other is likely to be rapid, and conversely.

Provided an infant is well nourished and thrives properly for the first six or eight months, the eruption of the teeth is likely to go on steadily after this time, even though the child may later have chronic indigestion or suffer from extreme malnutrition from any cause excepting rickets. If, however, the symptoms of malnutrition date from birth, dentition is almost invariably delayed. It is often a matter of very great surprise to see children who are markedly emaciated as a result of chronic indigestion or ileo-colitis and yet go on cutting their teeth regularly. I have under observation at the present time a delicate infant of sixteen months, whose body length is twenty-eight inches and whose weight is less than nineteen pounds—almost exactly what they were eight months ago—and yet he has now thirteen good teeth.

Eruption of the Permanent Teeth.—The first to appear are the first molars, which usually come in the sixth year, and hence the name six-year-old molars, which is applied to them. These appear posterior to the second molars of the first set. The following table from Forchheimer gives the average time of the appearance of the second teeth:

First molars	6 years.
Incisors	7 to 8 "
Bicuspids	9 " 10 "
Canines	12 " 14 "
Second molars	12 " 15 "
Third molars	17 " 25 "

The order of appearance, therefore, leaving out the first molars, is essentially the same as that of the first set. The permanent teeth, with the exception of the molars, take the place of the corresponding deciduous teeth. As they grow and push upward they cause atrophy of the roots of the first teeth, and gradually cut off their blood supply, so that they loosen and fall out.

The place of dentition as an etiological factor in the diseases of infancy will be considered in the chapter on Difficult Dentition.

CHAPTER III.

PECULIARITIES OF DISEASE IN CHILDREN.

In many particulars disease in children differs from that of later life. These differences relate to etiology, pathology, symptomatology, diagnosis, and prognosis. The greatest contrast to adult life is presented by infancy and early childhood. After seven years, children in their diseases resemble adults more than they do infants.

ETIOLOGY.

1. **Inheritance** is an important factor. The disease most frequently transmitted directly is syphilis. Occasionally tuberculosis and other infectious diseases have been conveyed directly from the mother to the child. In cases where no distinct disease is transmitted, children may inherit from parents constitutional tendencies, or a diathesis which may manifest itself in infancy, or in some cases not until later childhood. Under this head we may place the influence of rheumatism, gout, the various neuroses, and possibly alcoholism and insanity. In consequence of these conditions in parents, the child may inherit no definite disease, but simply a vitiated constitution.

2. **Malformations** must be considered, particularly in the first two years of life. The most important of these, from a medical standpoint, are those of the heart, brain, and kidney. The various malformations of the mouth, nose, bladder, rectum, and genital organs belong more particularly to the domain of surgery.

3. **The Diseases or Accidents Connected with Birth.**—Some of these are distinctly traumatic, like the meningeal hæmorrhages. A very large class are the infectious processes in the newly born. Infection usually takes place through the umbilical wound, more rarely through the skin or mucous membranes. This class includes pyæmia, with its varied lesions in the brain, lungs, and serous membranes, erysipelas, ophthalmia, and tetanus. In the class of infectious diseases may also be included many of the varieties of pulmonary and intestinal diseases in the newly born, and probably also some of the hæmorrhagic affections.

4. **Conditions Interfering with Proper Growth and Development.**—These are among the largest etiological factors in the diseases of infancy. They are improper food or feeding, unhygienic surroundings, and neglect.

These may cause specific diseases, like rickets or scurvy, or may lead to a condition of general malnutrition or marasmus. In this way they become most important predisposing factors, in infancy, to the acute diseases of the gastro-enteric tract, and later in childhood, to functional nervous diseases.

5. **Infection.**—This has already been mentioned as an important factor in diseases of the newly born. The number of diseases in later life directly traceable to this is very large, and is constantly increasing. Under this head should be included not only the well-known classes of infectious and contagious diseases, but also a very large number of varieties of infection which as yet have not been differentiated, and the nature of which is but imperfectly understood.

SYMPTOMATOLOGY AND DIAGNOSIS.

In older children the symptoms of disease are very much the same as in adults, and similar methods of examination may be employed. What is really peculiar to children belongs especially to the first three years of life, before speech has developed. During this period the chief and almost the sole reliance of the physician must be upon the objective signs of the disease. It is not so much that diseases in early life are peculiar, as that the patients themselves are peculiar.

Two fundamental facts are always to be kept in mind: First, that the common pathological processes are comparatively few, being chiefly of the gastro-enteric tract, the lungs, and the brain, but that the variations in clinical types are almost endless; the second is, that in infants, on account of the susceptibility of the nervous system, functional derangements are often accompanied by very grave symptoms, and may even prove fatal in twelve or twenty-four hours, or there may be speedy and complete recovery after very alarming symptoms. In many of these cases the symptoms are so indefinite that an exact diagnosis is impossible during life. and even the autopsy may throw but little light upon them.

At the bedside, it is of great assistance to the physician if he can keep in mind the most frequent forms of acute disease that are likely to be met with. In the first group, including those which are very common, may be placed acute indigestion and ileo-colitis, bronchitis, pneumonia, pharyngitis, and tonsilitis; in the second group, including those which are not quite so common, may be placed otitis and the acute infectious diseases—measles, scarlet fever, diphtheria, influenza, and malaria; in the third group, including the rarer forms of acute disease—meningitis, tuberculosis, rheumatism, and diseases of the kidneys. Under all circumstances, the season, and the nature of the prevailing epidemic, if one exists, are to be considered.

In the examination of a sick infant quite a different method is to be followed from that pursued in adults. Much information is to be gained

from a history carefully taken from an intelligent mother or nurse, and much more from a close observation of the child, whether asleep or awake, quiet or crying.

The History.—The points to be most carefully investigated will vary somewhat with the nature of the illness. If the disturbance is one of nutrition, the minutest details relating to the character and preparation of the food from birth up to the present illness must be considered; also the progress of dentition, and whether this has been easy or difficult. All facts relating to the child's growth and development are significant—the period when it was able to sit alone, stand and walk, and its weight. Every previous illness should be investigated as to its nature, duration, and severity, especially the eruptive fevers, the diseases of the lungs and the digestive tract. All the facts relating to the present illness should then be brought out—the exact time and mode of onset, the presence or absence of fever, the amount of food taken, the existence of cough or hoarseness, the evidences of pain, such as restlessness or screaming, the character of the sleep, the condition of the bowels, the amount of urine passed, and the frequency of micturition. In every case the physician should inspect for himself the child's napkins, and never trust to the statements of the mother or nurse with regard to the character of the fæcal discharges or the urine. The question of exposure to any contagious disease should also be considered.

In chronic diseases it is of special importance to investigate the subject of heredity, from manifestations of disease both in the parents and in other children of the family. This is most important with reference to syphilis and tuberculosis. The character of the labour should be inquired into, whether it was difficult, prolonged, or instrumental.

Inspection.—What is learned by the inspection of a sick child will depend almost entirely upon the powers of observation of the physician. One accustomed to bring out the patient's symptoms by questions is dedecidly at a loss to know how to proceed in the case of a sick infant. With time, patience and method very much that is important and exact can be determined. In fact, the diagnosis of disease in infancy, instead of being, as is often supposed, a matter of extreme difficulty or impossibility, becomes with experience quite as easy as among adults.

In acute disease when the child is asleep or quiet the following points should be noted:

1. *Posture*—whether the child lies upon the back, the side, or the face; whether there is opisthotonos, or a general flexion of all the limbs.

2. Character of the *sleep*—whether it is quiet and peaceful or disturbed; whether there is constant tossing about, grinding of the teeth, etc.

3. *Respiration*—whether it is regular, or irregular. This can be determined only by careful observation for some minutes. It should be noted

whether it is rapid, or slow, easy, natural, and quiet, or whether there is nasal obstruction with snoring and mouth-breathing due to tonsillitis, diphtheria, scarlet fever, or adenoid vegetations of the pharynx. The best evidence of dyspnœa is the recession of the supraclavicular and suprasternal regions, the sinking in of the intercostal spaces, sometimes with lateral recession of the chest walls. There is usually present active dilatation of the nostrils.

4. *Pulse*—whether it is rapid or slow, full and strong or soft and compressible. The frequency of the pulse in infancy is of much less importance than the force and rhythm. A slow, irregular pulse is always significant, and should suggest meningitis; an irregular pulse, when rapid, has no special significance.

5. *Skin*—whether it is dry and hot, or covered with perspiration. The existence of pallor, general cyanosis, or blueness of the lips and finger nails should be noted; also the circulation in the extremities, whether they are warm, or cold and clammy.

6. *Facial expression*—whether this is calm and peaceful, drawn and anxious, intelligent or stupid, and whether the features are contracted from time to time as if from pain.

7. *Cough*—whether this is frequent, difficult, or severe.

8. *Cry:* Since this is the chief means by which the infant expresses discomfort or displeasure, it becomes exceedingly important but not always easy to determine whether an infant cries from pain, discomfort, hunger, temper, or from habit. In very many instances the cry under these conditions is so characteristic that one who is familiar with the child's language readily divines what is wrong. It is something which should never be disregarded, even though it may be the only obvious symptom. Tears are not seen until the second month, so that their absence before that time is not to be taken as an evidence that the cry is not from pain.

The cry of hunger is apt to be interrupted by vigorous sucking of the fingers. It is not usually sharp and piercing, like the cry of pain, but it is a worrying, fretful cry. It ceases immediately when the hunger has been satisfied.

The cry of indigestion is often mistaken for that of hunger, but in such cases, although crying may cease for a few minutes after taking food, from the temporary relief which this gives, it is likely soon to return with unabated vigour. Under such circumstances a frequent repetition of feeding or nursing should never be allowed, although very often this is just what is done.

The character of the cry of pain will depend somewhat upon the severity of the pain. When it is acute like that of colic or earache, it may be sharp and piercing, and accompanied by contraction of the features, drawing up of the legs, and other evident signs of distress. The child falls asleep only when exhausted, and soon wakes, often with a scream. In

pain of less severity there is usually moaning, but rarely a sharp cry. Infants cry not only from pain but from every sort of discomfort—wet diapers, cold feet, a cramped position, uncomfortable clothing, also if they are tired or sleepy, and from a great many other minor causes. The more delicate a child the more readily it cries from any cause.

The cry of weakness and exhaustion is quite characteristic. It may be noticed in a great variety of conditions. It is usually a low, feeble whine or moan, often nearly constant, except when the child is asleep.

The cry of temper is not generally heard before the fifth month. It is usually accompanied by stiffening of the body, throwing back of the head, and sometimes by vigorous kicking. It is loud, violent, and often prolonged.

The cry of habit is one of the most difficult to recognise. These habits are formed by indulging infants in various ways. Some children cry to be held, some to be carried, some to be rocked, some for a light in the nursery, some for a rubber nipple or some other thing to suck. The extent to which this kind of crying may be indulged in, even by very young infants, is surprising, and it explains much of the crying of early childhood.* The fact that the cry ceases immediately when the child gets what it wants is diagnostic of the cry from habit. The only successful treatment of such cases is to allow the child to "cry it out" once or twice, and then the habit is broken. Of course, before such a procedure is allowed to go on, one must be well assured that the cry is from this cause and no other.

There are some diseases in which the cry is sufficiently characteristic to be of diagnostic importance. Thus we hear the short, catchy, suppressed cry of pneumonia, the sharp nocturnal cry of tuberculous meningitis and of chronic bone disease, the moan of chronic indigestion and acute intestinal diseases, the hoarse nasal cry of hereditary syphilis, and the feeble whine of marasmus and of atelectasis.

9. The *mental condition* may be one of undue excitement, and it may be difficult to tell whether this is from fright at the approach of a stranger

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* On admission to the Babies' Hospital very young infants almost invariably cry a great deal for the first two days. It being against the rules to take such children from their cribs and hold them to quiet their crying, they soon cease the habit, and give no further trouble, crying subsequently only from the usual causes.

Dr. J. S. Thacher relates an experience which illustrates to what extent this habit may be formed in infants of only a few weeks. In a hospital ward under his care, containing fifteen or twenty mothers and newly-born infants, one of the women was seriously ill, and was so annoyed by the crying of the infants that they were allowed to be taken from their cribs and held or carried as soon as crying from any cause began. After several days the patient was removed from the ward, and for the next two or three days the crying in the ward was enough to drive one distracted: but the mothers were forbidden to quiet the infants by taking them up, and after two or three days' discipline the crying ceased and peace and order were again restored.

or from disease. More significant is a condition of apathy and dulness and general relaxation in which no resistance whatever is made to the examination. Such symptoms always indicate either extreme prostration or brain disease. A child may cry from pain or from fright. General hyperæsthesia is common in meningitis. Soreness of the legs only, suggests scurvy, rheumatism, or joint disease.

10. The condition of the *pupils* should be observed, whether contracted or dilated, and the nature of the response to light; also the presence of corneal ulcers and the interstitial keratitis so frequent in hereditary syphilis. The thin mucous film seen over the cornea always indicates grave prostration, and often approaching death.

11. The *lymph glands* of the neck should be noted: as when swollen they may indicate scarlet fever, diphtheria, or simple acute inflammation.

12. The presence or absence of *nasal discharge* should be determined, and also, if possible, its character. In acute disease this suggests diphtheria, scarlet fever, or influenza; if it is chronic, adenoid growths of the pharynx, or syphilis.

13. The appearance of the *mucous membrane of the mouth*, *teeth*, and *gums* may often be ascertained by watching the child while it is crying. It should be noted whether the tongue is dry or moist, also whether thrush is present, or any other form of stomatitis. The condition of the gums may be observed, whether congested or swollen or hæmorrhagic as in scurvy, and also the number, position, and character of the teeth. The general colour of the mucous membrane may be significant, as in cases of cyanosis.

Very much can be learned in acute illness by simply watching attentively a sick child for a few minutes, studying the foregoing points in order. By such observation and a carefully obtained history of the illness an experienced physician can often make a very probable diagnosis without further examination; the latter, however, should never be omitted.

The Physical Examination.—*Temperature.* The first step should generally be to ascertain whether or not there is fever. For this one should never fall into the habit of trusting to his sense of touch, for it is often very misleading. Only the rectal temperature in infants is to be depended upon, since axillary temperatures are untrustworthy, and those in the mouth difficult to obtain.

Immediately after birth the temperature of the child is about the same as that of the mother, or a little higher. It falls from 1° to 3° F. in the course of the first few hours, under the influence of the bath and radiation from the skin during dressing. Very soon it again rises to 98·5° or 99° F., near which point, under normal conditions, it remains during the first months of life, and in fact throughout childhood.

From a large number of personal observations upon healthy infants I

have found the rectal temperature to vary, under normal conditions, between 98° and 99·5° F. Within these limits the temperature may be considered normal. The heat-regulating center in the brain acts only imperfectly in the young infant, and very slight causes are enough to disturb the temperature. When the heat equilibrium has once been disturbed, slight fluctuations may continue for some time after the cause has been removed.

The temperature in infants is always higher than from corresponding causes in adults. Moreover, very high temperatures may be met with in cases not at all serious, and not infrequently when no explanation can be found even after the most thorough examination. In such cases the temperature very often does not remain at a high point for more than a few hours. It is a continuous high temperature rather than a single rise which is significant of disease in infancy. Nothing is more perplexing to the young practitioner than the frequency with which a high temperature is seen in infants in cases of comparatively mild illness. While a valuable guide in diagnosis, the temperature alone must not be depended upon in early life, nor should its significance be measured by the adult standards.

It is very common in chronic wasting diseases, in delicate infants and in those prematurely born, to find the temperature one or two degrees below the normal; 95° and 96° F. are of almost daily occurrence in hospitals. In one premature infant the temperature on admission was 93° F. The feeble heat-producing power of these infants, and the rapid radiation from their bodies because of the absence of subcutaneous fat, make the temperature a very important matter in their nutrition. Daily observations should be made with the thermometer, just as in cases of high temperature.

Some of the most puzzling elevations of temperature met with in infancy are the result of the application of artificial heat. Eröss has shown by very careful experiments that the body temperature can be raised by means of hot bottles or water bags from 1° to 5° F. This is accomplished much more readily in the case of feeble or delicate infants than in those who are stronger. The truth of his observations I have had abundant opportunity to verify in my own experience. This cause must be carefully eliminated in cases where unusually high temperatures appear after surgical operations or unexpectedly under other conditions.

For the purpose of making a systematic routine examination of the entire body, the child's clothing, with the exception of the napkin, should be removed, and the child laid upon the nurse's lap on a blanket. The *skin* may now be inspected for eruptions, and it is important that the entire body be examined. Next the general nutrition of the patient should be observed—whether it is emaciated or well nourished.

The *head* should be examined to see whether the sutures are ossified

or unnaturally open; whether the fontanel has closed, or, if open, whether it is depressed or bulging.

The details regarding physical examination of the *lungs* are discussed in the introductory chapter of the section devoted to pulmonary diseases.

In the auscultation of the *heart*, it should be remembered that under two years of age loud murmurs are almost invariably of congenital origin, that soft murmurs are frequently functional, and that acquired organic heart disease is extremely rare until after the third year.

In the examination of the *abdomen* there should be noted the presence or absence of tympanites or abdominal tenderness, whether general or localized, and the existence of retraction of the abdominal walls as in meningitis. The size and position of the liver and spleen are best determined by palpation. The lower border of the liver is usually slightly below the free border of the ribs. If the spleen can be easily felt below the ribs, it is as a rule enlarged. If it can not be felt in a satisfactory examination, it is not sufficiently enlarged to be of any diagnostic importance. It should be remembered that both liver and spleen may be displaced downward in rickets from contraction of the chest, giving the appearance of slight enlargement when they are normal in size. In acute disease a large spleen suggests malaria, typhoid, or tuberculosis; in chronic disease, malaria, syphilis, leucæmia, or anæmia.

Examination of the *urine* should not be forgotten. The staining of the napkin may give information regarding the discharge of crystalline uric acid or of concentrated urine. For other purposes the urine must be collected. This is often difficult. The most satisfactory method I have found is, in male infants, to tie a condom over the penis; in female infants, to put a small cup over the vulva inside the napkin. In those who are a year old the urine may readily be collected by putting the child upon the chamber every few minutes. It is important not to overlook phimosis or balanitis in the male or vulvo-vaginitis in the female, since these conditions may not only give rise to local but even to general symptoms.

A careful inspection of the *throat* should never be omitted in any acute illness, no matter what the other symptoms are; but usually this had better be deferred until the last. For this are required a good light and a quick glance. Upon the hard palate one may look for the first signs of the eruption in measles and scarlet fever, and the condition of the throat may be the first and one of the most important signs of both the diseases. Diphtheria may exist without pseudo-membrane, and marked general redness may be due to scarlet fever, influenza, or simple pharyngitis.

In chronic disease a somewhat different method of examination may be followed. The most important diseases because most often met with in infancy are, in the first place, those which are connected with nutri-

tion, chronic disturbances of the gastro-enteric tract, rickets, and scurvy; secondly, syphilis, tuberculosis, chronic diseases of the lungs, diseases of the blood, the bones, the kidney, and the heart.

In the examination, the general development of the child should be considered. Its height, weight, circumference of head, chest, and abdomen should be taken and these compared with the average for the child's age. The condition of the tissues should be noted, whether firm, soft, or flabby; the ligaments, whether relaxed or not; the presence of bony deformities; also the existence of pallor, cyanosis, and cachexia, and the general nutrition. It should then be determined whether the child has for its age a sufficient muscular development, as shown by sitting, standing or walking. Its speech, hearing, sight, general intelligence and, finally, its mental disposition should be investigated.

In the local examination special attention should be given to the shape of the skull, the condition of the sutures, the size and shape of the fontanel, and the progress of dentition. It should be noted whether there are glandular swellings in the neck or in different parts of the body; also hypertrophied tonsils or adenoids. Finally, there should follow a thorough examination of the heart, lungs, liver, spleen, blood, urine, bones, spine, and joints. The same order need not be followed in every case, but the examination should always be thorough, and with the body stripped. Unless this is done, serious deformities are often entirely overlooked, and an erroneous diagnosis made.

In children who are old enough to answer questions the same method may be pursued as in an adult examination. An important thing in dealing with children is a gradual approach, first winning the confidence of the child and diverting its attention from the real purpose in view; secondly, the avoidance of every rough examination which might by any chance produce pain; and, finally, deferring until the end of the examination the inspection of the throat, which must frequently be done forcibly, and is sure to interrupt any further chance of intimacy. With time and patience almost everything mentioned in the above category can be satisfactorily investigated.

PATHOLOGY.

The pathological processes which result from intra-uterine disease and those which are connected with delivery are peculiar to early life. They have already been referred to in the section on etiology. Of the processes of early life which begin after birth, the first in frequency are those of the mucous membranes resulting from the various forms of infection. In summer, it is the stomach and intestines which suffer chiefly; in winter, the respiratory tract.

The serous membranes are rarely the seat of primary inflammation. The pleura is seldom the seat of primary disease, but very often in-

volved secondarily to disease of the lung itself. Affections of the pericardium and peritonæum are quite rare. Meningitis is fairly common both in the simple and the tuberculous form.

Diseases of the lymph nodes (lymphatic glands) play an important part in connection with the acute diseases of the mucous membranes, with many affections of the skin and even of the viscera. Acute infection tends to excite suppurative inflammation, particularly in infants; a less active process leads to chronic hyperplasia in the mesenteric, mediastinal, and cervical glands, in the tonsils, adenoid tissue of the pharynx, etc. The lymph nodes in the neck and thorax are frequently the earliest seat of tuberculous deposits, and in very many cases they are the foci from which secondary infection of the lungs, brain, or joints may occur.

Of the visceral inflammations* those of the lungs are the most com-

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* The following table gives in a general way a very good idea of the relative frequency of diseases of the different organs in infancy. It is based upon seven hundred and twenty-six consecutive autopsies in the New York Infant Asylum, extending over a period of eight years during my connection with that institution. More than one half of the autopsies I made personally. Of these children seventy-two per cent were under one year, twenty-five per cent between one and two years, and only three per cent were over two years. The institution does not receive infants under one month, hence the absence of lesions peculiar to the newly born:

Table showing principal lesions in seven hundred and twenty-six consecutive autopsies in the New York Infant Asylum.

Lungs:		
Pneumonia—Primary		139
	Complicating other acute infectious diseases	112
	Complicating other conditions	71
	Noted to be present in	322
Pleurisy—	No case uncomplicated with disease of lungs.	
	Empyema	5
	Serous pleurisy	1
	Dry pleurisy in nearly all the severe cases of pneumonia.	
Atelectasis (congenital)		6
Pulmonary abscess (always with pneumonia)		7
Pulmonary gangrene (always with pneumonia)		2
Pulmonary tuberculosis		56
Mouth:		
Noma		1
Peritonæum:		
Acute peritonitis (localized 2, with acute pneumonia and pleurisy 2)		4
Kidneys:		
Acute nephritis (complicating scarlet fever 4, diphtheria 1, pneumonia 4, measles 1, pertussis 1, ileo-colitis 2, pyonephrosis 1, apparently primary 5)		19
Malformations of the kidney		7

mon, it being rare to find the lungs normal at autopsy after any acute infectious disease which has lasted a week. Up to the third or fourth year of life the heart usually escapes. In older children it may be involved, as in adults, in the rheumatic diseases. The liver and spleen are not often the seat of organic disease in early life, nor is serious disease of the kidney likely to be met with excepting in connection with scarlet fever. Organic disease of the brain itself is rare, as is also organic disease of the spinal cord, with the exception of poliomyelitis. Chronic diseases of the different viscera are decidedly rare, except when resulting from acute processes. Diseases of the bones and joints are common, and of extreme importance. They are usually of tuberculous, less frequently of syphilitic, origin. Diseases of the blood are quite common, but as yet but little understood. New growths are rare. The parts most frequently the seat are the kidney and the bones. Disorders of nutrition are extremely common and of great importance, particularly rickets and scurvy.

PROGNOSIS AND INFANT MORTALITY.

The younger the patient the worse the prognosis in all the diseases of childhood. This is in consequence of the feeble resistance of the infantile organism to all diseases, particularly those which are of an acute nature. On the other hand, the rapid metabolism of childhood makes it possible for many conditions of an organic nature to disappear with time, or, as the phrase is, to be "outgrown," provided the patient can be so placed that the general nutrition can be carried to the highest point.

The accompanying chart (Plate I) shows the mortality of New York city by months during the three years from 1890 to 1892, inclusive,

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Stomach and Intestines:

Acute ileo-colitis, with or without gastritis	116
Acute gastritis (without intestinal lesions)	None
Acute diarrhœal disease (without gross lesions)	72
Intussusception	1

Heart:

Pericarditis (all with acute pneumonia)	3
Congenital malformations	3
Acute or chronic endocarditis	None

Brain:

Acute, simple, or purulent meningitis (7 with pneumonia, 2 cerebro-spinal)	14
Tuberculous meningitis	11
Acute encephalitis	1
Chronic pachymeningitis	5
Chronic simple meningitis	1
Chronic hydrocephalus	3

There were twenty-six deaths from marasmus without gross lesions.

PLATE I.

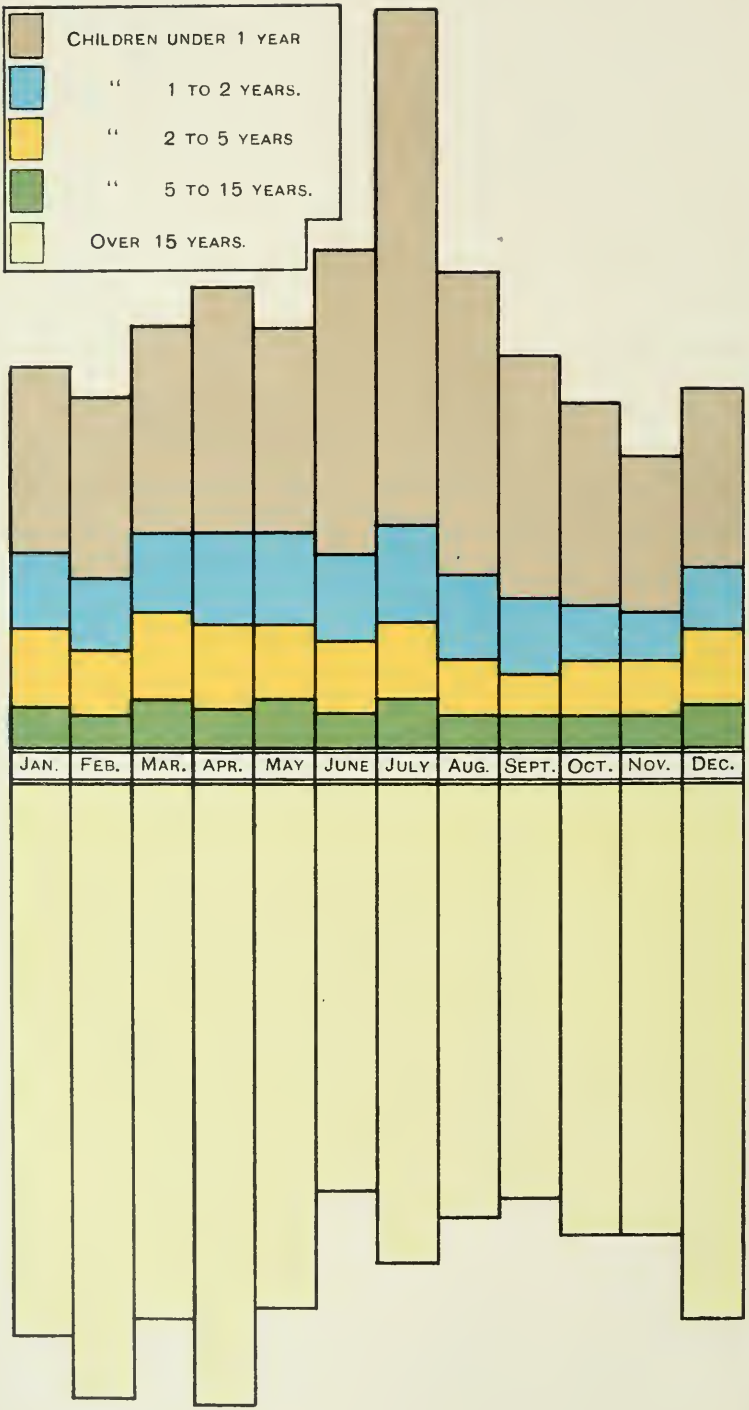

Chart showing by months the mortality of New York city for the different ages for three years. (Scale, 1 in. = 2,200 deaths.)

representing a total mortality of 128,136. This is distributed among the different ages as follows :

Under 1 year	32,916	=	26 per cent.
1 to 2 years	10,547	=	8 "
2 to 5 "	9,794	=	7 "
5 to 15 "	5,470	=	5 "
Over 15 "	69,409	=	54 "
	128,136		

Thus over one fourth of all the deaths occurred during the first year of life, and over one third in the first two years. The graphic chart gives a better idea of this than the figures. It will be noticed that the only age in which the mortality is much increased in the summer months is in the first year.

According to Eröss, who collected statistics from sixteen cities of continental Europe, of 1,439,056 infants born, there died in the first four weeks of life 130,610, or nearly ten per cent.

The Most Frequent Causes of Death at the Different Periods of Childhood.—According to Eröss, of 94,400 deaths occurring during the first four weeks, fifty-six per cent were due to congenital debility. The other causes which raise the mortality in this period are asphyxia, infection, congenital malformations of the heart, intestine, or genito-urinary tract, hæmorrhages, convulsions, acute attacks of diarrhœal diseases, and pneumonia. Pneumonia is exceedingly common in very young infants, both as a primary and secondary lesion.

Statistics from America and Europe show that in all large cities infant mortality has been steadily increasing for the past twenty-five years. This is due to many causes—overcrowding, neglect, and unhygienic surroundings. But more important than all is artificial feeding as at present ignorantly practised. In my experience it is exceedingly rare to find a healthy child who has been reared in a tenement house, and who has been artificially fed from birth. While among the poor the capacity for maternal nursing seems to be diminishing year by year, among the better classes it has come to be the exception and not the rule. In my private practice not one third of the mothers have been able, even though willing, to nurse their infants. But as ignorant and improper feeding are not confined to the poor, we find among rich and poor alike the largest number of deaths in the first year due to disease of the gastro-enteric tract and marasmus, either alone or associated. In the second rank come acute diseases of the respiratory tract, especially acute broncho-pneumonia. All other causes of mortality fall far below these two. Of the nervous diseases, convulsions and tuberculous meningitis are the only ones that are common. Of the acute infectious diseases pertussis takes the first place, with measles second, while tuberculosis ranks first of the chronic infec-

tions. Although rarely the cause of death, rickets is a very important factor in increasing the mortality of other diseases.

During the second year the deaths from marasmus are few. The diseases of the gastro-enteric tract are still a large factor in the death rate, but by no means to so great a degree as in the first year of life. Nearly if not quite as important during this period are the acute diseases of the lungs and the acute infectious diseases, especially measles, diphtheria, and pertussis. Deaths from scarlet fever are much less numerous. General tuberculosis and tuberculous meningitis are frequent.

From the second to the fifth year the deaths are mainly from acute infectious diseases—chiefly diphtheria and scarlet fever—much less frequently from measles or pertussis. In the next group come the acute diseases of the lungs, general tuberculosis, and tuberculous meningitis.

From the fifth to the fifteenth year the mortality in childhood is remarkably small, diphtheria and scarlet fever being still in the front rank in point of frequency. Next come the acute diseases of the lungs, simple as well as tuberculous meningitis, diseases of the bones, appendicitis, rheumatism, and cardiac disease.

Sudden Death.—This is not a very uncommon occurrence in infants who are apparently healthy. They are sometimes found dead in bed under circumstances in which grave suspicions may unjustly rest upon the attendants. The causes are often very puzzling. While sudden death sometimes occurs in children who are apparently in perfect health, it is very much more frequent in those who are delicate or suffering from malnutrition. Among this latter class, such as are seen especially in institutions, sudden death is by no means rare.

The most frequent causes of sudden death in infants are the following:

1. *Malformations.*—While in most cases, to be sure, malformations of a serious nature give rise to symptoms, they may be absent, or may be so slight as to be overlooked. Infants may succumb during the first few days of life from malformations of the heart, lungs, kidneys, stomach or intestines, and sometimes from diaphragmatic and umbilical hernia.

2. *Internal hæmorrhage.*—This is chiefly limited to the first two weeks of life. In the cases that have come to my notice the cause has been rupture of some subperitoneal hæmorrhage into the general abdominal cavity. The primary hæmorrhage is most frequently into the suprarenal capsule. It may be beneath the capsule of the liver. Such cases are reported in the chapter upon Visceral Hæmorrhages in the Newly Born. Under these circumstances no symptoms may exist until the occurrence of collapse, with death in a few hours.

3. *Asphyxia from overlying.*—This is not very common, excepting among the lower classes, and is most frequently due to intoxication on the part of the mother. Such children after death present the usual lesions

of death from asphyxia, but without any evidence of violence. This form of asphyxia is most frequently seen in infants a few weeks old. A recent writer in the British Medical Journal states that one thousand infants die every year from this cause in the city of London alone.

4. *Asphyxia from aspiration of food into the larynx and trachea.*—This may be due to vomiting or to the regurgitation of food during sleep; in a very weak infant it may occur while awake. This is usually seen in infants who are less than a year old, and most of the reported cases have been under six months. Such children are usually delicate. There seems to be vomiting with an attempt at crying, during which the food is drawn into the air passages. In some cases, as that reported by Demme, a single large clot of milk has been found in the larynx. In others, food is found in the larynx, trachea, and large bronchi. Cases have also been reported by Partridge and Parrot, and I have myself met with at least three. The infants have generally been found dead in bed within a few hours after feeding. This accident is more likely to happen when an infant lies upon its back.

5. *Asphyxia associated with enlargement of the thymus gland.*—I have notes of three such cases. Two of them occurred in the New York Infant Asylum and one at the Nursery and Child's Hospital. The children were aged respectively three, four, and ten months. The symptoms were asphyxia, followed by convulsions and death in a few hours. The thymus was in all the cases very greatly enlarged, the weight being over one ounce. Only one of these children was markedly rachitic. I have found in literature records of fifteen other cases of a similar nature in children varying from three to sixteen months. The symptoms in all have been similar to those in my own cases. The asphyxia is apparently due to pressure upon the pneumogastric. Rickets was present in about one half of the recorded cases.

6. *Atelectasis.*—In very young infants there may be no symptoms excepting malnutrition until sudden death occurs, sometimes with convulsions and sometimes without any such symptoms. I have in several instances known death to follow compression upon the lungs by the overdistended stomach, the symptoms coming on very soon after feeding or associated with an attack of indigestion. (See Atelectasis.)

7. *Marasmus.*—In this class of cases sudden death is of very common occurrence. These children are often as well two or three hours before death as for several weeks. Death frequently occurs at night, the children being found dead in bed in the morning. In some of the cases the exciting cause seems to be the lowering of the temperature, while in many no exciting cause can be found; the vital spark simply goes out after burning for some time with a feeble intensity. In some of these cases the autopsy reveals atelectasis, but in many cases nothing abnormal is found, death apparently resulting from heart failure.

8. *Convulsions in children previously showing no signs of disease.*—Most of these cases are seen in children who were previously rachitic. In them the autopsy shows no lesion except those commonly associated with death from convulsions. It is extremely rare for a cerebral lesion such as hæmorrhage to produce death in this way. In some of these rachitic cases death is due to spasm of the glottis.

9. *Asphyxia in older infants and young children.*—This may result from the pressure of a retropharyngeal abscess upon the larynx or trachea, or from the rupture of such an abscess during sleep and the entrance of pus into the air passages. While in most such cases other symptoms have been present, they may be latent. A rare cause of sudden asphyxia in children from eighteen months to five years is pressure upon the pneumogastric by tubercular bronchial glands, or by abscesses in the posterior mediastinum connected with caries of the spine. I have seen examples of both the latter. Gibney has reported a case of sudden death from dislocation of the upper cervical vertebræ consequent upon caries.

Sudden asphyxia may follow the ulceration of tubercular lymph nodes and the escape of cheesy masses into the trachea or primary bronchi. This usually occurs in children from two to five years old, and many cases have been reported.

10. *Death after a few hours' illness, in which the chief symptom is high temperature.*—This is quite a common occurrence. Children who are apparently well may be taken with great prostration and a high temperature, which may rise rapidly to 106° or even 107° F., with death in from six to twelve hours, sometimes preceded by convulsions. In my hospital experience I have met with many such cases. In infants, the most frequent explanation of these symptoms, as shown by autopsy, is acute congestive pneumonia; in older children it may be due to malignant scarlet fever or epidemic meningitis, although I have never seen an instance of either of these diseases in which death occurred in the first twenty-four hours.

It does not fall within the scope of this chapter to consider cases of sudden death from heart failure after diphtheria, with pleurisy with effusion, or with myocarditis. These will be discussed elsewhere.

PROPHYLAXIS.

There is no more promising field in medicine than the prevention of disease in childhood. The majority of the ailments from which children die, it is within the power of man in great measure to prevent. Prophylaxis should aim at the solution of two distinct problems: (1) The removal of the causes which interfere with the proper growth and development of children; (2) the prevention of infection. The former can come only through the education first of the profession and then the

general public, in the fundamental principles of infant feeding and hygiene. This is a department which has received altogether too small a place in medical education. The latter must come through the profession, and through legislation, the purpose of which shall be more rigid quarantine, more thorough disinfection, and improved sanitation in all its departments.

THERAPEUTICS.

Treatment in the diseases of children, and particularly those of infants, is a difficult subject. Therapeutics in infancy consists in something more than a graduated dosage of drugs. Many therapeutic means which are valuable in adults are useless in children, and many others which are of little value in adults are extremely useful in children. There is no doubt of the truth of the statement that children in the past have suffered much from overzealous treatment, particularly from drug-giving. It should be a fundamental principle never to give a dose of medicine without a clear and definite indication. If this rule is followed, it is surprising to find how often medication can be dispensed with, and also, in many cases, how much better children do without drugs than with them. A second rule is equally important: never to give a nauseous dose when one that is palatable will answer the purpose equally well. This is no small matter, and one that is well worth the physician's careful attention, if he would succeed in the management of sick children. The simpler prescriptions are made, the better. As a rule, infants revolt against most of the highly seasoned sirups and elixirs which are used to disguise the taste of unpleasant doses. Bitter medicines when mixed with water, are frequently administered without the slightest difficulty.

It is a common mistake to underestimate the importance of the hygienic surroundings of the patient, the value of good nursing, careful feeding, and judicious stimulation, just as it is to overestimate the beneficial effects of drugs. In the great majority of acute ailments not serious in character for which a physician is called, the patient recovers quite as promptly without drugs as with them. This does not mean that such children require no treatment, but that the least important part of the treatment is drug-giving, while the most important part is attention to the hygienic matters just referred to. In cases of severe illness, in infants especially, we must avoid all unnecessary medication, in order that the stomach may not be disturbed and vomiting excited. Hence the importance of relying as far as possible upon local measures of treatment. The tendency to recovery from all acute processes, while seen in adults, is even more striking in children, where, if we can but remove that which hampers the bodily functions, Nature will conduct the case to a satisfactory termination. Thus, after an attack of ordinary bronchitis of no great severity, it is often seen that the disturbance of the stomach and intestines, which

can be directly traced to the drugs employed, continues long after the original disease has subsided, and is very much more difficult to relieve. In diseases of the stomach and intestines especially there is a great amount of overmedication, very much to the detriment of the patient. In all chronic disturbances of nutrition—chronic indigestion, malnutrition, and anæmia—nothing is of so much value as change of air and surroundings. This is most striking in the case of city children. With them it is a frequent experience that tonics of every description are of little or no avail, and yet immediate and most marked improvement begins when the children are sent to the country.

The tablet triturates have furnished us with a convenient method of administering many drugs to children. Those which are especially useful are: calomel, from one tenth to one half grain; gray powder in the same doses; antimony and ipecac, one one-hundredth of a grain each; phenacetine, one to two grains; arsenious acid, one one-hundredth of a grain; paregoric, ℥v; Dover's powder, one tenth of a grain; atropine, one four-hundredth to one two-hundredth of a grain. This list might be very greatly extended.

As to the method of administration, it is to be remembered that several small doses are more easily given and less likely to disturb the stomach than a few larger ones. This method of administering very many drugs to children will be found extremely satisfactory — e. g., sodium bromide, one half grain every fifteen minutes, is often better than five grains every two hours; phenacetine, one half grain every half hour, is better than two grains every two hours; calomel, one tenth of a grain every hour, is better for constipation than a single dose of two grains.

Antipyretics.—The indications for the employment of antipyretics in children are somewhat different from those in adults. It is to be borne in mind that, where the cause is similar, all temperatures in children are higher than in adults. Thus a simple pharyngitis, which in an adult causes a rise of temperature only to 100° or 101° F., is in a child not infrequently accompanied by a temperature of 104°, or even 105° F. The height of the temperature, as measured by the thermometer, is not to be taken as the only guide for the employment of antipyretics. In many cases the temperature is 104°, or even 105° F., and yet the child exhibits no signs of unusual discomfort. Such a temperature manifestly does not call for interference. Again, a temperature of 103° F. may be accompanied by very marked restlessness and other signs of distress which may be relieved by employing some antipyretic measure. The number of cases seen in practice, of high temperature apparently from trivial causes, is very great. One must not be unduly alarmed even by a very high temperature if it is of short duration. It is the continuously high temperature which indicates serious illness. Whenever the temperature

is found to be much above the normal it should be carefully watched, but not interfered with until a diagnosis has been made, unless the symptoms urgently demand it; otherwise the physician may lose one of the most valuable aids to diagnosis, since it is not the height of the temperature but its course which is significant. The routine practice of ordering full doses of antipyretic drugs whenever on the first visit an elevation of three or four degrees is discovered can not be too strongly deprecated. In many cases it is very important to know whether the temperature uninfluenced by drugs is remittent, intermittent, or steadily high, and hence the advantage of waiting until a diagnosis has been made before disturbing the temperature curve, always provided, of course, that the child is in no danger from the high temperature—a condition which is certainly not common. Since the cause of a great many obscure temperatures is found in the stomach and intestines, it very often happens that a purgative, stomach-washing, or intestinal irrigation may be the most efficient antipyretic. In cases of moderate elevation of temperature we need go no further than cold sponging.

The most reliable antipyretic measure for infants is the use of cold. This may be employed—

(1) *As an ice cap to the head.*—In many cases of quite high temperature and restlessness in infants this alone will reduce the temperature one or two degrees and allay the nervous symptoms. It may be used continuously or intermittently, according to circumstances.

(2) *Cold sponging.*—For this purpose water about 80° to 85° F., equal parts of alcohol and water, or equal parts of vinegar and water may be employed. In the case of infants, all the clothing except the diaper should be removed and the child laid upon a blanket. The body should be sponged for from ten to twenty minutes, preferably under a sheet which is thrown over the body. Cold sponging must be very frequently employed in order to be efficient in reducing high temperature. Its great value in allaying nervous symptoms, even when the temperature is not very high, is not sufficiently appreciated. Its effect is often more satisfactory than an anodyne.

(3) *Cold pack.*—This is one of the simplest and most efficient means of reducing temperature which can be employed. The child should be stripped and laid upon a blanket. The entire trunk should then be enveloped in a small sheet wrung from water at a temperature of 100° F. Upon the outside of this, ice may now be rubbed over the entire trunk, first in front and then behind. By this method there is no shock and no fright, and any ordinary temperature can usually be readily reduced. The rubbing with ice should be repeated in from five to thirty minutes, according to circumstances, after which the child may be rolled in the blanket upon which he is lying without the removal of the wet pack. The head should be sponged with cold water while this is being carried

on, and artificial heat, if necessary, should be applied to the feet. The pack is continued from one to twenty-four hours, according to circumstances.

(4) *The cold bath.*—This is more easily employed in the case of infants than larger children. The child is put into a bath at a temperature of 100° F., the bath being gradually lowered by the addition of ice to 85° or 80° F. The body should be well rubbed while the child is in the bath and water should also be applied to the head. On removal from the bath, the body should be quickly dried and rolled in a warm blanket. The bath is usually continued from five to twenty minutes.

(5) *Irrigation of the colon* is an efficient means of lowering the temperature. The water should be from 40° to 50° F.; it should be injected through a catheter, and not more than a pint should be introduced at one time. It is not to be advised except in cases of colitis, where the double purpose of lowering the temperature and cleansing the intestine may be accomplished at the same time.

Antipyretic Drugs.—Except in cases of malaria, quinine should not be employed for the reduction of temperature in children. The dose required is so large, the difficulty of administration is so great, and the tendency to upset the stomach is so uniform, that its use should be discouraged altogether; besides, its effect is extremely uncertain.

Of the three antipyretics more recently introduced—phenacetine, antipyrine, and antifebrine—their value in children is in the order named. Phenacetine, has the advantage of being tasteless, but the slight disadvantage of being insoluble. Antipyrine is so bitter as to make its administration often difficult. The prostration attending the use of antifebrine is rather greater than that of either of the others. None of these drugs is, however, to be employed in large doses with the sole purpose of reducing the temperature. Their great value in pædiatrics consists rather in allaying the nervous symptoms which accompany fever, and this purpose can be accomplished by the use of comparatively small doses. To an infant of one year, phenacetine or antipyrine can be given in one-grain doses every hour or two hours until the desired effect is produced. For a child of five years a dose of two grains may be given in the same manner. When used as indicated, these drugs are of very great value in making the patient more comfortable, in promoting sleep, and in allaying headache and general pains. In cases of hyperpyrexia they are, however, much less certain and less safe than the use of cold. In many cases of mild pyrexia the symptoms are relieved by the administration, either separately or in combination, of citrate of potassium, spiritus ætheris nitrosi, and liquor ammonii acetatis, in small frequent doses.

Stimulants.—In spite of the many statements to the contrary, alcoholic stimulants are well tolerated even by very young infants. Proportionately larger doses of alcohol than of most drugs may be administered

to infants; still, stimulants, and alcohol in particular, are no doubt very greatly abused in the hands of many practitioners.

The indications for the employment of stimulants are much the same in young children as in adults. They are to be used whenever the pulse is weak, soft, and compressible, and whenever the general powers of the patient are very greatly depressed. In most of the acute fevers they are not to be given early in the disease, and in many cases they are not required at all; but whenever the patient's general strength is greatly reduced, and what is known as the typhoid condition develops, they are to be used freely, whatever the disease may be. They must often be used very sparingly while the temperature is high, but given freely as soon as it falls. In many acute febrile diseases stimulants are not called for at any period. This is especially true of most cases of lobar pneumonia. The time, however, when they are most likely to be needed is at or just after the crisis of the disease, when for twenty-four hours they should be very freely given. In broncho-pneumonia they are more uniformly required, and their use should be begun earlier. This is particularly true of the broncho-pneumonia which develops secondarily to the infectious diseases. In all toxic diseases, such as diphtheria, alcohol should be begun as soon as depressing symptoms show themselves, and continued in doses regulated by the degree of prostration. In the acute gastro-enteric diseases the depletion is often so great and there is so little absorption of food that the patients must in certain cases be sustained by alcohol for several days.

Alcoholic stimulants are contra-indicated in all acute febrile processes where there is high temperature, dry skin, flushed face, and a full, strong pulse. In such conditions they are often injurious.

The method of administering stimulants is of no little importance. Brandy and whisky are in most cases to be preferred to the wines, but not always. Champagne may be substituted when spirits are not well borne by the stomach. For infants under one year old, brandy should be diluted with at least eight parts of water. It is commonly given in too concentrated a form. Altogether the best method of administration is to determine the amount to be given in every twelve hours, have it diluted sufficiently, and then administer it in small doses at short intervals. In this way vomiting is rarely produced. The addition of brandy to the water required by the thirst makes it less likely to disturb the stomach.

The quantity of alcohol will depend very much upon circumstances. An infant one year old, for whom alcoholic stimulants are needed at all, should be given, to begin with, half an ounce of whisky or brandy during twenty-four hours, the quantity being increased for a short period to an ounce and a half, or in bad cases even to two ounces; but it is very rarely, if ever, advisable to go beyond this limit.

In children four years old double the amount may be employed in the corresponding conditions. Larger quantities than those mentioned are of doubtful advantage. Alcohol when used injudiciously is capable of doing much harm.

Tonics.—Cod-liver oil stands at the head of the list of tonics for young children. It is particularly in the convalescence after acute diseases of the respiratory tract that we see its most striking benefit. It is also of very great use in anæmia, and in a large number of children who are extremely delicate. In these patients it may be advantageously administered throughout the greater part of nearly every winter season. In convalescence after attacks of gastro-enteric disease it is not nearly so useful, and often must be withheld for a long time. It is a mistake to give cod-liver oil at any time when the tongue is coated, the digestion poor, and the stomach easily disturbed. In the case of infants, as a rule, the pure oil is to be preferred to the emulsions, but this is not always the case. The administration of small doses—i. e., ten or twenty drops of the oil three times a day continued for a long period—is much better than the use of larger doses for a shorter time.

A perfect preparation of iron for use in infancy has not yet been discovered. During the first few years all astringent preparations should be avoided. For use at this age the best forms are probably the bitter wine, Robin's peptonate, Gude's peptomanganate, Drees's albuminate, and the malate of iron. The peptonate and peptomanganate have the advantage of mixing easily with milk. For older children nothing is more satisfactory than Blaud's pills.

Arsenic is second only to iron in the treatment of the anæmia of children, and in very many cases it is to be preferred to iron. The tablet triturates of arsenious acid, one one-hundredth of a grain, may be given immediately after meals three times a day, or one or two drops of Fowler's solution largely diluted with water.

Alcohol is of very great value as a tonic in combination with some of the bitters, either small doses of quinine, nux vomica, or the bitter wine of iron. Usually wines, especially sherry, are to be preferred to spirits, although some children take spirits better. When combined with a bitter there is little danger of the formation of the alcoholic habit, even though its use may be long continued.

Of the bitter tonics, quinine and nux vomica are easily superior to all others.

Opiates.—Strong objections have been urged by many against the employment of opium in the diseases of infancy. While opiates have no doubt been abused, the fact remains that opium is almost as valuable a remedy in the treatment of disease during the first five years as at any other period of life. Infants are, however, peculiarly susceptible to the drug, and relatively much smaller doses are required than

of most medicines. If the physician will accustom himself to the use of very small doses, he will be surprised to see how satisfactory are the effects produced.

The most useful preparations for young children are paregoric, Dover's powder, the deodorized tincture, morphine, and codeine. The following table gives what may be considered safe initial doses at the different ages:

	1 month.	3 months.	1 year.	5 years.
Paregoric	♏ i	♏ ii	♏ v to x	♏ xxx to xl
Deodorized tincture	♏ $\frac{1}{20}$	♏ $\frac{1}{10}$	♏ $\frac{1}{4}$ to $\frac{1}{2}$	♏ ii to iii
Dover's powder	Gr. $\frac{1}{20}$	Gr. $\frac{1}{10}$	Gr. $\frac{1}{4}$ to $\frac{1}{2}$	Gr. ii to iii
Morphine	Gr. $\frac{1}{1000}$	Gr. $\frac{1}{600}$	Gr. $\frac{1}{200}$	Gr. $\frac{1}{30}$ to $\frac{1}{20}$
Codeine	Gr. $\frac{1}{300}$	Gr. $\frac{1}{200}$	Gr. $\frac{1}{60}$	Gr. $\frac{1}{10}$ to $\frac{1}{8}$

Ordinarily doses like the above should not be repeated oftener than every two hours. In exceptional circumstances, as when very great pain is present, the dose may be given more frequently. In the hypodermic use of morphine it should be remembered that its effects are always more uniform and striking than when the drug is administered by the mouth, and the dose should therefore be smaller. In every instance where a full dose of opium has been given the physician should wait until the effects have subsided before the dose is repeated.

Anodynes.—Chloral is usually well borne even by quite young infants. In them it should never be administered by the mouth, but, on account of its irritant properties, always by the rectum. After rectal administration its effects are usually manifest in half an hour, and sometimes sooner. The dose for an infant of one month is one grain; three months, two grains; one year, three to five grains. It may be repeated every two to four hours, according to indications. Other drugs may replace this in most diseases, but in the case of infantile convulsions nothing is so reliable as chloral.

Belladonna is well borne by children, and in larger doses than most drugs. A tolerance is quite readily established. The eruption is more readily produced than the other physiological effects, and even quite small doses may be sufficient to bring out a very abundant blush. The parents should be advised of this fact, lest undue alarm be felt.

The drugs classed as antipyretics—phenacetine, antipyrine, and antifebrine—are exceedingly valuable in the treatment of many diseases of infancy where irritative nervous symptoms are prominent. In many cases they may advantageously take the place of opium, except where pain is the principal symptom, as in otitis or pleurisy. In all conditions where spasm is a prominent symptom, whether of the larynx or bronchi, or local or general convulsions, antipyrine is especially valuable.

Drugs well borne by Children.—In this list might be mentioned belladonna, the bromides, the iodides, chloral, quinine, calomel—in fact, all mercurials—and alcohol.

The drugs not well borne include particularly cocaine and all preparations of opium. In the case of many others, while the constitutional effects are well tolerated, they must be given carefully to young infants, since they are irritants to the stomach. In this class may be mentioned the salicylates, salol, the astringent preparations of iron, and the acids.

Counter-irritants.—These are of great value in a large variety of diseases. *Blisters* should never be employed in the case of infants, and very rarely, and never needlessly, in the case of older children. In the latter they may be required in inflammations of the ear, of the joints, or of the spine; they should never be applied to the chest.

The *mustard paste* is probably the most satisfactory means of producing quick counter-irritation over a large surface. To make a mustard paste: Take one part powdered mustard and six parts of wheat flour, mix with lukewarm water, and spread between two layers of muslin. This should be removed as soon as a thorough redness of the skin has been produced—in most cases from five to eight minutes, according to the strength of the mustard employed. This may be repeated as often as every three hours, and continued for a week if necessary, without producing excoriations of the skin. For older children the paste may be made one part mustard to four parts flour. In pulmonary diseases it should be large enough to surround the chest. When it is used to produce general reaction in heart failure it should cover the entire trunk.

The mustard pack.—The child is stripped and laid upon a blanket, and the trunk is surrounded by a large towel or sheet saturated with mustard water. This is made as follows: One tablespoonful of mustard to one quart of tepid water. In this a towel is dipped, and while dripping wound around the entire body. The patient should then be rolled in the blanket. This pack may be continued for ten or fifteen minutes, at the end of which time there will usually be a very decided redness of the whole body. It may be repeated according to indications. Where it is desired to produce a general counter-irritation, the mustard pack is not quite as efficient as the mustard bath, but it has the advantage in causing much less disturbance to the patient. The mustard pack is useful in the condition of collapse or of great prostration from any cause whatever, in convulsions, and in cerebral or pulmonary congestion.

The *turpentine stupe* is made by wringing a piece of flannel out of water as hot as can be borne by the hand. Upon this is sprinkled ten or fifteen drops of the spirits of turpentine. The stupe is then applied to the body and covered with oiled silk or dry flannel. It is useful chiefly in abdominal pains or inflammations, but in infancy must be carefully

watched or vesication will be produced. For continuous use it is not so valuable as the mustard paste.

Stimulating liniments containing turpentine and other irritants are useful in inflammation of the chest, although less reliable than the mustard paste. One of the mildest and most useful preparations is camphorated oil. Another is olive oil four parts and turpentine one part. These may either be rubbed upon the surface, or a piece of flannel may be saturated with them and then applied to the skin. The old-fashioned spice bag is useful in many cases where a very mild counter-irritant is desired over the abdomen.

Dry cups may be used even in young infants, to relieve acute pulmonary congestion. They are sometimes of very great value, and may succeed in cases in which there is no reaction from the mustard. From four to six cups may be applied, and the effect may be continued by the application of the mustard paste. Wet cups should never be used in young children.

Poultices are useful in local inflammations about the glands of the neck, the joints, and in cellulitis in various parts of the body. The prolonged use of poultices can not be too strongly condemned in cases of otitis. In diseases of the chest, poultices may do harm because their weight embarrasses respiration, and sometimes because of the exposure when they are changed. They are most useful in pulmonary diseases in which there is great pain, as in pleurisy or in pleuro-pneumonia. In bronchitis and in broncho-pneumonia they are objectionable, certainly for prolonged use, on account of their weight. Better effects can generally be produced by hot fomentations and counter-irritation. Ground flaxseed is the best material for poultices. This should be mixed with boiling water until the proper consistency is reached, when the poultice should be put into a bag of muslin. The poultice should be covered with oiled silk or cotton batting, so that it will retain its heat as long as possible. To be of value, poultices must be applied hot and changed frequently.

Hot fomentations are more cleanly than poultices and much more easily changed. One of the best means of applying them is by a piece of spongio-piline wrung from water as hot as the hand can bear. Where this can not be obtained, a large piece of flannel may be used in the same way, covered with cotton batting, and then with oiled silk. This method of using hot fomentations is exceedingly satisfactory for applications to the extremities.

Cold.—Cold is useful in all forms of inflammation of the eyes and brain. In inflammation of the cervical lymph glands and of the joints it is of undoubted value, but its advantage over heat is questionable. The efficiency of both cold and heat in these cases depends largely upon the method of application. Sometimes in pleurisy much greater relief is obtained from the use of an ice bag to the chest than from hot applications,

but this is not the general experience. The treatment of pneumonia by the application of the ice bag to the chest has some excellent advocates, although my own experience has not led me to look upon it with much favor. It is admissible only in lobar pneumonia. The use of cold in inflammations of the larynx, trachea, or bronchi is, in my opinion, positively contra-indicated, certainly so in infants and young children.

Cold is best applied to the head by an ice cap made like a helmet; an ordinary rubber or flannel bag filled with ice may answer the purpose. The rubber coil filled with ice water is also an excellent method. For inflamed glands or joints the ice bag should be used; for the eyes cold compresses changed every minute.

The Hot Pack.—All clothing is to be removed and the child's body covered with towels wrung from water at a temperature of from 100° to 110° F., after which the body should be rolled in a thick blanket. These hot applications may be changed every twenty or thirty minutes until free perspiration is produced, which may be continued as long as necessary. This is mainly useful in uræmia.

The Hot Bath, like the mustard pack or the mustard bath, may be used to promote reaction in cases of shock or collapse. The patient should be put into the bath at a temperature of 100° F., the water being gradually raised to 105°, or even to 110°, but rarely above this point. The body should be well rubbed while the patient is in the bath. A thermometer should be kept in the water to see that the temperature does not go too high. During the bath, in most cases, cold should be applied to the head.

The Hot-Air or Vapour Bath.—All the clothing should be removed and the patient laid upon the bed with the bedclothing raised above the body ten or twelve inches, and sustained by means of a wicker support. The bedclothing should be pinned tightly about the neck, so that only the head is outside. Beneath the bed clothing hot vapour is introduced from a croup kettle or a vapourizer. This will usually induce free perspiration in fifteen or twenty minutes. It may be continued from twenty to thirty minutes at a time. Instead of vapour, hot air may be introduced in the same way. The air space about the body is indispensable. The vapour bath is applicable chiefly to cases of uræmia.

The Mustard Bath.—Four or five tablespoonfuls of powdered mustard should be mixed for a few minutes with one gallon of tepid water. To this should be added four or five gallons of plain water at a temperature of 100° F. The temperature of the bath may be raised by the addition of hot water to 105° or 110° F. if desired. Nothing is more efficient than the hot mustard bath for a general derivative effect in bringing the blood to the surface in cases of shock, collapse, heart failure from any cause, or in sudden congestion of the lungs or brain. The bath should not usually be continued for more than ten minutes. If necessary, it may be repeated in an hour.

The Bran Bath.—Put one quart of ordinary wheat bran in a bag made of coarse muslin or cheese cloth and place this in four or five gallons of water. The bran bag should be frequently squeezed and moved about until the bath water resembles a thin porridge. It may be of any temperature desired, but usually about 90° to 95° F. is best. A bran bath is of great value in cases of eczema, excoriations about the buttocks, or in other cases where the skin is very delicate, and plain water seems to irritate it.

The Tepid Bath may be given at a temperature of 95° to 100° F. It is very useful in many conditions of excitement or extreme nervous irritability. To induce sleep it is often more efficient than drugs.

The Cold Sponge or Shower Bath should be given in the morning before breakfast, and in a warm room. The child should stand in a foot tub containing warm water enough to cover the feet, then a large sponge holding about a pint of water at a temperature of from 40° to 60° F. should be squeezed three or four times over the chest, shoulders, and spine of the child, the skin being rubbed meanwhile. The bath should not last more than half a minute. It should be followed by a brisk rubbing until a thorough reaction is established. This is very useful at all ages, but a particularly valuable tonic in delicate children. It may be used in those only eighteen months old. Not the least of the beneficial results is the full expansion of the lungs from the strong cry which the bath usually excites. In younger infants a cold plunge may be substituted. This should be merely a single dip of the entire body in water at a temperature of 50° to 60° F. In order that beneficial effects shall follow the cold plunge or cold sponging, a good reaction must be established. If children lack sufficient vitality to secure this, and if they remain pale, pinched, and blue for some time after the bath, it must be discontinued altogether, or water of a higher temperature used.

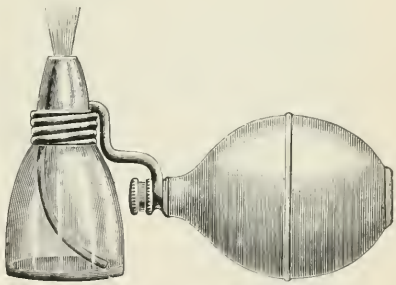

Fig. 8.—Albolene atomizer.

Nasal Spray.—This may be either of an aqueous or oily solution. For the oil spray an atomizer similar to that shown in the accompanying cut should be employed. It is valuable in cases of dry catarrh, where there is a formation of crusts in the nose. A variety of oils may be used in the spray, albolene being perhaps as satisfactory as any. Fig. 8 shows an efficient atomizer for albolene.

There are a good many forms of hand atomizers to be found in the market for the production of an aqueous spray. For a cleansing nasal

spray, Dobell's* solution, Seiler's† solution, Listerine ten-per-cent solution, or a two-per-cent solution of boric acid may be used.

Nasal Syringing.—In cases of considerable nasal obstruction and in the more serious affections of the rhino-pharynx only the syringe can be considered an efficient means of cleansing the cavity. The nasal syringe should be small enough to be easily worked with one hand. It should have a soft-rubber tip to prevent injuring the nose, and the tip should be large enough to fill the nostril. The best syringe for nasal use is shown in Fig. 9. This is made either of glass or hard rubber and fulfils all the

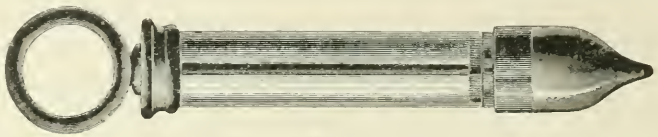

Fig. 9.—Nasal syringe.

conditions mentioned.‡ It is easy of action, can be readily cleansed, and holds about half an ounce. The same syringe should not be used for more than one patient, unless it has been very thoroughly disinfected. In hospitals, and even in private practice, nasal syringes are frequent carriers of infection. Two positions may be used in nasal syringing. In diphtheria, scarlet fever, or any constitutional disease attended by great depression, the child should not be removed from the bed. The syringing may be done by a single nurse who stands at the head of the bed, alternately syringing the right and left nostril, turning the head from side to side (Fig. 10). The other method is to hold the child erect on the lap with the head in-

* Dobell's solution:

Sodium biborate	ʒ j
Sodium bicarbonate	ʒ j
Glycerin of carbolic acid	ʒ ij

Water to make half a pint.

† Seiler's solution:

Sodium bicarbonate	ʒ j
Sodium biborate	ʒ j
Sodium benzoate	gr. xx
Sodium salicylate	gr. xx
Eucalyptol	gr. x
Thymol	gr. x
Menthol	gr. v
Oil gaultheria	gtt. vj
Glycerine	ʒ viij ss.
Alcohol	ʒ ij

Water to make sixteen pints.

This is also sold in tablets, one of which is dissolved in four ounces of water to make the solution of the above strength.

‡ This is made by the Goodyear Company.

clined a little forward, the syringing being done by a person who stands behind. In syringing, the water should come out of the opposite nostril or out of the mouth, to make it certain that the rhino-pharynx has been

Fig. 10.—Method of syringing the nose.

reached. When properly done, no prostration and very little irritation are caused.

Syringing the mouth and pharynx is useful in many pathological conditions of these parts, particularly in children too young to gargle. Either an ordinary hard-rubber piston syringe or a bulb (Davison) syringe may be used. If the pharynx is to be reached, the nozzle is used as a tongue depressor. This should be placed at the angle of the mouth between the back teeth. The child should be held in the sitting posture, with the head inclined forward. Only mild solutions should be employed.

Inhalations.—These are of very great utility in all affections of the respiratory tract. To be efficient, the patient should be put under a tent. A satisfactory tent may be made by erecting a T-shaped piece of wood at the head and foot of the crib and throwing over this a large sheet folded and pinned at the corners. Another method is, to stretch a cord around the top of each of the four posts of the crib, or simply from the centre of the head piece to the centre of the foot piece; the sheet should be used as in the first instance. A very good tent may be improvised by throwing a large sheet over an open umbrella. Instead of an ordinary cotton sheet one of rubber cloth may be used. For hospital use I have found it convenient to have a rubber cover made to fit closely over the top of the crib to be used for inhalations. The better the tent the more satisfactory are the results from inhalations.

Inhalations may be in the form of vapour or spray. The apparatus employed may be the croup kettle, the vapourizer, or the steam atomizer. As all of these are used with alcohol lamps, innumerable accidents from fire have occurred with them. Patients and nurses should always be cautioned regarding this. The ordinary croup kettle is a clumsy affair and especially likely to be the cause of accidents. In Fig. 11 is shown one of an improved pattern,* which possesses the advantages both of the ordinary croup kettle and of the vapourizer. The base has been weighted, to prevent the apparatus being easily upset. The pail is low, which fact also contributes to its stability. It is provided with a safety alcohol lamp, the flame of which can be regulated by a screw. The lamp holds enough alcohol to burn from five to six hours. This kettle may be used to produce simple vapour, or vapour from lime water, or a medicated vapour may be employed. If the latter is desired, the substance to be vapourized is placed on a sponge held in the expansion of the spout. The kettle should be filled with hot water before using. It should be placed upon the floor or a low box beside the crib, so that the end of the spout is just inside the tent at a level with the surface of the bed.

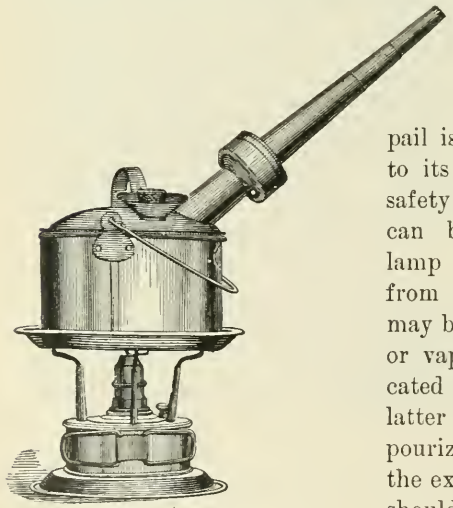

Fig. 11.—The author's croup kettle.

The vapourizer † (Fig. 12) is one of the most satisfactory means of

* Made by Lewis & Conger, New York.

† Made by Whitall & Tatum, Philadelphia.

obtaining medicated inhalations. The boiler is half filled with water, and the substance to be vapourized is placed upon a sponge which lies on a per-

Fig. 12.—Vapourizer.

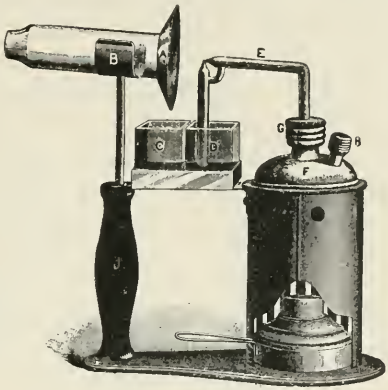

Fig. 13.—Steam atomizer.

forated diaphragm placed at the top of the boiler, so that all the steam generated in the boiler passes through it.

The steam atomizer is shown in Fig. 13. For this no tent is required. It should be placed about one and a half or two feet from the patient's face, and the clothing protected by a rubber sheet. This is very efficient where steam or vapour of lime water are used, but is not to be advised for carbolic acid, creosote, etc.

Oiled-silk Jacket.—In all forms of acute pulmonary inflammation this form of local application has largely supplanted the time-honoured poultice, both in hospital and in private practice. It keeps the skin at a uniform temperature, maintains a moderate degree of counter-irritation, and gives the patient a great deal of comfort. The jacket consists of three layers—an outer one of oiled silk, an inner one of cheese cloth or gauze, and a middle one of cotton batting or wool. The middle layer should be half an inch in thickness. The purpose of the lining is to keep the cotton in position. Fig. 14 shows the pattern of the jacket. It is generally made in two pieces, each of which should be about twelve inches wide and twelve inches long for a child of one year. These are sewed together along one border and lapped at the other, where it is secured by safety pins A properly made jacket will last two weeks.

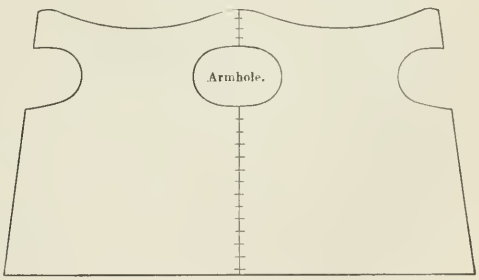

Fig. 14.—Pattern for oiled-silk jacket.

Stomach-Washing consists in the introduction of water into the stomach through a flexible catheter or stomach tube and then siphoning it out. It was introduced into general practice among infants by Epstein, of Prague. To Seibert (New York) is due the credit of bringing the subject prominently before the minds of the medical profession in America. It is one of the most valuable therapeutic measures we possess. Stomach-washing has been employed almost daily for the past seven years in the hospitals with which I am connected, during which period the stomach has been washed many thousand times. No accident whatever has occurred, and the operation may be considered entirely free from danger; in fact, it is difficult to pass the tube anywhere else than into the œsophagus. The amount of prostration may be compared to that of an ordinary attack of vomiting.

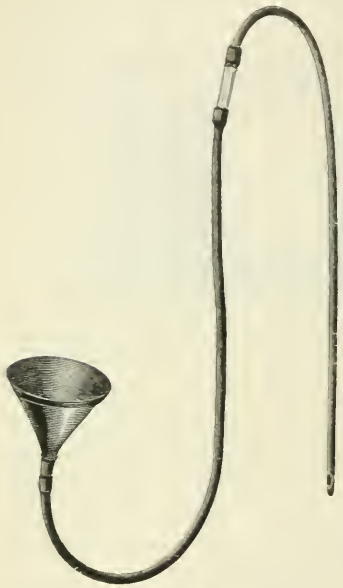

Fig. 15.—Apparatus for stomach-washing.

The apparatus for stomach-washing is very simple (Fig. 15). There is required a soft-rubber catheter, size 16, American scale (24 French)—one with a large eye is preferred; a glass funnel, holding four to six ounces; two feet of rubber tubing, and a few inches of glass tubing to join this to the catheter. The child should be held in a sitting posture (Fig. 16), the body well protected by a rubber sheet, with a large basin conveniently near. The catheter should be moistened. While the tongue is depressed with the forefinger of the left hand, the catheter is passed rapidly back into the pharynx and down the œsophagus. It is important that the first part of the introduction should be as rapid as possible, for if the child begins to gag from the pharyngeal irritation the introduction of the tube may be quite difficult. No resistance is ordinarily encountered after the tube reaches the œsophagus. About ten inches of the catheter should be passed beyond the lips. When it has reached the stomach the funnel should be raised as high as possible, to allow the escape of gases almost invariably present. It should then be lowered, in order to siphon out the fluid contents. If nothing escapes, the funnel is then to be raised and from two to six ounces of water poured into it from a pitcher; the funnel is then lowered and the water siphoned out. This procedure is repeated from four to ten times, or until the fluid comes back perfectly clear. About a quart of water is ordinarily used. Various solutions have been advised

for stomach-washing, but nothing is better than boiled water, used at the temperature of from 100° to 110° F.—the higher temperature being employed when the gastric irritation is very great. Through the tube are easily discharged mucus and small curds; larger ones are gradually broken down by repeated washing. Vomiting may be induced by overdistending the stomach with water. If there is great thirst there is often an advantage in leaving one or two ounces of water in the stomach. To this water it is at times beneficial to add lime water.

Stomach-washing in its application is practically limited to children under two and a half years. It is easiest in those under eighteen months.

FIG. 16.—Position for stomach-washing.

Children of three years and over are usually so much alarmed and struggle so violently as to make it difficult and undesirable.

The indications for stomach-washing are: 1. In acute indigestion, either with or without persistent vomiting. Here the purpose is simply

to clear the stomach of its irritating contents, and a single washing may be sufficient. 2. In chronic indigestion attended with a great production of gastric mucus, and sometimes, though rarely, by dilatation of the stomach. In these cases daily washing is required for a considerable period. 3. In poisoning.

Gavage.—Gavage consists in the forcible introduction of food into the stomach through a tube. It has long been employed in France, and was popularized there by Tarnier in the treatment of premature infants. Until 1892 it was but very little used in this country—chiefly after operations upon the mouth and larynx. Recent experience, however, has shown it to have a much wider application.

The same apparatus is employed as in stomach-washing, and the method is similar, with the exception that for gavage the child should be placed flat upon the back, the head being steadied by an assistant. In older children a mouth-gag is often necessary. Sometimes, where there is great resistance to the introduction of the tube through the mouth, it may be passed through the nose. After the tube has entered the stomach the funnel should be raised to allow the gas to escape. The food is then poured into the funnel; as soon as it has disappeared the tube is tightly pinched and quickly withdrawn, to prevent food from trickling into the pharynx, since this is often a cause of vomiting. In young infants, after removing the tube, it is well to keep the jaws separated by the fingers for a few moments to prevent gagging. If the food is regurgitated this usually happens at once. It may then be introduced a second time. After feeding, the child should be kept absolutely quiet upon the back.

In cases where all the food is given by gavage the interval between feedings must be considerably longer than under other circumstances. The food given should be either wholly or partly predigested, since digestion in these cases is usually feeble. The stomach should be washed before the first feeding, and afterward at least once a day, in order to remove mucus and to be sure that it is empty before the meal is given.

Gavage is valuable, as already indicated in connection with the incubator, in the management of premature infants and after certain operations upon the mouth and neck. It is also useful, first, in the case of very young infants, who, suffering from severe malnutrition, can not be induced to take food enough to sustain life; secondly, in many acute diseases, particularly in septic cases where the child will not readily take the necessary food, as in diphtheria, scarlet fever, typhoid, pneumonia, etc.; thirdly, in many cases of cerebral disease where food is refused on account of delirium or coma; and, fourthly, in uncontrollable vomiting. This last use of gavage has been very fully worked out by Kerley, who found, after a large number of experiments, that food given by gavage was often retained, when very much smaller quantities administered by the spoon, bottle, or even from the breast, were immediately vomited. Kerley's experiments

were conducted in the New York Infant Asylum during my service there, and his results have been verified by subsequent experience in that and in other institutions. The explanation seems to be that the passage of the tube causes less irritation of the pharynx than does the food after it has been swallowed, vomiting being due apparently to such pharyngeal irritation.*

Gavage is a very simple procedure and one which a nurse can easily be taught. It is free from danger, and in a great majority of cases food is not regurgitated. Much of the success in using it depends upon the rapidity with which it can be done. With a little experience only fifteen or twenty seconds are required. In acute septic cases not only may food be given, but also such medicines and stimulants as may be required, with little or no trouble. The advantage of gavage over the continued coaxing or holding the nose and forcing the patient to swallow will be at once apparent to one using it.

Irrigation of the Colon.—By irrigation of the colon is meant the flushing of the entire large intestine by fluids injected high up through a catheter or rectal tube. Under no circumstances is it possible to inject fluids beyond the ileo-cæcal valve, but we can be quite sure that if proper precautions be taken they will reach as high as this point.

The apparatus required for irrigating the colon is a fountain syringe, five or six feet of rubber tubing, and a flexible rectal tube or soft-rubber catheter—No. 18 or 20, American scale, being preferred. The child is placed upon the back, with the thighs flexed and the buttocks brought to the edge of the bed or table. It should lie upon a rubber sheet so arranged as to form a trough emptying into a large basin or tub. The clothing is rolled up to the hips. The bag containing the water is hung four or five feet above the bed. The catheter is oiled and inserted just within the anus before the water is turned on. As it flows the catheter is gradually pushed upward to a distance of twelve or fourteen inches. The water distending the intestine in advance of the catheter usually makes its introduction quite easy. If, however, the attempt be made to introduce the catheter before turning on the water, it almost invariably doubles upon itself. In Fig. 17 is shown the colon of an infant of six months in position. It is the peculiar curve and the great length of the sigmoid flexure that make the introduction of water difficult, unless the tube is passed quite to the descending colon. When this is done the remainder of the colon fills with ease; but if the tube is introduced only three or four inches the irrigation is not likely to extend beyond the sigmoid flexure.

Usually a pint, and often a quart, will be introduced before any water returns. This is an advantage, since one can then be reasonably sure that

* For fuller report of Dr. Kerley's cases see Archives of Pædiatrics, February, 1892; also article by the writer, New York Medical Record, April 28, 1894.

the upper part of the colon has been reached. The water is passed from time to time alongside the catheter, often with considerable force. At least a gallon of water should be used for a single irrigation. The washing should be continued until the water returns quite clean. Gentle kneading of the abdomen should be continued during the irrigation, particularly the early part of it, to facilitate the passage of the water into the

Fig. 17.—Colon of a child six months old, in position. (From a photograph.)

upper part of the colon. At the end of the irrigation the rubber tube is detached and the water allowed to escape through the catheter, which remains *in situ*. Sometimes as much as a pint of water remains in the intestine. This is usually passed within half an hour. As the irrigation of the colon almost invariably excites active peristalsis of the lower ileum, this part of the intestine is emptied as well. It is to be remembered that the colon of an infant six months old will hold one pint without distention, and at the age of two years from two to three pints.

Irrigation of the colon is useful to clear this part of the intestine of mucus, fæcal matter, undigested food, and the products of decomposition.

It may also be employed as a means of local medication in ileo-colitis. Where the object is simply to cleanse the intestine, a saline solution—a teaspoonful of common salt to a pint of water—is preferred. In cases of inflammation of the colon various astringent injections may be used; but the employment of antiseptic injections is of doubtful advantage.

The temperature of the water used for irrigation may be varied according to the special indications. For ordinary purposes, where cleansing only is aimed at, the temperature of from 80° to 95° F. seems to be best. When the body temperature is high, or when there is much pain, tenesmus and straining, ice water has important advantages. The patient's temperature may often be reduced as effectively by an ice-water injection as by a bath. In cases of collapse or great prostration hot injections may be employed; these should not be higher than 110° F., but at this temperature they may be used with safety.

Irrigation under most circumstances is required only once in twenty-four hours. When it is employed it is important to use a large quantity of water. In cases of ileo-colitis with severe symptoms two irrigations a day may be advantageous. This means of treatment certainly forms a most valuable addition to our therapeutics in the management of intestinal diseases. With ordinary care irrigations are free from danger. They must be done thoroughly to be of value, and either by the physician himself or an experienced nurse. The chief points of importance are, that the catheter should be introduced high into the bowel, and that a large quantity of fluid should be employed.

Enemata.—Simple enemata are useful in infants and older children, to empty the bowels in cases of constipation. Where an immediate effect is desired the most efficient is one containing glycerine—e. g., for an infant, one teaspoonful to one ounce of water. Oil enemata are useful where the fæcal mass is hard and dry and expelled with difficulty. For this purpose from two drachms to half an ounce of sweet oil may be given. Enemata should always be given with care, and preferably a rubber tube should be attached to the nozzle of the syringe, since injury may be done by a hard-rubber or metal tip.

Nutrient enemata are of very little value in infancy. In older children they may be used as in adults. For this purpose either completely peptonized milk or some of the forms of beef peptones, like Mosquera's beef jelly, may be employed. In giving stimulants in enemata care should always be taken that they be well diluted—one part of brandy to at least eight parts of water.

The administration of drugs *per rectum* is useful in certain cases where, on account of the unpleasant taste or vomiting, the administration by mouth is difficult. In this connection we may mention particularly quinine and chloral. As a diluent milk is preferable to water. If quinine is used, the bisulphate is the best preparation, but this must be well diluted.

The use of stronger solutions than four grains to the ounce often results in the production of rectal catarrh. The temperature of all enemata which are to be retained should be about 100° F. It is necessary in infancy to press the buttocks together for at least an hour afterwards to prevent the expulsion of the injection.

Hypodermic Medication.—This is not often used in childhood, but it must not be forgotten that it is at times of the greatest service even in infancy. The use of morphine hypodermically in convulsions, of morphine and atropine in cholera infantum, of atropine in opium poisoning, of strychnine in heart failure, as in pneumonia and syncope, may be cited as examples. These are all conditions in which the hypodermic needle may save life.

Massage.—In older children massage is useful for the same conditions as those for which it is employed in adults; the most important are anæmia and general malnutrition—in conjunction with the "rest treatment"—in chorea, and in chronic constipation. For the last mentioned only abdominal massage is employed. The special method of doing this will be referred to in the chapter on Constipation. In children, even more than in adults, it is necessary that in the beginning only the mildest movements of massage should be employed, and these but for a short time.

In infancy massage has a limited application, and it is doubtful whether it really does more than can be accomplished by the general friction of the body. This rubbing, either with the bare hand, or with cocoa butter, or some other fat, is very useful in all forms of malnutrition, in rickets, and in wasting diseases where the circulation is feeble and the muscular tone low. Any form of fat may be employed for inunction. Cocoa butter is cleanly and has a pleasant odor, and is, I think, quite as valuable as the more commonly employed cod-liver oil, which is exceedingly disagreeable. The inunctions should be given daily after the morning bath, the child lying upon the nurse's lap before an open fire, covered only by a blanket. The rubbing should be continued for fifteen to twenty minutes each time.

PART II.

SECTION I.

DISEASES OF THE NEWLY BORN.

CHAPTER I.

ASPHYXIA.

The lungs in the full-term fœtus are of a uniform dark red colour, and show very distinctly upon their surface the lobular divisions. They are firm and solid and readily sink in water. The connective tissue is very abundant, and forms distinct fibrous septa, which stretch through the lungs in every direction.

Inflation of the lungs begins with the first cry uttered by the infant as it is born into the world. The parts first expanded are the anterior borders of the lungs, then the upper lobes, and finally the lower lobes posteriorly. The superficial lobules are nearly always expanded before those in the interior of the lung. The inflation is sometimes irregular, because of the accumulation of mucus in some of the bronchial tubes. The right lung is frequently stated to be expanded earlier than the left. Although this is often the case, there is no uniformity in this respect. The important point to be remembered is, that the parts last inflated are the posterior portions of the lower lobes. The expansion of the lungs is a gradual process, and in healthy infants it is probably not complete much before the end of the second day. In delicate children it may be postponed for several days, or even weeks. The above statements are based upon post-mortem observations upon infants dying from various causes during the first weeks. It has often been a matter of great surprise to find at autopsy on an infant two or three days old, that less than one half of the lung tissue was expanded, although the child had breathed well and shown no signs of atelectasis. Under normal conditions at full term inflation of the lung takes place very readily, but not so readily in premature or delicate infants, on account of the feebleness of the respiratory muscles. The longer it is postponed after birth the more difficult does it become, on account of the changes which occur in the collapsed air vesi-

cles. The condition of the child *in utero* may be described as one of fœtal apnœa, its oxygen being received and its carbon dioxide discharged through the placenta, which is essentially the organ of respiration at this period. This condition is interrupted by cutting off the supply of oxygen and the accumulation of carbon dioxide in the blood. Which of these is the important factor in inducing pulmonary respiration has been much debated; but the best experimental evidence seems to show that it is the want of oxygen which stimulates the respiratory centres.

Under the term "asphyxia" may be included all cases in which primary respiration is not spontaneously established with sufficient force to maintain life. Usually there is no attempt at pulmonary respiration until after the birth of the child, but it may occur *in utero* or at any stage of parturition. Asphyxia may be of intra-uterine or extra-uterine origin.

Etiology.—1. *Intra-uterine asphyxia.* The maternal causes include any disturbance of the placental circulation during labour—anything which prolongs the second stage of labour, convulsions, hæmorrhage, the use of ergot in the second stage, or, finally, the death of the mother. The causes relating to the child are pressure upon the cord, multiple winding of the cord about the neck, early separation of the placenta, and pressure upon the brain. If the respiratory stimulus comes before the birth of the child, the effort at respiration may cause the entrance into the mouth and air passages of amniotic fluid, mucus, blood, meconium, etc.

2. *Extra-uterine asphyxia.* This condition is a much less common one. It arises from causes quite apart from those above mentioned, and depends upon malformations or intra-uterine disease of the organs of respiration, circulation, or of the brain. It may be secondary to an injury of any of these organs received during parturition. It is also seen in premature infants, where it depends upon the feeble development of the nerve centres and respiratory muscles and upon the soft, yielding chest walls.

Lesions.—In infants dying of intra-uterine asphyxia there are seen the usual changes found in death from suffocation, together with the effects of attempts at breathing *in utero.* There is general congestion of all the viscera, particularly of the brain and its meninges, the liver, and the lungs. They may show small, punctate hæmorrhages, and occasionally large extravasations. Blood or bloody serum may be found in any of the serous cavities. The right heart is overdistended with dark, soft clots, and the blood generally is more fluid than normal. The lungs may contain no air, but more frequently there are small, scattered areas in which lobular inflation has taken place. If the child has lived several hours there are larger areas of expanded lung, especially in the upper lobes, and these may even be emphysematous, if artificial inflation has been employed. In the mouth, nose, larnyx, and even as far as the finest bronchi, there may be found aspirated materials—amniotic fluid, blood, mucus, or meconium. In extra-uterine asphyxia there are organic changes in the vis-

cera—malformations of the lungs or the heart, intra-uterine pneumonia or pleuritic effusion, malformation of the diaphragm and sometimes of the brain.

Symptoms.—Under normal conditions the newly-born infant begins at once to scream and to use its limbs, the purplish colour of the skin giving place in a few moments to a rosy pink. In the first degree of asphyxia—*asphyxia livida*—the child is deeply cyanosed. Either no attempt whatever is made at respiration, or it is superficial and repeated only at long intervals. The pulse is slow, full, and strong. The vessels of the cord are distended. Muscular tone is preserved, and also cutaneous irritability, so that with the application of almost any kind of external stimulus, respiration is excited and the symptoms disappear.

In the second degree—*asphyxia pallida*—the picture is quite a different one. The face is pale and death-like, though the lips may still be blue. The heart's action is weak, and by palpation can rarely be felt at all. By auscultation the sounds are feeble, irregular, and usually slow. The cord is soft, pale, and flaccid, and its vessels nearly empty. The sphincters are relaxed, and meconium oozes from the anus. There is entire loss of tone in the voluntary muscles, so that the extremities and entire body seem perfectly limp. Cutaneous sensibility is abolished. The extremities are often cold. There may occur a few short, convulsive contractions of the respiratory muscles, but these are without effect and soon cease. Unless such cases receive the most prompt and efficient treatment, the heart's action becomes more and more feeble until it ceases and death occurs. Other cases are partly resuscitated and may survive for a few hours or days, when they gradually sink, respiration becoming more and more feeble in spite of all efforts to maintain it. Between these two extremes all degrees of severity are seen.

In extra-uterine asphyxia there may be some attempts at voluntary respiration continuing for several hours, sometimes for a day or two, but this may be inadequate to sustain life.

Diagnosis.—Almost the only condition with which asphyxia is likely to be confounded is cerebral compression from a meningeal hæmorrhage. The difficulties in the case are much increased by the fact that the two conditions are not infrequently associated. It may then be impossible to tell that in addition to asphyxia, intracranial hæmorrhage is present. If the hæmorrhage is extensive and the asphyxia only moderate, a diagnosis is possible in most of the cases. In hæmorrhage there is often a history of undue compression during delivery—sometimes the use of forceps. The fontanel is bulging; there is coma, and there may be paralysis. The respiratory murmur may be quite strong for several hours, but it gradually fails as the child becomes completely comatose. Anæmia resulting from a large hæmorrhage, like that due to rupture of the cord, may simulate the severe form of asphyxia.

Prognosis.—This depends upon the grade of asphyxia and the treatment employed. There is but little tendency to spontaneous recovery in any form. In the milder cases recovery is almost invariable with any intelligent treatment. In the severest cases the outcome is always doubtful, although by persistent effort many that are apparently hopeless may be saved. In a prognosis as to the ultimate result, the frequent complication of asphyxia with meningeal hæmorrhage should always be kept in mind. Apart from this complication it is doubtful whether asphyxia has anything to do with the production of idiocy.

Treatment.—In every case the first step is to clear the mouth and pharynx of mucus by means of the finger covered with absorbent cotton. In the milder forms respiration is usually excited either by spanking the child or the alternate use of hot and cold baths. If the hot bath is employed, the water should be from 110° to 120° F., or about as hot as the hand will bear. After a few moments the child may be dipped into cold water, or the body may be douched with it. In the livid cases relief is often afforded by allowing the cord to bleed for a few moments before ligation. The loss of half an ounce of blood is ordinarily sufficient. Simply swinging the child in the air is a powerful stimulus to respiration. The above means will suffice in the great majority of cases. In the more severe forms, however, these are inadequate. There is no response whatever to external stimulation, either by heat or mechanical irritation. In these cases two methods of resuscitation may be employed: artificial respiration and direct inflation of the lungs.

One of the most widely employed methods of inducing artificial respiration is that of Schultze. The infant is grasped by both axillæ in such a way that the thumbs of the physician rest upon the anterior surface of the chest, the index fingers in the axillæ, and the remaining fingers extending across the back. The child is thus suspended at arm's length between the knees of the physician, the feet downward and the face anterior. The body is now swung forward and upward, until the physician's arms are nearly horizontal. This produces the inspiratory effort. When this point is reached, an arrest in the swinging causes flexion of the trunk, the head now being directed downward, the lower extremities fall toward the physician until the whole weight of the body rests upon the thumbs. In this way expiration is produced. Lusk cautions against the employment of this method if the heart's action is very feeble, as it may cause the heart to stop altogether.

A method introduced by Dew has been extensively employed in New York. The infant is grasped in such a way that the neck rests between the thumb and forefinger of the left hand, the head being allowed to fall far backward, the upper portion of the back resting upon the palm of the hand; with the right hand the knees are grasped between the thumb and fingers, the thighs resting against the palm of the hand. Inspiration

is produced by depressing the pelvis and lower extremities thus causing the abdominal organs to drag upon the diaphragm, and at the same time gently bending the dorsal region of the spine backward. In expiration the movement is reversed, the head being brought forward and flexed upon the thorax, while at the same time the thighs are flexed so as to bring them against the abdomen. The body is thus alternately folded upon itself and unfolded as the movements are carried on. If there is much mucus in the mouth, the movement of expiration should first be made with the body completely inverted. This method is simple, efficient, and much less fatiguing than that of Schultze when it is to be maintained for a long time. It is also of great advantage in that it can be carried on while the child is in the hot bath, one of the greatest objections to the method of Schultze being the loss of animal heat incident to its use.

In all cases where artificial respiration is used the first movement should be that of expiration, to expel, so far as possible, foreign substances from the air passages. The movements should be made from eight to twelve times a minute, and not too forcibly, the child being kept in the hot bath between the movements, and as much as possible during them. As long as the heart beats resuscitation is possible, and the case should not be abandoned.

Inflation of the lungs is not usually of so much general value, although it is sometimes successful when all other means have failed. It may be done by the mouth-to-mouth method, or by the introduction of a catheter

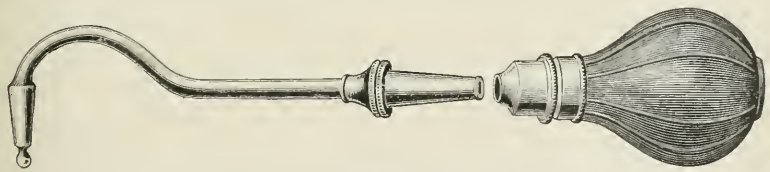

Fig. 18.—Ribemont's laryngeal tube for inflating the lungs.

into the larnyx. The former is much easier, but is much less certain, since the air is liable to pass into the stomach. If, however, the head be carried pretty well backward, compression made over the epigastrium, and the nose closed, this is less likely to occur. The introduction of a flexible catheter into the larynx is by no means an easy matter even with considerable practice. The use of a stiff catheter is not so difficult, but it is capable of doing harm. A much better instrument is the laryngeal tube of Ribemont (Fig. 18). This is inserted like an intubation tube. By means of the rubber bag attached, air may be forced into the lung, or mucus aspirated from the trachea and bronchi as may be desired. In all these methods, but especially when the catheter is used, care is necessary not to employ too much force. It should always be remembered that the ca-

pacity of the lungs of the child is much less than that of those of the physician. Like artificial respiration, inflation is to be used in connection with the external application of heat, preferably the continuous hot bath.

A method lately introduced by Laborde, of making rhythmical traction upon the tongue eight to ten times a minute as a means of exciting respiration, is one of the most efficient within our reach. It may be resorted to in conjunction with other methods, or used alternately with them.

In cases of asphyxia it is not enough to make the child cry. The deep respirations must be made to continue, for very often it happens that resuscitation is only partial, and that the child after six or eight hours lapses into its previous condition. All severe cases require careful watching for the first twenty-four or thirty-six hours, as a repetition of the treatment is often required.

CHAPTER II.

CONGENITAL ATELECTASIS.

This condition is one in which there is a persistence of the fœtal state in the whole or in any part of the lung.

Atelectasis is the pathological condition with which asphyxia of the newly born is usually associated. In most of the cases the condition of atelectasis is completely overcome by the means employed in resuscitation; in some, however, these means are only partially successful, so that a portion of lung of variable extent remains in the fœtal condition. These are the circumstances in which most of the cases of atelectasis arise. But there are others in which there is no history of early asphyxia, where the primary respirations, although taking place spontaneously, have not been of sufficient force and depth to produce full pulmonary expansion. This usually occurs in feeble infants, or in those who are premature. The causes of congenital atelectasis are therefore, in the main, those mentioned as producing asphyxia.

Lesions.—In cases where the child dies during the first few days the amount of expanded lung is often very small, frequently not more than one fourth of the pulmonary area. The expanded portion is usually the anterior borders of the upper lobes. This is often the seat of acute emphysema. The rest of the lung is still in the fœtal state; it is of a brownish-red colour, very vascular, does not crepitate, and shows the lobular outlines both on the surface and on section. With a little force the atelectatic lung may be completely inflated.

If children have lived several months, nearly the whole of the upper

lobes and the anterior portion of the lower lobes are usually well inflated. These portions are either normal or slightly emphysematous. The posterior portion of the upper lobes and the lower lobes are almost invariably the seat of the atelectasis. On the surface even these portions may present quite a large area of expanded vesicles, but the lobe is solid to the touch, and crepitates but slightly. On section it is seen that only the most superficial part of the lung is inflated, often only to the depth of a line, while the interior of the lobe is unexpanded. Small hæmorrhages are frequently seen beneath the pleura.

It is usual for both lungs to be affected, and often, but by no means uniformly, to about the same degree. It is frequently a great surprise to discover that a child has lived two or three months without presenting any signs of cyanosis, using not more than one third of its pulmonary area. This variety of atelectasis closely resembles the hypostatic pneumonia of delicate infants, and very often the two conditions are associated. It may require the microscope to decide between them. If congenital atelectasis has existed for some months, there are usually found evidences of pneumonia. Inflation is not so easy as in recent cases, but with force the greater part of the lung can usually be expanded. The heart commonly shows the right auricle and ventricle to be distended with dark clots, and there is occasionally found a patent foramen ovale or some other form of congenital lesion. The liver and spleen are in most cases congested, and the spleen may be considerably enlarged. The mucous membrane of the stomach and intestines is sometimes deeply congested.

Symptoms.—In one group of cases the children are asphyxiated at birth, but the attempts at resuscitation have been only partially successful. Although the patients may live for a few days, there is cyanosis, which gradually deepens, and death takes place from asphyxia, exhaustion, or convulsions.

In a second group of cases the infants have been asphyxiated at birth, and resuscitated perhaps with difficulty, but to all appearance completely. They do not thrive, however, remaining small and delicate, gaining very little or not at all in weight, and showing poor circulation, cold extremities, and occasionally subnormal temperature. It is characteristic of these cases that the cry is never loud, strong, and lusty. Some of them will not cry at all. Such children may live several weeks, or even months. There may develop at any time, often quite suddenly and without assignable cause, attacks of cyanosis with prostration. Children may have several such attacks, which do not excite suspicion since they pass away spontaneously. In other cases the symptoms are so severe that they may result fatally in a few hours, death being frequently preceded by convulsions. If energetically treated the symptoms may pass away but, reappearing in a few hours, or again after a week or more, they gradually deepen in intensity until death occurs.

Two cases coming under my observation in the New York Infant Asylum in 1890, illustrate this point. The infants were twins, ten weeks old and delicate. Suddenly at night one child was taken with convulsions, became deeply cyanosed, and died in two and a half hours. It had been suffering from a slight attack of indigestion and diarrhœa for a week previous, but apparently was not seriously ill. The other twin had been on the previous day as well as for several weeks. Two hours after the death of the first child the second was taken with similar symptoms, dying in a few hours. At autopsy I found very extensive atelectasis involving the posterior part of the upper and the greater part of both lower lobes. The lesions were almost identical in the two cases. In both, the stomach was greatly distended with food and gas. I have repeatedly seen the effect of overdistention of the stomach in producing cyanosis in young children, and in this instance I believe it to have been the exciting cause of the final symptoms. It was subsequently learned that during the six weeks of observation the nurse had witnessed several slight attacks of cyanosis in one of the infants.

I have seen a number of such cases, in which there was nothing whatever to attract attention to the lungs until the final attack of cyanosis occurred, the children showing only the signs of malnutrition. In not all of these cases is there a history of asphyxia at birth. Some are only puny, delicate or premature, exhibiting during the early weeks of life all the signs of feeble vitality. The subsequent course is the same as in those in which there is early asphyxia. The duration of life in these cases depends chiefly upon the extent of the atelectasis.

It is not to be supposed that all cases of congenital atelectasis terminate fatally. Infants in whom there is every reason to believe that atelectasis exists, from the occasional attacks during the first few weeks of cyanosis, feeble cry, poor circulation, etc., may under favourable conditions recover completely, even though no special treatment is directed to the lungs.

Diagnosis.—For this the physical signs are of much less value than the symptoms. It should be remembered that the principal seat of the disease is the lower lobes posteriorly. Percussion usually gives resonance over the entire chest, although this may be somewhat diminished posteriorly. There is not, however, so much change as one would expect to find, for the collapsed areas are surrounded by others which are overdistended, and there are in the midst of the collapsed parts, especially upon the surface, lobules which are inflated. If the two sides are involved to about the same degree, as is often the case, we can get no difference in the percussion note over the two lungs, and the change from the normal may be so slight as not to be appreciable. Where only one lung is affected a difference can usually be made out. The respiratory murmur is rarely bronchial, but generally only feeble in its intensity, and rather ruder in quality than normal. As

in the case of percussion, if only one lung is affected this is of some value in diagnosis, but it is not sufficiently marked to be readily recognized when both sides are involved. Occasionally râles are present.

Treatment.—In the newly-born child, whether asphyxiated or not, the physician should see to it that the infant not only cries, but does so loudly and strongly, and that this cry is repeated every day. If children do not cry naturally they must be made to do so by the alternate use of the hot and cold bath, as in cases of asphyxia, or by mechanical means, like spanking. This should be repeated at least twice a day, and continued for from fifteen to thirty minutes. It may seem cruel, but it is often the only means of saving life. Expansion of the lungs is much more easily induced during the first few days of life, becoming more and more difficult the longer it is delayed. Provided the condition is recognized, treatment is fairly successful. In institutions where delicate infants spend most of the time in their cribs, atelectasis is likely to be found. An infant needs exercise, and this is often only to be obtained by taking the child from its crib several times a day, by general friction, massage, the stimulus of fresh air, etc. Nothing is more certain to perpetuate atelectasis than to allow the infant a life of feeble vegetative existence. Food and feeding must be carefully attended to, but even these are of less importance than the maintenance of the animal heat. The temperature is often subnormal, and should be closely watched. If there is difficulty in keeping the child warm it should be rolled in cotton and surrounded by hot bottles, or kept in an incubator during the first few weeks. (See page 10.) During attacks of cyanosis the same means are to be employed as in cases of asphyxia of the newly born—cutaneous stimulation and artificial respiration—the administration of drugs being of little or no value.

CHAPTER III.

ICTERUS.

Several varieties of icterus are met with in the newly born.

1. It is often seen in the various forms of pyogenic infection. In such cases the icterus is usually mild.

2. It may depend upon syphilitic hepatitis—a rare cause.

3. It may be due to congenital malformations of the bile-ducts.

4. The most frequent of all varieties is the so-called idiopathic icterus, sometimes spoken of as "physiological" icterus.

In the cases included under the first and second heads icterus is a minor symptom. The other varieties are sufficiently important to require separate consideration.

MALFORMATIONS OF THE BILE-DUCTS.

The common bile-duct is the most frequently affected. There may be atresia at the point where it opens into the intestine, the duct may be represented by a fibrous cord, or it may be absent altogether. In many cases this is the only lesion ; in others it is associated with an impervious hepatic or cystic duct; in still others the common duct is normal, but the cystic or hepatic ducts are impervious.

At autopsy all the organs are usually found intensely jaundiced, particularly the liver. In recent cases this is very much swollen, but presents no marked organic changes. In cases which have lasted several months there is commonly found chronic interstitial hepatitis, sometimes to a very marked degree. This was present in nine of the fifty cases collected by Thompson.* The gall-bladder is usually small, and often rudimentary. In cases of atresia of the common duct it may be greatly distended.

The condition of the bile-ducts is ascribed to an error in development and subsequent catarrhal inflammation. There does not seem to be sufficient evidence to prove that hereditary syphilis is an etiological factor of much importance. This was present in but five of Thompson's cases.

Symptoms.—The most striking symptom is jaundice, which is usually noticed a day or two after birth, and steadily increases until it becomes intense. The urine is colored a dark brown or bronze by bile pigment, and even the meconium stools may be white, except in cases where malformation is limited to the cystic duct. The liver as a rule is much enlarged. The spleen is often swollen. Hæmorrhages beneath the skin or from any of the mucous membranes are quite common. Vomiting is usually absent. In most cases there is progressive wasting, and death within the first few weeks. Of Thompson's fifty cases, nine lived less than a month, and only eighteen over four months. Lotze has reported a case of a child living eight months with an impervious hepatic duct. A frequent cause of death in the rapid cases is convulsions.

These malformations cannot be influenced by any treatment.

PHYSIOLOGICAL OR IDIOPATHIC ICTERUS.

In 900 consecutive births at the Sloane Maternity Hospital icterus was noted in 300 cases. In 88 it was intense, in 212 it was mild. According to the statistics of various lying-in hospitals of Germany, it was found in from 40 to 80 per cent. of all infants. In the 300 cases just referred to, icterus was noticed on the first day in 4, on the second day in 19, on the third day in 72, on the fourth day in 86, on the fifth day in 67,

* Edinburgh Medical Journal, 1892.

and on or after the sixth day in 44. From the second to the fifth day is therefore the usual period for its appearance.

It usually increases in severity for one or two days and then slowly disappears. The average duration in the mild cases is three or four days; in those of moderate severity about a week; in the most severe cases it may last for two weeks. The icterus is first noticed in the skin of the face and chest, then in the conjunctivæ, then in the extremities. The skin varies in colour from a pale to an intense yellow. The urine in most cases is normal. It sometimes is of a light brown colour, and only in the most severe cases does it contain bile pigment. According to Runge, both urea and uric acid are produced in larger amounts than in children not icteric. The stools are unchanged, the normal yellow evacuations occurring in the icteric as early as in those not affected.

According to some observers, in infants who are icteric the initial loss in weight is greater and the subsequent gain slower than in other children. This is not borne out by the Sloane statistics. Of the 300 icteric children, 155 made satisfactory progress in every respect and gained rapidly. The progress in 106 cases was said to be "fair"—i. e., at the time of discharge, usually on the tenth day, a slight gain in weight was noted. The remaining 39 did badly, not gaining in weight and showing other symptoms of malnutrition. The proportion of icteric infants who did well, moderately, and badly, was practically the same as of the other children in the institution not suffering from icterus. Icterus occurs with equal frequency in both sexes. According to Kehrer, it is more frequent in first children than in later ones, and considerably more frequent in premature children than in those born at term. The presentation, the duration of labour and its character—whether natural or artificial—have no influence upon the production of icterus. As a rule icteric children appear in other respects healthy, but in those below the average size the icterus is apt to be more intense.

Few subjects have given rise to wider speculation than this form of icterus. Its exact pathology is at present unknown. Of the many theories advanced, that of Silbermann is perhaps the most satisfactory—viz., that the icterus is due to resorption, and is hepatogenous in its origin. With this view Frerichs and Schultze agree. Silbermann explains the resorption by the existence of stasis in the capillary bile-ducts which are compressed by the dilated branches of the portal vein and the blood capillaries. The change in the circulation of the liver is one of the results of the change in the blood which occurs soon after birth. This results from an extensive destruction of the red blood cells—a kind of blood fermentation. The more feeble the child the more intense the icterus, because the blood changes are more intense. In consequence of this destruction of red blood cells abundant material for the formation of bile pigment exists and accumulates in the hepatic vessels.

In jaundiced infants who have died from accident or other causes the skin and almost all the internal organs are found icteric. There is also staining of the internal coat of the arteries, the endocardium, the pericardium, and the pericardial fluid. Sometimes the subcutaneous connective tissue is yellow, also the brain and cord; the spleen and kidneys only in the most severe cases. In the kidneys uric-acid infarctions are often found, and sometimes bile pigment. The liver is rarely discoloured. The bile-ducts are normal. In certain cases Birch-Hirschfeld has discovered bile pigment in the liver cells.

This jaundice is never fatal, and is not serious. Other conditions, such as atelectasis, may coexist, which may make the case grave. The chief point in diagnosis is not to confound physiological icterus with that depending upon other more serious conditions, such as sepsis or congenital malformation of the bile-ducts. In sepsis other symptoms are present, usually an abnormal condition of the umbilicus, and the symptoms appear at a later date. In malformation of the bile-ducts the jaundice is very intense, and is frequently accompanied by marked hepatic enlargement.

Physiological icterus requires no treatment.

CHAPTER IV.

THE ACUTE INFECTIOUS DISEASES OF THE NEWLY BORN.

It is possible for the newly-born infant to suffer from almost all of the common infectious diseases. Smallpox probably has been most frequently observed. In rare instances measles, influenza, typhoid fever, malaria, and pneumonia have occurred in the first days of life. As the mothers in many instances were suffering from the diseases during or just prior to delivery, the infants appear to have been infected before birth through the circulation of the mother. In other cases, especially in pneumonia and influenza, infection may take place soon after birth. The symptoms of these diseases in the newly born differ little from those occurring in any young infant. The prognosis, however, is very much worse on account of the tender age and feeble resistance of the patient.

In addition to the diseases mentioned, there are other forms of infection which belong especially—some of them exclusively—to the newly born. We shall consider: (1) The Pyogenic Diseases, which are due to the entrance of pyogenic germs; in this class are to be included Ophthalmia and Erysipelas; (2) Tetanus; and (3) diseases probably infectious, but as yet not proved to be so—Acute Fatty Degeneration, Epidemic Hemiglobinuria, and Pemphigus.

THE ACUTE PYOGENIC DISEASES.

This group of diseases—known also as puerperal fever of infants, or sepsis in the newly born—presents a great variety of symptoms and lesions. They have, however, the one feature in common, viz., that they result from the entrance of pyogenic bacteria* into the body of the child. The two micro-organisms most frequently causing the suppurative processes are the staphylococcus pyogenes aureus and the streptococcus. These are probably the exciting cause of four-fifths of the cases. The remainder are due to one or more of the other bacteria which cause suppuration. The germs may be found alone, or they may be associated with others. In the investigations made thus far the streptococcus has been most frequently found. This was discovered by Prudden in the dust of a ward in the New York Infant Asylum, where several cases had occurred, also in an umbilical abscess, and in the pseudo-membranous sore throat of one of the cases. Of a group of three cases, all occupying the same bed at the Sloane Maternity Hospital, one was studied bacteriologically by Prudden, and showed only streptococci. A case of meningitis occurring in the same hospital was studied by Van Gieson, who found in cultures from the exudate only streptococci, which were also present in the umbilical vessels. The streptococcus was discovered by Allard in cases of osteomyelitis. In three recent cases of my own, all with multiple joint suppuration, the staphylococcus was found in two and the streptococcus in one—in every case in pure culture. The severity of the symptoms depends somewhat upon the nature of the bacteria which excite the disease, the form being usually milder when due to the staphylococcus than when due to the streptococcus. Still more important, however, is the degree of virulence of the bacteria at the time of infection. Thus the streptococcus sometimes excites only a very mild, and at others a most violent inflammation.

Most frequently the avenue of entrance is the umbilical wound. This obtains probably in four fifths of the cases. It may be through an abrasion of the skin, such as often exists about the anus or genitals, through a wound about the scalp or body inflicted during instrumental delivery, through erosions of the mucous membrane of the mouth, or through the eyes. Infection through the milk is denied by some writers. Although it has been shown that in a great proportion of the cases the milk of a woman suffering from mastitis or from septicæmia contains pyogenic germs, still the taking of these into the stomach is very unlikely to in-

* There were formerly described cases of "septicæmia" in the newly born; but restricting this term to its present significance—an infection due to bacterial products only—septicæmia is of doubtful occurrence at this period, unless we include as such some of the forms of diarrhœal disease. The cases of "sepsis" in the newly born studied by modern methods have shown with great uniformity the presence of pyogenic bacteria.

fect the infant. Karlinski has reported a fatal case, in which the milk appeared to be the means of infection, and by experiments on animals he proved the possibility of infection in this manner. Bacteria may be aspirated during or after labour, giving rise to septic pneumonia. The source of the poison may be other septic cases in an institution, either among infants or mothers. It may be carried by the physician, the nurse, the instruments, or the dressings.

Infection through the umbilicus may occur either before or after the separation of the cord. The poison may enter through the umbilicus, although this may give no external evidence of disease. This was true in a case recently studied by Van Gieson, in which the infant died of meningitis when eight days old. The cord had healed properly, and at the autopsy the navel appeared normal. It was accidentally discovered that the umbilical vessels inside the body contained pus. From this the meningitis evidently arose, as the same bacteria were found by culture both there and in the brain. Entering through the mouth, bacteria may lead to infectious processes in the throat, or spreading downward may involve the stomach and intestines, rapidly producing death; or the alimentary tract may be the focus from which infection of distant parts may arise.

Clinical Varieties.—*Omphalitis.*—In this variety there is inflammation of the umbilicus, and cellulitis of the abdominal wall in the immediate neighbourhood. This results in the formation of an umbilical phlegmon. It may terminate in resolution, in abscess, or in gangrene. The usual termination is in abscess. These abscesses may be small and superficial, or they may be more deeply seated between the abdominal muscles and the peritonæum. Omphalitis usually begins in the second or third week of life, before the umbilicus has cicatrized. Locally there are redness, swelling, and induration. The process may result in abscess, there may be diffuse inflammation of the abdominal walls of an erysipelatous character with extensive sloughing, or the infection may spread to the peritonæum.

Inflammation of the umbilical vessels.—This is one of the most frequent primary processes in pyæmic infection. The umbilical arteries are more frequently involved than the vein. According to Runge, inflammation of the vessels is always preceded by inflammation of the connective tissue which surrounds them, as the poison is taken up by the lymphatics and not by the blood-vessels. Omphalitis is frequently present, but in some cases the umbilicus shows nothing abnormal.

In arteritis the vessels may be involved to any degree: sometimes only a short distance from the abdominal wall, sometimes quite to the bladder. They contain pus, and often septic thrombi. Saccular dilatation is frequently present at several points. Pus sometimes exudes from the umbilical stump on pressure. The other lesions accompanying arteritis

are those of pyæmic infection, more or less widely distributed. There are frequently peritonitis, suppuration of the joints, erysipelas, multiple abscesses of the cellular tissue, sometimes suppurative parotitis. Atelectasis is common. Pneumonia was found in twenty-two of Runge's fifty-five cases.

In cases of phlebitis, the umbilical vein is usually involved for its entire length from the abdominal wall to the liver. This may lead to an acute interstitial hepatitis going on to suppuration, or to phlebitis of the portal vein and some of its branches. In either case there is more or less parenchymatous hepatitis, and often multiple abscesses of the liver, most of the patients being jaundiced. Peritonitis also is a frequent complication.

Peritonitis.—This is one of the most frequent pathological processes in pyæmic infection, and is very often the cause of death. It is generally associated with umbilical arteritis, and often with erysipelas. In a considerable number of cases it is the most important lesion found. It may be localized or general. Localized peritonitis is generally in the neighbourhood of the umbilicus or of the liver. It may result in adhesions, or in the formation of peritoneal abscesses. More frequently the peritonitis is general, and resembles the septic peritonitis of adults. There is a great outpouring of lymph coating the intestines and other viscera and the inner surface of the abdominal wall, causing adhesions between the abdominal contents. Collections of sero-pus are found in the pelvis and in various pockets formed by the adhesions. Sometimes blood is present in the exudation.

The special symptoms which indicate peritonitis are vomiting, abdominal tenderness and distention, and protrusion of the umbilicus. The abdominal enlargement is chiefly from gas, but may be partly from fluid. There are present thoracic respiration, dorsal decubitus, and flexion of the thighs as in all varieties of acute peritonitis. The temperature is usually high.

Pneumonia.—The most common form seen is pleuro-pneumonia. There is an abundant exudate of grayish-yellow lymph covering the lung. Occasionally collections of pus are found in the sacs formed by the adhesions. Serous effusions are rare. The pulmonary lesion consists usually in a broncho-pneumonia, with consolidation of larger or smaller areas in the lungs—more often in the upper than in the lower lobes. It is not uncommon for minute abscesses to be found in the lung at various points. There is a purulent bronchitis of the larger and smaller tubes.

The symptoms are obscure and often indefinite. The only characteristic ones are cyanosis and rapid respiration, with recession of the chest walls on inspiration. The physical signs are inconstant and uncertain. Pneumonia cannot usually be diagnosticated during life. In most of the fatal cases of pyogenic infection, whatever its type, there is found some

involvement of the lungs. The changes are most extensive in cases in which the serous membranes are involved.

Pericarditis is rare and usually associated with pleurisy. Endocarditis is very rare. Hirst has, however, reported a case.

Meningitis.—The pia mater is the least liable to be affected of all the serous membranes, with the possible exception of the pericardium. When meningitis is present it is usually associated with peritonitis or with pleurisy. The lesions are those of acute purulent meningitis with a copious exudation, sometimes associated with meningeal hæmorrhages, or with acute encephalitis and the production of multiple minute abscesses in the cortex. The local symptoms are usually not marked, and are sometimes very obscure. The most characteristic are stupor, strabismus, dilated pupils, opisthotonus, bulging fontanel, convulsions, and occasionally localized paralyses. The temperature is generally high.

Gastro-enteritis.—Diarrhœa is a frequent symptom in all septic cases, constipation being rarely present. In many instances vomiting is a prominent symptom. In a small proportion of cases the most important local lesions are in the intestines, generally in the nature of a superficial catarrhal inflammation.

Pseudo-membranous inflammations of the throat.—These are rarely seen in the newly born. In 1888 J. Lewis Smith made a report on a group of five cases occurring as a small epidemic in the New York Infant Asylum. They were associated with other lesions, and all were fatal. In several cases there was omphalitis. One of these was studied biologically by Prudden, who found no Loeffler's bacilli, but streptococci both in the exudation in the throat and in the umbilical abscess. The streptococcus was cultivated from the dust of the ward, and it is probable that this was the nature of the infection in all the cases. These throat inflammations are to be regarded as one manifestation of a general streptococcus infection.

Osteomyelitis.—Allard * has reported a series of cases in which, after the general and local symptoms of pyogenic infection had existed for some time, suppuration occurred over various bones, especially the humerus, tibia, metatarsal bones, sacrum, etc. Trephining revealed the lesions of osteomyelitis. The abscesses usually made their appearance between the fourth and the sixth week. The most rapid case died on the fourteenth day, and none lasted more than two-and-a-half months.

Joint suppuration.—In certain pyæmic cases, and in some in which there are no other symptoms, acute suppuration in the joints occurs without any change in the bones themselves. This may come on very acutely in the first or second week, or more slowly as late as the third or fourth week. A single joint may be involved, or at times almost every articula-

* Thèse, Paris, 1890.

tion in the body. I have recently seen four cases of this kind. In one, a shoulder and one temporo-maxillary articulation were involved; in another, a shoulder and hip; in the remainder there were multiple lesions affecting nine or ten joints, including the elbows, ankles, and sterno-clavicular joints, together with the wrists, fingers, and toes.

Abscesses in the cellular tissue.—These are quite frequent, and may occur with suppuration in the joints or internal organs, or they may exist as the only lesion. They may be found where the adipose tissue is scanty, as over the heels, the elbows, and the malleoli; also in the thighs, the ischio-rectal region, and sometimes in the abdominal walls. They are nearly always multiple. They vary in size from that of a small pea to one containing half an ounce of pus. They are due to the introduction of pyogenic germs, usually staphylococci. Their course is benign, and they require no treatment except incision and cleanliness. Where there is a disposition to their continued formation, the skin should be washed with an antiseptic solution.

Erysipelas.—This is seen especially during the first two weeks of life, and most frequently starts from the umbilicus, although it may follow any wound or abrasion of the skin. When originating at the umbilicus it is generally complicated by other lesions, such as peritonitis and umbilical phlebitis. If it start from any other part of the body it may be uncomplicated. It is now pretty well agreed among bacteriologists that the difference between the streptococcus pyogenes and the streptococcus of erysipelas is in the degree of their virulence. While we have the two extremes well marked—typical erysipelas on the one hand, and simple cellulitis terminating in a circumscribed suppuration, on the other—we have all the intermediate grades of severity between them.

Erysipelas starting at the umbilicus gives rise to an area of induration, with a redness which is quite sharply circumscribed. It may be superficial, or it may involve the deeper tissues. It may terminate in diffuse suppuration or in gangrene. The erysipelas of the newly born tends to spread with rapidity, often extending over nearly the whole trunk. The general symptoms are great prostration, high temperature—from 102° to 105° F.—localized pain and tenderness, great restlessness, wasting, vomiting, and diarrhœa. The disease is always serious, and when starting from the umbilicus usually fatal. The prognosis is better in cases originating elsewhere, but under all conditions the disease is a very serious one.

Distribution of the Lesions.—The frequency of the different visceral lesions in eighty-seven autopsies published by Bednar was as follows: Peritonitis in twenty-nine, pneumonia in fifteen, pleurisy in ten, meningitis in nine, meningeal hæmorrhage in eight, encephalitis in eight, cerebral hæmorrhage in four, entero-colitis in five, pericarditis in four. In thirty-one cases there was umbilical arteritis, and in nine cases umbilical

phlebitis. There was one case each of pulmonary hæmorrhage, pleural hæmorrhage, acute hydrocephalus, acute bronchitis, and suppuration in the cellular tissue. Runge's later observations of thirty-six cases showed umbilical arteritis in thirty, umbilical phlebitis in three, and normal umbilicus in three. He found pneumonia in twenty-two of fifty-five cases. Other lesions frequently associated are atelectasis, swelling and softening of the spleen, cloudy swelling of the liver and kidneys, occasionally with foci of suppuration in these organs. The blood is dark, and coagulates imperfectly.

General Symptoms.—These may begin at any time during the first ten days—very rarely after the twelfth day. Fever is an exceedingly variable symptom—it may be very high; it may be almost absent; occasionally there is subnormal temperature. The course of the temperature is very irregular. Wasting is constant and quite rapid. It depends upon the inability to take and digest food, upon the intestinal complications, and upon infection. In quite a number of cases wasting is almost the only symptom. Icterus is exceedingly common; in many of the worst cases it is intense. It is met with where the liver is the seat of an acute parenchymatous or acute suppurative inflammation, and in many other cases where it depends apparently upon the blood changes. Hæmorrhages are common, and may be the direct cause of death. They are most frequent from the umbilicus, from the intestine, and into the subcutaneous cellular tissue. They may occur in almost any organ or from any mucous membrane. Nervous symptoms are generally present, and are sometimes marked. They are restlessness, rolling of the head, a constant whining cry, twitchings of the muscles of the extremities or face, stiffening of the body, more rarely general convulsions. Late in the disease, dulness and stupor are present. The pulse is rapid and weak and the respirations are often irregular even when there is no cerebral complication. Diarrhœa is frequent; the stools are green, brown, sometimes black from the presence of blood, and are often very foul. Vomiting is less common.

In addition to these there are symptoms due to the various forms of local inflammation—peritonitis, meningitis, pneumonia, subcutaneous suppuration and gangrene, these all being found in varying degrees and in various combinations.

Prophylaxis.—Pyogenic infection of the child, like puerperal fever in the mother, may be considered a preventable disease. Its occurrence is usually due to a failure to carry out proper rules regarding cleanliness and asepsis in connection with delivery. The statistics of the Moscow Lying-in Asylum, published by Miller in 1888, show that previous to the general introduction of antiseptic methods, from six to eight per cent of all infants born in the institution died from some variety of infection. In twenty-three hundred successive labours at the Sloane Maternity Hospital, in New York, up to January, 1893, not a single marked case occurred.

From these figures it will be evident that in the vast majority of cases the occurrence of a case of infection of a serious nature, is the fault of the physician or nurse in attendance.

The umbilicus should be cleansed and treated like any other fresh wound. Dry dressing should invariably be employed, and antiseptic gauze or salicylated cotton in preference to household linen. If suppuration occurs at the time the cord separates, the parts should be cleansed daily with 1–3,000 bichloride solution, and powdered with iodoform. All wounds of the face, scalp, and other parts should be treated in the same way. The ligatures and everything which comes in contact with the umbilical wound should be sterilized. Careful attention should be given to the mouth, genitals, and all the muco-cutaneous surfaces, to prevent excoriations and intertrigo. Finally, every septic case occurring in an institution should be immediately isolated. A nurse in charge of a septic woman should not have the care of the infant.

Prognosis.—Pyogenic infection in the newly born, even in its mildest forms, is a serious disease, and in its severer forms is almost invariably fatal. Few cases recover in which there is present any form of visceral inflammation.

Treatment.—The treatment of cases of pyogenic infection practically resolves itself into the treatment of individual symptoms as they arise. Wherever suppuration occurs, external abscesses should be evacuated and treated antiseptically. For the local inflammations of the lungs, peritonæum, and brain, little or nothing can be done in the way of direct treatment. The condition is one to be prevented, but not cured. The general indications are to sustain the patient by proper feeding and the use of stimulants whenever required by the pulse. For local use in erysipelas, nothing, in my experience, is better than a ten-per-cent ointment of ichthyol made up with lanoline, kept constantly applied. When affecting only one of the extremities, the treatment by the Kraske method, of making scarifications beyond the line of redness and covering with wet bichloride dressings, is sometimes successful, but this is not applicable to cases involving the trunk.

OPHTHALMIA.

Ophthalmia of the newly born is to be classed among the pyogenic diseases. It usually consists in a purulent conjunctivitis. In the more severe cases there may be ulceration of the cornea, and even perforation into the anterior chamber of the eye.

The infectious nature of this ophthalmia is now fully established. In the most severe cases the micro-organism generally found has been the gonococcus; but in the milder forms the gonococcus is absent, and any of the common pyogenic germs may be found. In the gonorrhœal cases the infection occurs during labour from the secretions of the mother,

from the examining fingers of the physician, or from instruments; or after birth from infected cloths and other materials which come in contact with the eye. Healthy lochia produce only a catarrhal inflammation. The infection occurring after birth may take place at any time. That due to gonorrhœal infection from the mother is generally manifested on the third day, and is often violent from the outset.

The symptoms are swelling of the lids, chemosis, copious purulent discharge, sometimes hæmorrhages from the lids, ulceration and there may even be sloughing of the cornea. The course of the disease depends upon the cause and upon the treatment employed. In the cases not due to the gonococcus the course is generally benign, and with ordinary cleanliness usually results in recovery without any permanent damage to the sight. The gonorrhœal cases, unless energetically treated from the outset, are very frequently followed by permanent loss of vision. The best statistics upon the causes of blindness in adults show that from twenty-six to thirty per cent of such cases are due to ophthalmia in the newly born. This disease is occasionally complicated by other symptoms of gonorrhœal infection of a pyæmic nature. Widmark, Lucas, and Davies-Colley have reported cases followed by acute articular symptoms.

Prophylaxis is of the utmost importance. Credé's statistics show that in 1874 the frequency of ophthalmia in his lying-in hospital was 13·6 per cent. In the three years ending 1883, among 1,160 newly-born children only one or two cases occurred. The method of prophylaxis which he adopted consists in dropping into the eyes of every child, immediately after birth, one or two drops of a two-per-cent solution of nitrate of silver. The general adoption of Credé's method, or of some similar means of disinfection, has resulted in a very great diminution in the frequency of ophthalmia throughout the world. These prophylactic means should be obligatory in all institutions, and should be used in all cases in private practice wherever there is any possible suspicion of the existence of gonorrhœa. In all other cases the eyes should be carefully cleansed with a saturated solution of boric acid. The use before delivery of an antiseptic vaginal douche is theoretically indicated, but practically it has been found to be inadequate to the prevention of the disease.

Treatment.—Everything which comes in contact with the eyes should be carefully disinfected. All cloths, cotton, etc., used for cleansing should be immediately burned. The strictest antiseptic precautions should be insisted on to prevent the spread of the infection by nurses. In institutions containing infants, severe cases of ophthalmia should always be isolated. The most important thing is to keep the eyes clean. In severe cases they must be cleansed every twenty minutes, night and day. It is best accomplished by means of an eye-dropper with a slightly bulbous tip, inserted alternately at the inner and the outer angle of the eye, and the fluid injected with force sufficient to empty thoroughly the conjunctival sac. For

this purpose a saturated solution of boric acid, or a 1–5,000 solution of bichloride, may be employed, the important feature being that the eye be cleansed thoroughly, and so frequently that the pus is never allowed to accumulate. Once or twice in twenty-four hours two or three drops of a one-per-cent solution of nitrate of silver should be put into the eye; or a stronger solution may be employed and immediately neutralized with a salt solution. The next most valuable means of treatment is cold. Ice-cold compresses should be employed for thirty minutes every two hours in the milder cases, while in the most severe ones they must be used continuously. These should be cooled by placing them on a block of ice, and changed at least every minute, so that they are kept cold. If the cornea is involved the pupil should be kept dilated by means of atropine, and this is wise in all severe cases.

TETANUS.

Tetanus is an acute infectious disease characterized by tonic muscular spasm, which increases in severity by paroxysms occurring at longer or shorter intervals. It may be limited to the muscles of the jaw (trismus), or may affect all the muscles of the trunk, extremities, and neck.

Though many writers have sought to maintain a difference between tetanus of the newly born and tetanus of later life, whether traumatic or not, their identity has been admitted for at least a dozen years. The discovery of the exact cause of tetanus is due to the work of Nicolaïer, who in 1884 found a bacillus in the soil, with which he produced the disease in animals. He demonstrated the presence of this bacillus in the wounds of tetanus patients. Nicolaïer did not, however, obtain the germ in pure culture; but this was done by Kitasato in 1889. The bacillus is generally known as Nicolaïer's bacillus. Since that time the germ has been found in the wounds of numerous patients with tetanus, including newly-born infants.

The rapidity with which the infection spreads from the point of inoculation is very remarkable, as shown by Kitasato's experiments. Thus, if one hour elapsed after infection before cauterizing the inoculated wound, the animal succumbed to the disease. The bacilli are not found in the blood or internal organs. The symptoms of the disease have been shown to depend upon the absorption of a toxic product of the tetanus bacillus called *tetano-toxine.*

The germ of tetanus usually gains access to the body of the infant through the umbilical wound. It exists in the soil, and the disease prevails endemically in certain localities. It is common in certain parts of Long Island and New Jersey. Among the negroes in some parts of the South it has for many years occurred with great frequency. It is stated that on one of the islands of the Hebrides every fourth or fifth child dies of tetanus. In a single house in Copenhagen eighteen cases

were observed. Tetanus is rare except where dirt and filth prevail; but these alone are not sufficient to produce the disease. It is a very rare disease in the tenements of New York.

Lesions.—There are no essential lesions of tetanus. Those which have been found have been partly accidental and partly a result of the disease rather than its cause. In most of the cases intense hyperæmia of the spinal cord and its membranes is found, and not infrequently small extravasations of blood. Such small hæmorrhages are occasionally found in the meninges of the brain—more frequently at the base than at the convexity. In rare instances hæmorrhages of considerable size have occurred into the brain itself. The lungs are generally congested, and the right side of the heart overdistended. In most of the cases the umbilicus has not healed, and it may present evidences of septic infection in varying degrees.

Symptoms.—These, as a rule, begin on the fifth or sixth day, or at the time of the separation of the cord. The first symptoms may not appear until the tenth or twelfth day, but rarely later than this. Generally the first thing noticed is difficulty in nursing, which, on examination, is found to be due to rigidity of the jaws (trismus). Nursing may be impossible on this account. The muscles of the jaw feel hard, the lips pout and all the muscles of the face seem firm. Soon a slight stiffening of the body occurs, the child straightening the back as it lies upon the lap and continuing rigid for a moment or two. In the interval it is at first completely relaxed. These paroxysms soon increase in frequency until they may come on every few minutes, being excited by any movement of the body. The relaxation is then only partial, and the neck and extremities, sometimes nearly the whole body, become rigid and stiff as a piece of wood. The arms are extended, the thumbs adducted, and the hands clenched. The thighs and legs are extended, and no motion is possible at the hip or knee. The jaws can be separated slightly or not at all. The firm contractions of the facial muscles give a peculiar expression to the features. There is a low, whining cry. Swallowing is difficult, sometimes impossible. The pulse is rapid and soon becomes weak. The temperature at first is normal, but in the most acute cases rises rapidly to 104° or even 106°; in the milder cases it does not go above 101° F.

Death is due to exhaustion, to fixation of the respiratory muscles, or to spasm of the larynx. In the less severe cases all the symptoms are milder, and there may be intervals in which the rigidity is scarcely noticeable, so that respiration and deglutition may be carried on for some time. In cases which terminate in recovery the temperature is but slightly elevated. The tonic contractions gradually become less severe, and the paroxysms less frequent. The children usually suffer for several weeks from the general symptoms of malnutrition, which are proportionate to the severity of the attack. Of eighty-eight fatal cases which are reported

by Stadtfeldt all but five died between the ages of six and ten days. The duration of the disease in the fatal cases is seldom more than forty-eight hours, often less than twenty-four hours; in those terminating in recovery, between one and three weeks.

Prognosis.—No disease of infancy is more fatal than tetanus. Where it prevails endemically it is regarded by the laity as so uniformly fatal that usually no physician is called. Scattered through medical literature are quite a large number of isolated cases in which recovery has occurred. At the present time the proportion of fatal cases is probably between ninety and ninety-five per cent. Sporadic cases more frequently recover than those occurring in districts where the disease is endemic. The later the development of the symptoms, the slower their course, and the lower the temperature the more likely is the case to recover.

Prophylaxis.—A proper understanding of the nature of the disease has brought with it the means of rational prevention. The first essential is obstetrical cleanliness, which must include scissors, hands, dressings, ligatures—in short, everything which comes in contact with the umbilical wound. In districts where tetanus is endemic, thorough antiseptic treatment of the umbilicus should be insisted upon, both at the first dressing and later, particularly at the time of the separation of the cord.

Treatment.—All drugs whose physiological action is that of motor depressants of the spinal cord have a certain amount of value in tetanus. The most important ones are chloral, the bromides, and calabar bean. Nearly all the reported cures have been by one of these drugs or a combination of them. The mistake usually made is in using too small doses to be of any efficacy. Enough to produce the physiological effects of the drug must be given. The initial dose should not be large, but it should be repeated until the full effects are obtained. Of those mentioned, chloral has been the one most generally relied upon. An hourly dose of one or two grains is usually required. If no effect is visible in ten or twelve hours the dose may be further increased, as the patient is in much greater danger from the disease than he can possibly be from the drug. Chloral may be given by the mouth or by the rectum, but must always be well diluted. The single case of recovery which I have witnessed was one treated by the bromide of potassium. This infant took eight grains every two hours for three days, afterwards smaller doses. Calabar bean has the advantage in that its extract may be given hypodermically; one tenth of a grain may be administered from three to ten times daily, according to the severity of the symptoms. Monti has reported two cases cured by its use. The child must at all times be kept as quiet as possible, without unnecessary handling or bathing. If nursing or feeding by the mouth is impossible, because the jaws cannot be separated, the child may be fed by a tube passed through the nose. This is greatly to be preferred to rectal alimentation. Drugs may be administered in the same way.

The antitoxine treatment.—Behring and Kitasato, after a series of experiments upon animals, have produced a substance called *tetanus antitoxine* which has the power of neutralizing the tetanus poison. In animals immunity is produced by its injection. It is also curative in those cases where tetanus has been induced artificially. As yet the number of cases in which this treatment has been applied to man is too small to admit of positive deductions regarding its value. The practical difficulties in applying it are great, because of the very rapid absorption of the tetanus poison from the wound. The treatment is not efficient unless it is adopted very early in the disease. This is not always easy, as cases are not common. In Italy, ten cases, chiefly of traumatic tetanus, have been reported cured by the antitoxine; but experience elsewhere has not been quite so satisfactory. In England, two cases of traumatic tetanus have been cured by the injection of the serum. Escherich has recently reported (1894) four cases of tetanus in the newly born treated by antitoxine, with one recovery, the symptoms of this case diminishing rapidly after the second injection. Papiewski treated three cases by this method, two of which recovered, but the course was such that the result could hardly be attributed to the antitoxine. The tetanus antitoxine is now prepared by Behring and by the New York Health Department; it is used subcutaneously like the diphtheria antitoxine.

EPIDEMIC HÆMOGLOBINURIA (WINCKEL'S DISEASE).

The essential features of this disease are hæmoglobinuria with icterus and cyanosis, this combination giving the skin a deeply bronzed hue (*maladie bronzée*). It is a rare disease, but has generally occurred epidemically in institutions. It is usually fatal. All the symptoms point to an acute, rapid disintegration of the red blood-cells—a sort of blood fermentation. The changes have been compared with those produced in the blood in poisoning by chlorate of potash or phosphorus. The cause is, without doubt, some sort of infection, but its exact nature has not been discovered. Although generally called by the name of Winckel,* who in 1879 made a full report upon an epidemic of twenty-three cases in a hospital in Dresden, the disease was quite well described by Charrin† in 1873, with a report of fourteen cases, and observed by Bigelow,‡ in Boston, in 1875. All the cases included in Winckel's report occurred in one institution, affecting one fourth of the children born during the period.

There are cyanosis, and a more or less intense icterus of the skin and

* Winckel, Veröffentlich. der pädiatrischen Section der Gesellsch. f. Heilk., Berlin, April, 1879.

† Charrin, Thèse de Paris, 1873.

‡ Bigelow, Boston Medical and Surgical Journal, March, 1875.

internal organs. The umbilical vessels are usually normal. The kidneys are swollen, show small hæmorrhages into their substance, and under the microscope the straight tubes are seen to be filled with crystals of hæmoglobin, but contain no blood-cells. The bladder frequently contains brownish, smoky urine. The spleen is swollen and filled with blood pigment, which is diffused throughout the cells of the pulp, and free in the blood-vessels. Punctate hæmorrhages are seen in most of the other viscera. Fatty degeneration is at times observed in the heart and liver. Peyer's patches and the mesenteric glands are frequently swollen.

This disease most frequently attacks those who have been previously healthy. The symptoms usually begin from the fourth to the eighth day after birth. They are intense and fulminating in character, seldom lasting more than two days, and often only one. The early symptoms are general restlessness, rapid pulse and respiration, prostration, cyanosis of the face, and general icterus, which is at first slight, but steadily increases until it becomes intense, the skin resembling that of a mulatto. The temperature is normal or slightly elevated. Gastro-enteric symptoms are occasionally present, but they are not a feature of this disease. There is rapid asthenia, often terminating in coma or convulsions. The most characteristic symptoms are those connected with the urine. It is passed frequently, in small quantities, with pain and straining. It is of a brown, smoky colour, and under the microscope shows hæmoglobin in considerable quantity, renal epithelium, and sometimes granular casts and blood-cells, but does not contain bile pigment. Albumin is sometimes present, but not in large quantity. Examination of the blood shows an increase of the white cells and many free granules.

Treatment is of little avail, since all severe cases die. It is to be directed against individual symptoms.

FATTY DEGENERATION OF THE NEWLY BORN (BUHL'S DISEASE).

A disease has been described by the author whose name it bears, the essential nature and causation of which are unknown. It is characterized by inflammatory changes leading to fatty degeneration in the viscera, especially the heart, liver, and kidneys; it seldom lasts more than two weeks, and is almost invariably fatal. There may be hæmorrhages in any of the viscera, into the serous cavities, or from any mucous membrane. In the lungs are found large or small hæmorrhagic infarctions, and the bronchi contain blood and bloody mucus. There is granular or fatty degeneration of the epithelial cells of the alveoli. In cases that have lasted some time, the heart-muscle is pale, soft, and fatty. The liver in recent cases is large and soft; in those of longer standing it is pale and jaundiced, and shows marked fatty degeneration. The spleen is large and soft. The stomach and intestines contain blood, and the mucous membrane shows ecchymoses. The epithelium of the tubules of the

kidney is fatty, and the tubes are choked with granular and fatty detritus. The umbilicus is normal, but often there are hæmorrhages into the neighbouring tissues. Many of the lesions are similar to the ordinary post-mortem changes, and when found they should not be interpreted as pathological unless the autopsy has been made within at least twelve hours after death.

The disease occurs most frequently in patients who have previously presented the symptoms of asphyxia, which to a greater or less degree have persisted. In other respects the infants may be strong and well-nourished. The symptoms develop gradually. Those most constantly present are vomiting of blood, bloody stools, icterus, and œdema which may affect only the dependent parts, or may be general. When the cord separates there is often bleeding at the umbilicus. The constitutional symptoms are prostration, rapid loss in weight, and all the evidences of malnutrition. There is no appreciable rise in temperature. External hæmorrhages may be wanting altogether. Death occurs from progressive asthenia or hæmorrhage. The clinical features resemble those of pyogenic infection, but in Buhl's disease the umbilicus is healthy, aside from occasional hæmorrhages, and there is no rise of temperature. The disease occurs in isolated cases, not in groups. The treatment is entirely symptomatic.

PEMPHIGUS.

Pemphigus is a term used to designate a lesion rather than a disease. By it is meant an eruption of bullæ occurring usually upon a red base, the contents being in most cases clear serum. The term has been made in the past to include several different diseases even in the newly born.

1. Traumatic pemphigus is a condition which has been induced by putting infants into very hot baths.

2. Pemphigus is seen as one of the lesions of congenital syphilis. In these cases the eruption is often present at birth. It rarely appears after the fourteenth day. The bullæ are often seen upon the palms and the soles, but may be present on any part of the body. These infants are usually in a wretched condition, and die in a few weeks, often in a few days.

3. There is a variety of pemphigus which seems clearly due to infection. This has been observed in small epidemics in institutions. Quite a number of such epidemics have been seen in Europe, but none that I am aware of have been reported in America. Koch reports twenty-three cases occurring in two years in the practice of one midwife, she herself being probably the source of infection. The same writer states that in two cases the disease developed upon the breasts of mothers who were nursing affected children. While the infectious character of the disease is pretty generally admitted, the exact nature of the exciting cause has not yet been

determined. Strelitz discovered in the exudate two varieties of pathogenic cocci. Demme found diplococci.

The clinical picture presented by this form of pemphigus is so striking that the disease can scarcely be mistaken. The symptoms begin in most cases between the third and sixth day of life. There is a bullous eruption, which appears upon the abdomen, neck, face, or thighs. It is commonly seen first upon the trunk. Usually there are but ten or twenty bullæ present; but nearly the whole body may be covered except the palms and soles, where they are rarely seen. They may even appear upon the conjunctiva or the mucous membrane of the mouth. The single vesicles vary in size from one fourth to one or two inches in diameter. They are usually rounded, with a reddened base. The contents may be clear or cloudy. The small vesicles may coalesce and form very large bullæ. Rupture usually occurs in one or two days, and there is left a moist red surface, which quickly dries. After the falling off of the crust there remains a red or violet patch upon the skin. The eruption may come out quite rapidly, almost at once, or the disease may be prolonged, the bullæ appearing in crops for from one to three weeks. If ulceration occurs the duration of the disease may be considerably lengthened. In many particulars the pemphigus resembles impetigo contagiosa, with which it has no doubt often been confounded.

The principal point in diagnosis is to distinguish between syphilitic and non-syphilitic pemphigus. The latter usually occurs in well-nourished infants, and has a much better prognosis. In infants previously healthy it usually ends in recovery when the bullæ are few in number; but if they develop rapidly over a large surface the outlook is very unfavourable.

The treatment consists in absolute cleanliness, and in the use of absorbent antiseptic powders, such as equal parts of boric acid and starch, to dry up the eruption, or antiseptic lotions, such as 1 to 10,000 bichloride, or a one-per-cent solution of ichthyol.

CHAPTER V.

HÆMORRHAGES.

Hæmorrhages are quite frequent during the first days of life, and are important not only from the fact that they are often the cause of death, but, when the brain is the seat, from their remote effects. There are several conditions in the newly born which predispose to bleeding—the extreme delicacy of the blood-vessels, and the great changes taking place in the blood itself and in the circulation in the transition from intra-uterine to extra-uterine life. Hæmorrhages may complicate many of the

diseases of the early days of life, such as syphilis or sepsis, or they may exist alone.

The cases may be divided into two groups: (1) Traumatic or Accidental Hæmorrhages, which depend upon causes connected with delivery; (2) Spontaneous Hæmorrhages, or The Hæmorrhagic Disease of the Newly Born.

TRAUMATIC OR ACCIDENTAL HÆMORRHAGES.

These are mainly due to pressure in natural labour, or to means employed in artificial delivery, but some of them may possibly result from injuries received before birth. Their position is influenced by the presentation and the nature of the means employed in delivery. They are more frequent in large children, in difficult labours, and where from any cause the body of the child has been subjected to undue pressure. The most important of these are hæmatoma of the sterno-mastoid, cephalhæmatoma, and certain of the single visceral hæmorrhages, which may be intracranial, thoracic, or abdominal.

Hæmatoma of the Sterno-Mastoid.—Hæmatoma, or, as it is sometimes called, induration of the sterno-mastoid muscle, leads to the formation of a tumour in the belly of the muscle. It is a rare condition, usually noticed in the second or third week of life, and it disappears spontaneously, without causing any permanent deformity. The tumour varies from three quarters of an inch to one inch and a half in length, being about the size and shape of a pigeon's egg. It is movable, almost cartilaginous to the touch, and sometimes slightly tender. The situation of the tumour is usually about the centre of the muscle. There is no discoloration of the skin.

In about two thirds of the cases it occurs after breech presentations. It is much more frequent upon the right than upon the left side. In twenty-seven cases collected by Henoch the right side was involved in twenty-one and the left in only six cases. The explanation of this difference is to be found in the obstetrical position. Rarely, both sides may be involved. The head is usually inclined towards the shoulder of the affected side and rotated towards the opposite side. The tumour is frequently discovered by accident. Often it is the slight rotation of the head which is first noticed. Hæmatoma of the sterno-mastoid is frequently mistaken for an enlarged lymphatic gland; its position, however, is diagnostic. The swelling slowly diminishes in size, and in most cases by the end of the third month has entirely disappeared. Occasionally a slight torticollis remains for a longer time, but in the majority of cases the recovery is perfect. Hæmatoma of the sterno-mastoid is due to the twisting of the head during parturition. It is not an evidence of the employment of any improper violence in delivery. The twisting of the head produces laceration of some of the blood-vessels of the muscle, and in some cases there is doubtless rupture of some of the fibres of the muscle itself. Fol-

lowing this there occurs a certain amount of inflammation of the muscle and its sheath. The tumour is due partly to blood-extravasation and partly to inflammatory products. In one or two recent cases in which the sheath of the muscle has been opened it has been found filled with blood. Usually the inner border of the muscle is the part most affected.

The prognosis for complete recovery is good. The condition requires no treatment. Operative interference is positively contra-indicated.

Cephalhæmatoma.—This is a tumour containing blood, situated upon the head, usually over one parietal bone, and tending to spontaneous disappearance by absorption. The source of the blood is the rupture of the small vessels of the pericranium.

Etiology.—Cephalhæmatoma is sometimes due to a distinct traumatism like the application of forceps or to some other injury during labour. In the majority of cases, however, there is no evidence of such injury, and the cases are regarded as of spontaneous origin. Several etiological factors are probably present. Besides the conditions predisposing to all hæmorrhages, there is the increased pressure in the blood-vessels of the head during delivery, especially when labour is prolonged or difficult; there may be changes in the bone, such as an imperfect development of the external table, which has been found in a few instances, and in consequence of which the periosteum readily separates when the head is subjected to the pressure of the pelvis; and, finally, there may be changes in the blood itself. Cephalhæmatoma is a comparatively rare condition, being present, according to the statistics of the Sloane Maternity Hospital, in 20 of 1,300 consecutive births, or 1·6 per cent. This is rather more frequent than is stated by European observers. The condition is more common after first labours, after difficult labours, and in vertex presentations. It occurs twice as often in males as in females, probably from the greater size of the head in male children.

Lesions.—In the 20 Sloane cases, the situation was over the right parietal bone in 12; over the left in 2; over both parietals in 4; over the occipital in 2. The location of the tumour seems to have a very close relation to the position of the head in the pelvis. In 8 of the right-sided cases the head was in the left occipito-anterior position; in 3 it was in the right occipito-anterior; in 1 case the position was unknown. Of the cases with occipital tumours, both were breech presentations. Of the 16 cases with a single tumour the labour was natural in 10, tedious in 4, and in 2 forceps were used. Of the 4 double cases, 2 were forceps deliveries, 1 a tedious labour, and but 1 was natural.

In rare cases triple tumours are met with, one over each parietal and one over the occipital bone. The attachment of the periosteum along the sutures, usually limits the tumour to the surface of one bone. It never extends across the sutures or over the fontanel. In cases where there is a more definite injury, such as the forceps, the tumour may be present over

any one of the cranial bones, but more frequently over the parietal. The seat of the hæmorrhage is between the periosteum and the cranium. The scalp shows punctate hæmorrhages and sometimes infiltration with blood. In recent cases the blood is fluid; later it is coagulated. There is often developed about the blood-clot a sort of cyst wall which limits its extension. The bone is roughened, and there are at times small bony plates in the under surface of the periosteum. The amount of extravasated blood is usually from half an ounce to an ounce. In extreme cases it may be from four to six ounces. The cases following natural delivery are generally uncomplicated. The traumatic cases may be complicated by extravasations between the bone and the dura (internal cephalhæmatoma), or by meningeal or cerebral hæmorrhages. If there is a wound, infection may be followed by purulent meningitis and even by cerebral abscess.

Symptoms.—The tumour is usually noticed from the first to the fourth day after birth, appearing as a slight prominence in one of the positions indicated. Gradually increasing in size, it attains its maximum at the end of a week or ten days, and then slowly diminishes. In the average case the tumour is about the size of a hen's egg, and is oval in form. In marked cases it may be one third the size of the child's head. To the touch it is soft, elastic, fluctuating, and irreducible. It does not increase with the cry or cough. There is no extra heat and no sign of inflammation. Usually the tumour does not pulsate, although in rare instances pulsating cephalhæmatomata have been seen. Very soon the tumour is surrounded by a marginal ridge. At first this is apparently from coagulation of blood, but later it may be bony. The prominent ridge with the soft centre gives a sensation somewhat like that of a depressed fracture. Sometimes on pressure there is obtained a sort of parchment-crackling. This is generally found as the swelling is subsiding, and is sometimes clearly due to the formation of minute bony plates upon the inner surface of the periosteum. It may be found when there is nothing but thin coagula to explain it. In certain cases following severe traumatism, cephalhæmatoma may be complicated with wounds of the scalp, fracture of the skull, and even lacerations of the dura mater or the brain. In such cases the tumour may become inflamed, but in the spontaneous cases this is extremely rare. The usual signs of abscess develop, which may open externally or burrow. Fortunately this termination is seldom seen.

As a rule, without any interference, the uncomplicated cases go on to recovery. The complete disappearance of the tumour may be expected in from six weeks to three months, depending on its size; but a hard, uneven elevation may remain at its site for a longer time. The cases due to severe traumatism are more serious, the gravity depending not upon the cephalhæmatoma but upon the complicating lesions.

Diagnosis.—Cephalhæmatoma may be confounded with encephalocele. This, however, occurs along the line of the sutures or at the fontanels, is

partly reducible, pressure causes cerebral symptoms, and frequently the tumour increases with respiratory movements. Hydrocephalus is distinguished by the symmetrical enlargement of the head, the large frontanels, and the widely separated sutures. Caput succedaneum often appears in the same place as a cephalhæmatoma and at the same time, but is an œdematous, not a fluctuating tumour, is not circumscribed, lacks the hard, marginal border, and begins to disappear by the second or third day. From a depressed fracture of the skull, it is differentiated by the fact that in cephalhæmatoma there is a tumour and not a depression; the prominent margin which is raised above the contour of the skull, is not osseous and the skull can be felt at the bottom of the centre of the tumour.

The *treatment* in the uncomplicated cases is simply protective, all such cases tending to spontaneous recovery. No local or general treatment to promote absorption is required. The child should be so placed and so handled that no injury may be done to the affected part. Compresses are unnecessary. If complications exist, such as injury to the bones, dura, or brain, they are to be treated in accordance with general surgical principles. Operative interference is called for only when suppuration has occurred, or when there are brain symptoms which point to the existence of internal as well as external cephalhæmatoma.

Visceral Hæmorrhages.—While these are most frequent in large children and following difficult labours, they may occur in small children and where the labour has been easy and normal—their occurrence here being due to the feeble resistance of the blood-vessels. From one hundred and thirty autopsies upon still-born children or those dying soon after birth, Spencer concludes that intracranial hæmorrhages are more frequent in head-forceps than in breech cases, and more frequent in breech than in natural vertex deliveries. Other visceral hæmorrhages are much more frequent in breech cases.

Not all visceral hæmorrhages are to be classed as traumatic. They are often seen with the spontaneous hæmorrhages from the skin or mucous membranes. When, however, they are single, they seem to me of traumatic rather than of pathological origin.

The most important of the visceral hæmorrhages are intracranial. These are discussed in the chapter devoted to Birth Paralyses. Rarely there may be large hæmorrhages into the lung. Here the blood fills the air vesicles, the small bronchi, and coagula may be found even in the larger bronchi. A large part of a lobe or an entire lobe may be involved. On section the condition resembles atelectasis, and it may give the physical signs of consolidation.

The abdominal viscera suffer more than those of the thorax because less protected against pressure. Small hæmorrhages are not uncommon upon the surface of any of the viscera covered by peritonæum. Intraperitoneal hæmorrhages are rare, but may be very extensive, amounting to

one or two pints. Sometimes no ruptured vessel can be found. The hæmorrhage may be primarily in the peritoneal cavity, or it may result from rupture of one of the viscera, especially the suprarenal capsule. It may be large enough to produce death from loss of blood.

Small surface hæmorrhages of the liver are not infrequent. Occasionally one of considerable size occurs separating the peritoneal covering and forming a tumour generally upon the superior surface. Such laceration may be produced during labour, and a slow accumulation of blood may take place beneath the capsule, death resulting, as in the case reported by Mendelson (New York), from rupture into the peritoneal cavity on the third day. Steffen reports a case of laceration of the capsule of the liver in a still-born infant. Of the large hæmorrhages, those into the suprarenal capsules are perhaps the most frequent. Two cases have recently occurred in the Sloane Maternity Hospital. In one of these, the specimen of which I examined, the capsule was distended nearly to the size of an orange, and the kidney surrounded by a mass of blood-clots. Blood was extravasated into the retroperitoneal connective tissue, and rupture had taken place into the peritoneal cavity, which contained half a pint of partly coagulated blood. The child died on the fifth day. This case has been reported in full by Tuley.* Ahlfeld has reported a case of hæmorrhage into both suprarenals.

Except in the intracranial variety, visceral hæmorrhages cause few symptoms, and in the great majority of cases the diagnosis is not made. Intrapulmonary hæmorrhages have given rise to the signs of consolidation of the lung and even to hæmoptysis (Miram's case). The abdominal hæmorrhages are the most obscure. There may be a general abdominal distention with the usual symptoms of loss of blood, or there may be a circumscribed swelling. In many cases nothing is noticed until a rupture of a subperitoneal hæmorrhage takes place into the general peritoneal cavity, when there may be sudden collapse and death.

The visceral hæmorrhages are not amenable to treatment. The prognosis depends upon the size and position of the hæmorrhage. In the cases of abdominal hæmorrhage the diagnosis is extremely obscure and is rarely made during life.

SPONTANEOUS HÆMORRHAGES—THE HÆMORRHAGIC DISEASE OF THE NEWLY BORN.

A disposition to bleeding is seen with many diseases of the first few days of life, especially those of an infectious character, like syphilis and pyæmia. With most of these, however, the hæmorrhages are small, and the condition may be compared to the hæmorrhagic tendency seen in certain forms of infection of later life, such as measles, smallpox, and malignant endo-

* Archives of Pædiatrics, November, 1892.

carditis. There is, however, a class of cases in which the hæmorrhages are not associated with any other known process, and in which the escape of blood from the small blood-vessels is the chief or essential symptom. In these cases the bleeding is much more extensive than in the others mentioned. These hæmorrhages are characterized by the fact that they are spontaneous in origin, having no connection with delivery, they are multiple in location, and, while little influenced by treatment, they tend to cease spontaneously after quite a limited time. They are most often from the umbilicus, the mucous membranes of the stomach and intestines, or beneath the skin, but they may be from almost any mucous surface or into any organ of the body.

Etiology.—Exactly what causes these hæmorrhages is as yet unknown, but it is something which produces changes in the blood or in the blood-vessels, or in both, whereby the vessels are no longer able to hold their contents. In this class, as well as in the traumatic hæmorrhages, the predisposing causes of bleeding in early life must be emphasized—viz., the fragile condition of the blood-vessels and the great changes taking place soon after birth both in the circulation and in the blood itself. These hæmorrhages are not common, and are met with much more often in institutions than in private practice. In 5,225 births in the Boston Lying-in Asylum, Townsend reports 32 cases of hæmorrhage, or 0·6 per cent. In the Lying-in Asylum of Prague, Ritter observed 190 cases in 13,000 births, or 1·4 per cent. In the Foundling Asylum of Prague, Epstein reports hæmorrhages in 8 per cent of 740 infants.

These cases, except in very rare instances, are not manifestations of hæmophilia. Of 576 bleeders collected by Grandidier, only 12 had a history of hæmorrhage at the time of falling off of the cord, and symptoms very rarely appeared before the end of the first year. Hæmorrhages in the newly born are more frequent in males, while in hæmophilia females predominate, 13 to 1. The hæmorrhagic disease of the newly born is self-limited, and runs a definite course to recovery or death. The tendency to bleed does not extend beyond a few weeks, and often lasts but a few days; those who survive, recover perfectly. Circumcision has been done within a few days after the cessation of the hæmorrhages without any unusual bleeding. In a case lately under observation with the most extensive subcutaneous hæmorrhages I have ever seen, all tendency to bleed had ceased before the separation of the cord, although there had previously been bleeding at the navel. A similar case is reported by Townsend. These cases are not associated with difficult delivery. In only 6 of Townsend's * 50 cases was the labour abnormal. This is borne out by my own experience. Many of the children who bleed have previously been anæmic and in poor general condition; but, on the other hand, many have been

* Archives of Pædiatrics, 1894, p. 559.

strong and given every indication of being well nourished. Hereditary syphilis is associated in a small proportion of the cases—from 2 to 6 per cent, according to the observations of Epstein, Ritter, and Townsend. In 132 cases of congenital syphilis observed by Mracek, 14 per cent suffered from hæmorrhages.

A more frequent association with sepsis has been observed. Of the 61 cases observed by Epstein not less than 29, and of the 190 cases of Ritter,* 24 were associated with sepsis. In the Sloane Maternity Hospital, New York, in 1,500 consecutive births no case of hæmorrhage worth mentioning occurred, and during this period there was not a single case of marked sepsis among the infants born in the hospital. During the past year (1895) there have been no less than 8 marked cases of hæmorrhage in the Nursery and Child's Hospital in about 225 deliveries. While it is true that more cases of sepsis (pyogenic infection) have occurred among the children during this period than is usual, it is striking that not one of these hæmorrhagic cases gave any evidence of sepsis, and that none of the septic cases had bleeding.

From the foregoing facts it is quite evident that not all the cases of bleeding are due to the same cause, and that while this symptom occurs in cases of pyogenic infection, the latter does not explain most of the cases seen. The circumstances in which the hæmorrhagic disease occurs point strongly to an infectious origin, but with our present knowledge we cannot believe this cause to be the same as in ordinary sepsis—viz., the entrance of common pyogenic bacteria. Bacteriological findings thus far have not been altogether conclusive. The most important results were obtained in two cases studied recently by Gaertner.† In both of these there was found in the blood a short bacillus resembling in some respects the bacterium coli commune, but differing from it in several important points. This bacillus, injected into the peritoneal cavity in young animals, chiefly dogs a few days old, produced a disease accompanied by hæmorrhages resembling that seen in the newly born. The bacillus was recovered from the blood and all the organs of these animals. In a recent case occurring at the Nursery and Child's Hospital, cultures were made eight hours after death by Dr. J. J. Mapes. There was found in pure culture in the umbilical arteries, in the heart's blood, and in the spleen, a bacillus which in morphological and culture characteristics was apparently identical with that described by Gaertner. It will, however, be necessary that many other cases shall be recorded before the etiological connection between this germ and the disease is established.

While these hæmorrhages are not traumatic, bleeding is exceedingly prone to occur in the skin over pressure points such as the back, the

* Œsterreiches Jahrbuch für Pädiatrik, 1871, 127.

† Archiv für Kinderheilkunde, 1895.

elbows, the occiput, and the sacrum. It is also common from the mucous membranes which are the seat of pathological processes, especially from the eyes, the nose, and the genitals.

Lesions.—In very many of the cases the autopsy shows nothing except the hæmorrhages in the various situations and the blanching of the organs due to the loss of blood. The hæmorrhages of the brain are usually meningeal and diffuse. They are considered more at length in the chapter upon Birth Paralyses. The pulmonary hæmorrhages are usually small and unimportant, amounting only to small extravasations into the substance of the lung or ecchymoses of the mucous membrane of the bronchi. Ecchymoses may be seen upon the surface of the pleura, the pericardium, or the peritoneum, but large hæmorrhages into the pleura or pericardium are very rare. The thymus gland is often the seat of small extravasations. The stomach and intestines may contain considerable blood variously disorganized in the different parts of the canal, and there may be ecchymoses of the mucous membrane. In addition, ulcers may be found in the stomach and duodenum. In twenty-four autopsies upon cases with hæmorrhage from the stomach and intestines collected by Dusser,* ulcers were found in the stomach in nine cases, and in the intestines in four. These ulcers are multiple and are small, resembling the follicular ulcers of the colon. They are usually superficial, but may extend to the muscular coat and may even perforate. I have myself found ulcers in the stomach in a single case. They were associated with a moderate amount of follicular gastritis. The intestinal ulcers are found only in the duodenum and resemble those of the stomach. The cause of these ulcers is somewhat obscure; some of them are undoubtedly dependent upon inflammatory changes probably of infectious origin; others have been compared to the peptic ulcers of later life, and are attributed to thrombi in the blood-vessels of the mucous membrane. These ulcers are found in but a small proportion of the cases in which bleeding occurs from the alimentary tract, and they may be wanting even where it has been very profuse.

Small extravasations may be seen upon the surface of the liver, the spleen, or the kidneys. They may also be found in the substance of these organs. The large hæmorrhages upon the surface of the liver, into the suprarenal capsules and other subperitoneal extravasations have been included, improperly perhaps, in the group of traumatic hæmorrhages discussed in the preceding chapter. From a rupture of any of these there may be large extravasations into the peritoneal cavity. Microscopical examinations of the blood-vessels have been made in but a small number of cases. Mracek claims to have found evidences of endarteritis in some of the syphilitic cases in which there was bleeding. The changes found in the blood have not been uniform and have as yet been only im-

* Thèse, Paris, 1889.

perfectly studied. The associated lesions found are most frequently those due to sepsis.

Symptoms.—The time of beginning is most frequently in the first week of life, rarely after the twelfth day, although it has been observed as late as the sixth week. As a rule, the hæmorrhages from the stomach and intestines begin earlier than those from the navel or the skin. The location of the hæmorrhage in Ritter's 190 cases was as follows: Umbilicus, 138 (umbilicus alone, 97); intestines, 39; mouth, 28; stomach, 20; conjunctivæ, 20; ears, 9. In Townsend's 50 cases: Intestines, 20; stomach, 14; mouth, 14; nose, 12; umbilicus, 18 (umbilicus alone, 3); subcutaneous ecchymoses, 21; abrasion of skin, 1; meninges, 4; cephalhæmatoma, 3; abdomen, 2; pleura, lungs, and thymus, 1 each.

In many cases nothing is noticed until the hæmorrhage begins. The child may be previously healthy or feeble. The first bleeding noticed may be from the stomach, intestines, or any of the mucous surfaces, beneath the skin, or from the umbilicus. The amount of blood lost in most cases is not great, but there is a continuous oozing. The total hæmorrhage may be only one or two drachms or it may reach several ounces. The skin is usually pale, the pulse feeble, and the general condition one of considerable prostration, often from the outset. In all cases there is rapid loss of weight. The temperature may be high, low, or subnormal. A marked elevation of temperature may depend not upon the hæmorrhage but upon associated conditions. Fluctuations in temperature during the first three days are so common from disturbances of nutrition, that I attach much less importance than have some writers to this symptom. Icterus is not more frequent than among other infants. In a large number of the cases there is diarrhœa. Convulsions often occur at the close of the disease.

The duration of the disease in cases which recover is usually but one or two days. In fatal cases it is rarely more than three days, and often less than one. Death more frequently results from the gradual failure of all the vital forces than from a rapid loss of blood.

Umbilical hæmorrhage.—A slight oozing from the umbilicus not infrequently occurs when the ligature has been improperly applied, or when there is so much shrinking of the cord that the ligature has loosened. Sometimes rough handling at the time of the separation of the cord may excite a little bleeding. All the above conditions, however, are usually of trivial importance and are readily controlled by simple measures. Spontaneous hæmorrhage is quite a different matter. It is rather later than bleeding from the mucous membranes, usually occurring between the fourth and the seventh day. There may be bleeding into the cord as well as from its free extremity before it separates; after separation, from the stump. A slight stain upon the dressing is usually the first note of warning, but in exceptional circumstances a gush of blood is the first symptom. The hæmorrhage may be temporarily arrested by various means, but it

shows a strong tendency to recur in spite of everything which is done. The general symptoms depend upon the amount of bleeding and the rapidity with which it occurs. It is the same as in other hæmorrhages of the newly born. The usual duration is two or three days. It has been known, however, to persist for twelve or fourteen days, and it may be fatal in less than twenty-four hours from the time it is noticed.

Hæmorrhage from the stomach and intestines.—This occurs much less frequently from the stomach than from the intestines. The latter is called melæna. Gastro-enteric hæmorrhages begin, in the great majority of cases, during the first three days of life. Of Dusser's 75 cases, the hæmorrhage began on the first day in 24 cases; on the second day in 22 cases; on the third day in 9 cases; in only 10 cases later than the ninth day, and in no instance later than the twelfth day. The appearance of the blood vomited depends upon the length of time it has remained in the stomach. Usually it is in dark brown masses, and not very abundant; more rarely bright red blood may be ejected. The quantity varies from one drachm to half an ounce. Vomiting is liable to be excited by nursing. The blood discharged from the bowels is always dark coloured, usually intimately mixed with the stool, very rarely in clots. If in doubt between blood and meconium, one should look for the corpuscles with the microscope. When this is not conclusive on account of the disorganization of the corpuscles, a chemical test for hæmoglobin should be made. Concealed hæmorrhage into the stomach may take place, which may even be sufficient to produce death, no blood being vomited or passed by the bowels. In such cases the autopsy may reveal quite a large quantity of blood, both in the stomach and intestines.

Hæmorrhage from the mouth.—The quantity of blood is rarely large; but it is here that it is often first seen. Its source may be the mucous membrane of the mouth, pharynx, œsophagus, stomach, or bronchi. It may be associated with ulceration of the hard palate, with thrush, or with fissures of the lips.

Hæmorrhages from the nose are infrequent, and are more often due to syphilis than to other causes. These are rarely profuse, but are frequently repeated.

Subcutaneous hæmorrhages.—These may appear in places exposed to pressure, such as the sacrum, heels, occiput, or back; or in others which are not so exposed, as the abdomen, axillæ, or thighs. They may follow other lesions of the skin, such as pemphigus, eczema, or furunculosis. In some cases these hæmorrhages are very extensive, as in one recently under observation, where nearly one third of the thorax was covered. The extravasations are surrounded by an indurated border. Where they occur alone or form the principal lesion, the prognosis is favourable.

Hæmaturia.—The urine is not only stained with blood, but sometimes contains clots. This hæmorrhage may have its origin in the bladder, ure-

thra, or kidney. Blood coming from the kidney is sometimes due to the irritation of uric-acid infarctions, and may have nothing to do with the general hæmorrhagic disease.

Hæmorrhage from the conjunctiva.—The blood usually comes in drops from between the eyelids, chiefly from the tarsal surface. It is generally preceded by conjunctivitis.

Hæmorrhage from the ears may originate in the external meatus or the middle ear. It is generally preceded by otitis.

Hæmorrhage from the female genitals.—This not infrequently occurs without hæmorrhages elsewhere, and under such circumstances is rarely serious. Cullingsworth has collected thirty-two cases in children under six weeks of age—no case having resulted fatally. These are not to be regarded as cases of precocious menstruation. They are frequently preceded by catarrhal inflammations of the vagina.

Diagnosis.—This is generally easy, as the hæmorrhages are usually multiple and some of them external. A slight hæmorrhage from the intestine may be easily overlooked. Large hæmorrhages into the internal organs also are obscure and not often recognised. Spurious hæmorrhages from the stomach may occur as in the vomiting of blood which has been swallowed during parturition or sucked from the breasts. Bleeding may take place from the mouth, nose, or pharynx, and, after being swallowed, the blood may be vomited. When the principal bleeding is from the nasal mucous membrane, syphilis should be suspected.

Prognosis. — In all circumstances the hæmorrhage disease in the newly born has a bad prognosis. Of seven hundred and nine cases collected by Townsend, the mortality was seventy-nine per cent. No observer has seen more than one third of his cases recover. In any single case the prognosis depends upon the extent and severity of the hæmorrhage, upon the vigour of the child, and upon how well it can be nourished. No case should be looked upon as hopeless, for perfect recovery has repeatedly taken place where it seemed impossible.

Treatment.—The administration of drugs internally for the control of hæmorrhage is, in my opinion, entirely without influence upon the disease. The general treatment should have reference to maintaining the nutrition by careful feeding, judicious stimulation, and attention to the circulation, the body temperature, and the general condition of the child. External hæmorrhages may be treated locally. Bleeding points on the skin or mucous membranes within reach, are best treated by the application of chromic acid fused on a probe, or of nitrate of silver. Umbilical hæmorrhage is best controlled by covering the umbilicus with a small pad of sterile cotton, over which is folded from either side the skin of the abdominal wall. This is held in place by two strips of adhesive plaster crossing the umbilicus obliquely. After ligature *en masse* secondary hæmorrhage often occurs at the separation of the slough, so that the procedure

is frequently unsuccessful. The actual cautery is open to the same objection. There are a few instances on record where bleeding has been controlled by covering the wound with plaster of Paris. Astringents are applicable to all cases of external hæmorrhage—from the nose, skin, vagina, and the eyes. Astringent injections for gastro-enteric hæmorrhages are practically useless, as the blood is almost invariably either from the stomach or from the upper part of the small intestine.

CHAPTER VI.

BIRTH PARALYSES.

Birth paralyses are chiefly due either to pressure upon the child by the parts of the mother or to artificial means employed in delivery. They may be cerebral, spinal, or peripheral.

Cerebral paralyses are in almost every instance due to meningeal hæmorrhage. Very infrequently they depend upon cerebral hæmorrhage, laceration of the brain, or pressure from a depressed fracture.

Spinal paralyses are extremely rare, and only a few examples are on record. They are due to laceration of, or hæmorrhage into the cord or its membranes. These lesions produce paraplegia, the exact distribution of which depends upon the point at which the cord is injured.

Peripheral paralyses usually affect the face or the upper extremity. Paralysis of the face is due in most cases to the application of the forceps. Paralysis of the upper extremity is most frequently of the "upper-arm type," and is known as Erb's paralysis. It usually follows extraction in breech presentations. Peripheral paralysis of the lower extremity is almost unknown.

CEREBRAL PARALYSIS.

Cerebral paralysis is often used synonymously with meningeal hæmorrhage. This lesion is not infrequent, and is of great importance not only from its immediate effects, but because upon it depend many of the cerebral paralyses seen in later life. According to Cruveilhier, at least one third of the deaths of infants which occur during parturition are due to this cause.

Etiology.—The same predisposing causes exist in the cases of meningeal hæmorrhages as in others occurring at this time. A small number of cases are associated with syphilis; others with pyogenic infection. In a few cases there is a history of an injury—usually a fall or blow upon the abdomen—during the last months of pregnancy. Meningeal hæmorrhage

may occur as one of the lesions in the hæmorrhagic disease of the newly born. The most important causes, however, are connected with parturition. These hæmorrhages are essentially mechanical, and are favoured by everything which increases or prolongs pressure upon the head. The conditions with which they are associated are tedious labour, breech presentations with difficulty in extracting the head, instrumental deliveries, and premature births. The majority occur in first-born children. Certain cases are associated with cardiac malformations—according to Bednar, a small aorta with hypertrophied heart, or the transposition of the large blood-vessels. In many of the cases there is also a hæmorrhage outside the skull.

Lesions.—These hæmorrhages are very much more common at the base than at the convexity, and at the posterior, than at the anterior part of the skull. They are most frequently found over the cerebellum and the occipital lobes of the cerebrum. The entire extravasation is often beneath the tentorium. The extent of the hæmorrhage is exceedingly variable. There may be a single large clot at the convexity or at the base (Plate II), the hæmorrhage may be limited to the convexity of one hemisphere, or it may cover nearly the entire surface of the brain. Diffuse hæmorrhages are more common than a single circumscribed clot. Of eleven recent cases collected by McNutt (New York), in seven cases with vertex presentations the lesion was principally at the base, and usually limited to that region. In four breech cases, however, it was principally at the convexity. The source of the blood may be a laceration of one of the sinuses of the dura mater caused by the overlapping of the parietal bones. This was found in one of the cases of Hirst (Philadelphia). Much more frequently the blood comes from one of the cerebral veins, or from the capillary vessels of the pia mater. In thirty-seven of Bednar's fifty-two cases, the extravasation was beneath the pia mater. In the remainder it was between the pia mater and the dura—i. e., in the arachnoid cavity. Hæmorrhages between the dura and the skull may be said never to occur except when associated with fracture. If the child is still-born, or if death has occurred on the first or second day, the blood is partly fluid and partly coagulated; later it is entirely coagulated and may have undergone partial absorption. The amount of extravasated blood varies between one drachm and four ounces, the average amount being about one ounce. The blood extends into the fissures between the convolutions and sometimes into the ventricles along the choroid plexus, although this is rare. In large hæmorrhages the brain substance is softened and in places may be quite disintegrated; but with small extravasations these changes are very slight. In cases which survive for two or three weeks there is usually a certain amount of meningitis. The later changes—those of arrested development of the cortex and cerebral sclerosis—will be considered in the chapter devoted to Cerebral Pa-

PLATE II.

Meningeal Hæmorrhage in the Newly-Born.

From a patient in the Nursery and Child's Hospital, dying on the sixth day. Primary respirations poor; child very dull and apathetic, refused to nurse; once vomited blood and had an ecchymosis of the right conjunctiva. On the last day, high temperature (105° F.) and general convulsions. Some changed blood found in the stomach and intestines at the autopsy; brain greatly congested, and at the base was the clot shown in the picture.

ralyses in the section on Diseases of the Nervous System. Hæmorrhages into the membranes of the upper part of the cord are found in a large proportion of the fatal cases. Associated hæmorrhages of the lungs and other organs are not uncommon.

Symptoms.—If the hæmorrhage is large, the child is usually still-born, although its movements may have been active up to the commencement of labour. When the hæmorrhage is not so large as to be immediately fatal, the child may show no symptoms except dulness or torpor, with feeble or irregular respiration, death following within the first twenty-four hours. A large proportion of the cases are born asphyxiated, and frequently they are resuscitated only after considerable effort. They nurse feebly, often with great difficulty. Convulsions are common in cases which last for four or five days, and more with cortical hæmorrhages than with those at the base. Opisthotonus is sometimes present, and may be very marked. The limbs may be rigidly extended, and the hands clenched. More rarely there is complete relaxation of all the muscles. Sometimes there are automatic movements. The respiration is usually disturbed; in most cases it is slow and irregular. The pulse is feeble and slow. The pupils are more frequently contracted than dilated, and there may be oscillation of the eyeballs. In large hæmorrhages there is marked bulging of the fontanel, and often separation of the sutures. If the hæmorrhage covers one hemisphere, there is hemiplegia of the opposite side. Small localized cortical hæmorrhages may cause paralysis of the face, arm, or leg, according to the position of the lesion, or localized convulsions. In large hæmorrhages at the base convulsions are rare, and death occurs early, usually in the first two days. In extensive cortical hæmorrhages convulsions and rigidity of the extremities are frequent, and life is prolonged indefinitely.

The majority of the fatal cases die within the first four days. In those lasting a longer time the symptoms are tonic spasm of the trunk, or of one or more of the extremities, localized paralysis—monoplegia, diplegia, or hemiplegia, according to the lesion—with localized or general convulsions often continuing for two or three weeks and gradually subsiding. There is frequently a slight rise in temperature due to secondary inflammation. The mildest cases may show no symptoms at birth, and nothing abnormal may be noticed until the child is old enough to walk or talk. In those more severe there may be gradual and continuous improvement of the early symptoms, and the case may go on to complete recovery, but more frequently there results some permanent damage to the brain. The following observation of McNutt illustrates the course and termination of one of the severe cases of meningeal hæmorrhage:

Breech presentation, tedious labour, head delivered by forceps, almost continuous convulsions for the first nine days. After the convulsions there was complete paralysis of both sides of the body, not involving the face. The child never walked or spoke; the physical development was

very backward; the limbs became contractured; death occurred at two and a half years, from pneumonia. The autopsy showed atrophy of the brain on both sides about the fissure of Rolando.

The main diagnostic symptoms in recent cases are stupor, rigidity, convulsions, paralysis, and opisthotonus. These vary with the extent and situation of the lesion. The minor symptoms are changes in the pupils, oscillation of the eyes, and bulging of the fontanels.

Prognosis.—Large hæmorrhages at the base are usually fatal. Quite an extensive hæmorrhage over the convexity is compatible with life. The case may recover, as far as the immediate symptoms are concerned, but with serious damage to the brain. Smaller hæmorrhages over the convexity may be followed by complete recovery, but in the majority of cases more or less injury to the brain results, the full extent of which may not be seen for many years.

Treatment.—This is mainly prophylactic, the chief indication being to shorten tedious labours by the early use of the forceps. In a large number of cases where the hæmorrhage has been attributed to the forceps, the damage has rather been the result of the long-continued pressure before they were used. Nothing can be done after delivery to limit the amount of the hæmorrhage, except to keep the child as quiet as possible and to relieve individual symptoms as they arise.

FACIAL PARALYSIS.

The usual cause of facial paralysis is the use of the forceps, but this does not explain all the cases. The etiology of those in which the forceps have not been used is still somewhat obscure. In peripheral facial palsy the nerve is pressed upon either near its exit from the stylo-mastoid foramen, or where it crosses the ramus of the jaw, at which point the parotid gland gives it but little protection in the newly born. If the lesion is in front of this point, any one of the terminal branches may be affected; most frequently it is the temporo-facial branch. As only one blade of the forceps commonly touches the face in this region, the paralysis is, as a rule, unilateral.

Roulland has reported several cases not due to the forceps. In these the pressure is believed to have been produced by the promontory of the sacrum at the superior strait, or by the ischium at the inferior strait, as paralysis followed when the head was long arrested at one of these points. It was not seen with face or breech presentations. When facial paralysis is of central origin it depends generally upon a meningeal hæmorrhage, and the arm and leg of the same side as the face are involved. It is, however, possible for a very small cortical hæmorrhage to produce paralysis of the face only. This occurred in a case reported by McNutt.

In repose, the only symptom noticed may be that the eye remains open upon the affected side, owing to paralysis of the orbicularis palpebrarum.

When the muscles are called into action, as in crying, the whole side of the face is seen to be affected. The paralyzed side is smooth, full, and often appears to be somewhat swollen. The mouth is drawn to the side not affected. In this paralysis, the tongue, of course, is not implicated. It is therefore rare that nursing is seriously interfered with.* If the paralysis is of central origin, only the lower half of the face is involved, while in peripheral paralysis, as the trunk of the nerve is injured, the upper half of the face, including the orbicularis palpebrarum, is also affected.

The paralysis is generally noticed on the first or second day of life, and does not increase in severity. Its course and termination depend upon the extent of the injury done to the nerve. Some idea of this may often be gained by the amount of injury to the soft parts, although this is not an infallible guide. In cases not due to the forceps, the paralysis is slight and disappears in a few days; the great majority of the forceps cases follow the same favourable course, the paralysis gradually disappearing without treatment in about two weeks. In more serious cases it may last for months, or it may even be permanent. The reaction of degeneration is present in these severe cases, and there may even be perceptible atrophy of the muscles. This symptom is fortunately extremely rare.

Treatment.—Nothing should be done for the first ten days except to protect the eye and keep it clean. If improvement has begun by the end of this time, the probabilities are that the case will require no treatment. If no improvement has taken place by the end of the third or fourth week, electricity should be used regularly and systematically. If the muscles respond to it, the faradic current may be employed; if not, galvanism should be used. The electrical treatment should be continued for several months, or until recovery has taken place.

PARALYSIS OF THE UPPER EXTREMITY.

When this is due to a peripheral lesion it probably never involves the entire arm, but affects only certain muscles or groups of muscles. Although commonly occurring after an artificial delivery, it may be seen in cases where the labour has terminated naturally. Roulland † has reported a case in which deltoid paralysis, occurring in a large child, was attributed to pressure upon the shoulder during labour. In vertex presentations, paralysis is most frequently due to the forceps where one of the blades has extended down upon the neck, injuring the lower cervical nerves. It may be produced by traction with the finger in the axilla. Roulland reports a unique case of paralysis of both extremities, apparently due to

* In this connection it is to be remembered that the principal part in nursing is done by the tongue, and not by the lips.

† Paralysies des nouveau-nés, Paris, 1887.

the cord being very tightly wound around the neck. The great proportion of all cases of paralysis of the upper extremity follow extraction in breech presentations. The injury is usually inflicted by traction upon the shoulder in the delivery of the head, or in bringing down the arms when they are above the head. In the latter case the paralysis may be double and associated with fracture of the clavicle or humerus. In shoulder presentations, paralysis may be produced by traction upon the arm itself.

The most common form of peripheral paralysis is that known as the "upper-arm type," or Erb's paralysis, in which the injury is inflicted at the anterior border of the trapezius muscle at the lower part of the neck, usually in such a position as to affect the fifth and sixth cervical nerves. The muscles paralyzed are the deltoid, biceps, brachialis anticus, supinator longus, and sometimes the supra- and infra-spinatus. All these muscles may be involved, or only part of them, and in varying degrees. In case the injury is slight, the paralysis may not be noticed for some weeks. If severe, it is evident in the first few days. The arm hangs lifeless by the side; it is rotated inward, the forearm pronated, the palm looking outward (Fig. 19). The forearm and hand are not affected. In severe cases there may be anæsthesia of the outer surface of the arm, in the region supplied by the circumflex and external cutaneous nerves. This is rarely marked, and in its slighter degrees it is very difficult to determine. It is characteristic of this paralysis that the triceps is not affected, so that power to extend the forearm remains, although it cannot be flexed. Atrophy of the paralyzed muscles occurs after a few weeks, but the muscles are so small and so covered with fat that it is rarely noticeable before the second year. It is most conspicuous in the deltoid. In all severe cases the reaction of degeneration is present. In some of the cases of long standing there occurs a shortening of the tendon of the subscapularis muscle, often associated with subluxation of the humerus. The paralysis may be complicated with fracture of the clavicle, the neck of

Fig. 19.—Erb's paralysis, infant two months old.

the scapula, or the shaft of the humerus, or with epiphyseal separation of its head.

The prognosis depends upon the severity of the injury and also upon the time when treatment is begun. The great majority of cases recover spontaneously in two or three months, improvement being observed within a few weeks, first in the biceps and last in the deltoid. Spontaneous recovery is not to be looked for unless it occurs within the first three months. Not infrequently some degree of paralysis persists until the third or fourth year, and in some of the muscles, usually the deltoid, it may even be permanent. If the muscles respond to faradism, rapid improvement can generally be prophesied. If the reaction of degeneration is present, improvement will be slow and the paralysis may be permanent.

The diagnosis is usually not difficult, since the great majority of cases are of the "upper-arm type" with classical symptoms. Peripheral palsy of the arm can scarcely be confounded with that of cerebral origin. If the lesion is central it is one of the rarest occurrences for the arm alone to be involved; either the leg or face, or both, are generally likewise affected. If the case does not come under observation until the child is a year old, it may be difficult, or without a good history, it may be impossible to distinguish peripheral paralysis from that due to polio-myelitis. The peculiar group of muscles involved in Erb's paralysis is the only diagnostic point.

In recent cases the disability resulting from the tenderness or pain of syphilitic epiphysitis may simulate paralysis, but there is lacking the characteristic position of the arm, and a careful examination discloses the fact that the paralysis is only apparent. This may affect both sides. Fracture of the clavicle or epiphyseal separation of the head of the humerus may also be mistaken for paralysis. In cases of long standing, paralysis of the deltoid may resemble dislocation of the humerus. The reaction of degeneration differentiates paralysis from surgical injuries with similar deformities.

The treatment consists in the use of electricity, which should be begun at the end of the first month at the latest, and used regularly. If the muscles respond to faradism this may be employed, but in most severe cases they do not, and galvanism must be used, according to the rules laid down for facial paralysis.

CHAPTER VII.

TUMOURS OF THE UMBILICUS, MASTITIS, ETC.

Granuloma.—This is nothing more than a mass of exuberant granulations at the umbilical stump. The mass is generally about the size of a pea—sometimes larger—bleeds readily, and has a thin, purulent discharge.

It is promptly cured by the application of any simple astringent; powdered alum is probably the best. In case this is not successful, the granulations may be touched with nitrate of silver or snipped off with scissors.

Adenoma, Mucous Polypus, or Diverticulum Tumour—Umbilical Fistula.—The first three terms are used synonymously to describe an umbilical tumour covered with a mucous membrane which is similar in structure to that of the small intestine. It is usually associated with an umbilical fistula. This tumour is formed by a prolapse at the navel of the mucous membrane of Meckel's diverticulum. This diverticulum is the remains of the omphalo-mesenteric duct. When it is present in infants, it is found in various stages of development. Most frequently there is a

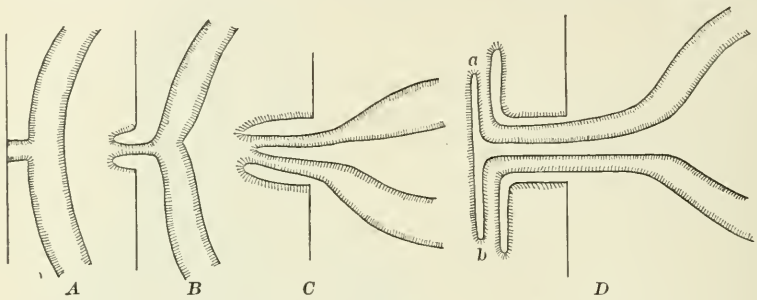

Fig. 20.—Umbilical fistula and tumours produced by prolapse of Meckel's diverticulum (Barth.)

blind pouch a few inches long given off from the lower part of the ileum. In other cases it may remain patent quite to the umbilicus, causing a fæcal fistula (Fig. 20, A). As the intestine below it is generally normal, this fistula may persist for months or even years, giving rise to no symptoms except a slight fæcal discharge from the umbilicus. In certain cases intestinal worms have been discharged through it. It may close spontaneously or be closed by operation.

A prolapse of the mucous membrane lining the diverticulum produces an umbilical tumour with a fistula at its summit (Fig. 20, B). This is the most common form. A cross-section shows under the microscope the structure of the intestinal mucous membrane both as an external covering and lining of the fistulous tract. The prolapse may involve not only the mucous membrane but the entire intestinal wall. There then exists a conical tumour with a fistula which has but one external opening, but at a short distance from the surface it bifurcates, one branch leading upward and one downward (Fig. 20, C). A continuation of the prolapse gives a broad pedunculated tumour (Fig. 20, D), which may reach the size of a man's fist. Its covering is the same as in the other forms. It may contain several coils of intestine. In this form there are usually two fistulous openings (*a*, *b*) which communicate with the intestine.

In all of these cases the tumour is smooth, irreducible, of a rosy pink

colour, and from its surface there oozes a mucous discharge. Microscopical examination shows the external covering to be the same in structure as the intestinal mucous membrane. These tumours are generally small, varying in size from a pea to a small cherry, but they may be very much larger. A fæcal fistula usually, but not invariably, coexists.* In the condition represented in Fig. 20, B, it is easy to see how an obliteration of the fistula may occur. The small tumours are readily cured by the ligature. The larger ones are usually associated with other serious malformations of the intestines, which make the outlook bad in almost every instance.

UMBILICAL HERNIA.

This is exceedingly common, and while not often serious it is a source of great annoyance. Umbilical hernia is much more common in female children than in males, and more frequent in those who are thin and poorly nourished than in plump, healthy infants. In the majority of instances the tumour is from one fourth to one half an inch in diameter; it may, however, be very large, and may even become strangulated. Cases of congenital umbilical hernia sometimes require surgical operation because of strangulation. The ordinary cases require only mechanical treatment. The most important thing is prevention. For this purpose it is necessary, after the cord has separated, to place a firm pad over the navel, and to use a snug abdominal band for the first two or three months. After this period it is uncommon for hernia to develop. In cases coming under observation after the third or fourth month, the pad and abdominal bandage are inadequate, and other means must be employed to retain the hernia. The best of these consists in the use of two adhesive strips applied obliquely over the abdomen, crossing at the umbilicus, the skin along the median line being folded inward so as to overlap the tumour, this forming the retention pad. Another method often successful is the use of a common wooden button or a piece of lead covered with kid and held in position either by rubber plaster or an abdominal band. These must be worn constantly for several months at least. The treatment of these cases after the first year, is extremely unsatisfactory. There is no truss or other apparatus for retention which I have ever seen which was wholly satisfactory. In a small hernia where the tumour is less than half an inch in diameter it is really unnecessary to use any form of apparatus, since these cases ordinarily show little or no tendency to increase in size, and the retention apparatus causes more annoyance than the hernia. These small herniæ seem to disappear spontaneously during childhood, as they certainly are not often seen in children over seven years of age.

* For report of such a case, and a fuller description, see article by the author, New York Medical Record, April 21, 1888.

MASTITIS.

According to Guillot, a certain amount of secretion in the breasts of the newly-born is physiological. It is certainly very common. It is most abundant between the eighth and fifteenth days, but may continue in small quantities as late as the third month. It is seen with equal frequency in both sexes. The quantity of the secretion amounts in most cases only to a few drops; in some, however, as much as a drachm has been obtained. Chemical analysis has shown this secretion to be essentially the same as the adult milk—containing fat, sugar, proteids, and salts. In gross appearance it resembles colostrum. The researches of Sinéty * have shown that the mammary gland of the newly-born contains *cul-de-sacs* lined with secreting cells, resembling those of the adult. During the period of secretion the gland is slightly reddened, its vessels turgid, and all the signs of functional activity are present. This condition in itself is of no practical importance, and in most cases, if left alone, the secretion ceases spontaneously after a week or ten days. If abundant, it can usually be dried up by painting the gland with tincture of belladonna. It sometimes happens, however, that the presence of this secretion tempts the nurse or attendant to rub or squeeze the breast. Such manipulation occasionally leads to serious results by exciting a mastitis which may terminate in abscess. Mastitis is not a very rare condition, and although the inflammation is not usually severe, it may be serious and even fatal. The predisposing cause is the congestion which accompanies functional activity, usually in the second week. The exciting cause is most often some form of traumatism—undue pressure, the squeezing of the breasts, or rough handling by the nurse. Through abrasions or fissures thus produced, micro-organisms find a ready entrance with the same result as in the adult. It seems possible that the germs may enter through the lactiferous ducts without any abrasion of the skin. Want of cleanliness is always a favourable condition for such infection.

The symptoms of mastitis usually begin during the second week of life. There are redness, swelling, and the usual signs of inflammation, which may terminate in resolution or in suppuration. The process may be limited to the mammary region, or a diffuse phlegmonous inflammation may be set up, as in a case reported by Bush,† in which there was extensive sloughing of the tissues of the whole of one side of the chest, with a fatal result. In the great majority of cases the process does not reach this degree of intensity, but suppuration with the formation of single or multiple abscesses is not uncommon. In the female it is possible for the cicatrization which follows such an inflammation to interfere with the sub-

* Gazette Médicale, No. 17, 1885.

† New York Medical Journal, March, 1881.

sequent development of the gland. The general symptoms are restlessness, loss of sleep, disinclination to nurse, and loss of weight. In cases of diffuse phlegmonous inflammation the general symptoms are those of pyogenic infection. Jourda* has collected fifteen cases of mammary abscess, twelve of which recovered. They began between the fourth and the forty-second days. In eleven cases, only one side was involved; in four, both sides.

Mastitis is usually due to want of cleanliness or to meddlesome interference; the parts should therefore be kept scrupulously clean, and on no account should squeezing of the breasts be permitted. They should be protected by a simple cotton pad. If acute inflammation develops, it should be treated in the beginning by hot applications. Should pus form, early incision with free drainage and general tonic and stimulant treatment are indicated.

INTESTINAL OBSTRUCTION.

The most frequent causes of intestinal obstruction in the newly-born are malformations of the intestine; rarely it may be due to pressure from tumours, or from a persistent omphalo-mesenteric duct or artery. The various pathological conditions present in intestinal malformations are considered in the chapter on Diseases of the Intestines. The most common seat of obstruction is at the anus, the bowel being normally formed throughout, lacking only the external orifice. The next most frequent condition is obstruction in the rectum, which may be due either to a membranous septum in the gut, or to obliteration of the tube for some distance. These rectal obstructions are readily recognised. By the examining finger or a bougie the lower limit of the obstruction can be made out, but there is no means by which the upper limit can be determined except by opening the abdomen. When the obstruction is above the rectum, localization is more difficult; but the most frequent seat is the duodenum. Of 38 cases collected by Gaertner, the seat of obstruction was the duodenum in 19 cases, the jejunum in 3, the ileum in 11, the colon in 6, the ileum and colon in 1. There is often obstruction at more than one point.

The symptoms vary with the seat and the degree of the obstruction. In atresia of the anus or rectum there is at first simply an absence of all discharges from the bowel. Later there is abdominal distention from dilatation of the sigmoid flexure and colon. After several days vomiting begins. If there is atresia of the duodenum or any part of the small intestine, vomiting begins early—usually by the second day of life—and it is persistent. Nothing is passed from the bowels after the first dark discharge of the contents of the colon, which is chiefly mucus. There is rapid asthenia, and death from inanition usually occurs in four or five days. The higher the obstruction the shorter the duration of life. If the condition is one of stenosis only, the symptoms are similar to those described

* Thèse, Paris, 1889.

but less severe, and life may be prolonged for several weeks, or even months. The constipation in these cases is not absolute. When the cause of obstruction is external pressure, the symptoms do not always begin immediately after birth. I have recently seen a child in whom nothing abnormal was noticed for the first three weeks, but at the end of that time there developed all the signs of acute intestinal obstruction. Laparotomy revealed a loop of intestine constricted by a tiny cord, which was probably the remains of the omphalo-mesenteric duct.

Cases of imperforate anus and membranous septum in the rectum are readily relieved by proper surgical treatment. In the other varieties of obstruction, whether in the rectum, in the colon, or in the small intestine, although life may be prolonged by the formation of an artificial anus, the ultimate result is almost invariably fatal, death usually resulting from marasmus during the early weeks of life.

DIAPHRAGMATIC HERNIA.

This is due to a congenital deficiency in the diaphragm, which in nearly all the reported cases has occurred on the left side at its anterior portion. The opening may be so small as to allow the passage of only a single coil of intestine, or so large that a considerable part of the abdominal contents find their way into the thoracic cavity. This causes displacement of the heart to the right, prevents the expansion of the left lung, and if it occur in intra-uterine life may prevent the development of the lung. In Gautier's case the left half of the diaphragm was deficient, and nearly all of the small intestine, the stomach, spleen, and pancreas were found in the left chest. The left lung was rudimentary.

If inflation of the lungs by the catheter or otherwise is attempted, a sense of resistance is experienced. A physical examination of the chest shows that movement is limited to one side, the apex beat is far to the right, and usually there is tympanitic resonance over the left side. If a large deficiency in the diaphragm exists, infants usually survive but a few hours; if a smaller one, life may be prolonged indefinitely. Northrup* has reported a case in a child who lived to the age of three years and presented very obscure physical signs. It died from intercurrent disease, the only local symptom being marked dyspnœa. In this case several loops of the ileum, the cæcum, and the vermiform appendix were found in the thoracic cavity.

SCLEREMA.

Sclerema is a condition characterized by hardening of the skin and subcutaneous tissues. It may occur in circumscribed areas or extend over nearly the entire body. It affects infants who are very feeble and usually terminates fatally. Although sclerema is chiefly seen in the first days of

* Archives of Pædiatrics, vol. ix, p. 130.

life, it is not limited to the newly-born, but may occur at any time during the first few months. It is not to be confounded with œdema of the newly-born, with which condition it is, however, sometimes associated. From published reports it appears to be of not very infrequent occurrence in Europe, chiefly in large foundling asylums. In America, sclerema is an extremely rare disease. In a discussion in the American Pædiatric Society, in 1889, following the report of a case by Northrup, scarcely a dozen cases could be recalled by the members present. I have seen but five cases. In the newly-born, sclerema affects those who are premature or very feeble, sometimes those who are syphilitic. Later it may follow any condition leading to extreme exhaustion, especially the different forms of diarrhœal disease.

The first thing to attract attention is usually the induration of the skin. It is often seen first in the calves or the dorsum of the feet, sometimes first in the cheeks, but soon extends over the greater part of the body. It is especially marked in the cheeks, buttocks, thighs and back, and regions where adipose tissue is abundant. It may affect the body uniformly or in circumscribed areas. The skin may be smooth or it may appear somewhat lobulated. The colour is normal or slightly bluish, often tinged with yellow. The lips are blue, and the capillary circulation so feeble that after pressure upon the nails the blood returns slowly or not at all. The limbs are stiff and board-like. The skin is cold to the touch, and often the thermometer in the axilla will not rise above 90° F. In cases reported by Roger and Parrot, an axillary temperature of 71° F. was recorded. The general feeling of the body has been well likened by Northrup to that of a half-frozen cadaver. The tongue and the mucous membrane of the mouth are cold; no radial pulse can be felt; the respiration is slow, irregular, embarrassed, and at times the movements of the thorax are scarcely perceptible. The cry is a feeble whine, scarcely audible. The duration of the disease is usually from three to four days. Death occurs slowly and quietly. If recovery takes place there is gradual improvement in the circulation and nutrition, and, later, a disappearance of the areas of induration.

The causes of sclerema are general, not local, the most important etiological factors being great feeblenesss, with lowering of the body temperature, and, in consequence, hardening of the subcutaneous fat. If it be true, as stated by Langer, that the fat of childhood contains more palmitine and stearine than that of adults, it is easy to see how this may occur. There are no essential lesions in this disease. Atelectasis is often present, and may have something more than an accidental association, as incomplete aëration of the blood is no doubt a factor in the production of the symptoms. In Northrup's case, the skin after being injected was studied with great care microscopically, with absolutely negative results.

The prognosis is very bad, because of the grave conditions of which it

is the expression, but it is not invariably fatal. In its milder forms, where treatment is begun early, recovery may take place. The diagnosis is to be made from œdema by the fact that there is no pitting upon pressure, by the rigidity of the body, and by the great reduction in the temperature. The most important thing in treatment is artificial heat; nothing but the incubator is efficient. In addition to this, care should be taken to promote the general nutrition by careful feeding and by all other means possible.

ŒDEMA.

Œdema has often been confounded with sclerema, but, although they may sometimes exist together, the conditions are quite distinct. Œdema occurs in delicate infants, and is associated with a feeble heart, especially of the right side, in consequence of which there are insufficient aëration of the blood, overfilling of the veins, and often a lowering of the body temperature. It also depends upon poor blood states, like severe anæmia, and I have seen it occur after hæmorrhages. The kidneys are unaffected.

The swelling is first noticed in the eyelids, the dorsum of the feet, the hands, or in dependent parts of the body. It may come on quite suddenly. In severe cases there may be general anasarca, but dropsy into the serous cavities is rare. Sometimes the first thing observed may be a sudden increase in weight before the œdema of any part is striking enough to be noticed. The general condition is feeble; the surface of the body cool; the temperature often subnormal; the cry weak; the urine often scanty, but rarely albuminous. The diagnosis of œdema is quite easy, the parts having the same appearance as in older patients. They are soft and waxy-looking, and pit upon pressure. While in most cases the prognosis is unfavourable, the disease is not necessarily fatal, since some even of the severe cases recover. The usual duration is five or six days; but there are frequently relapses.

The object of treatment is first to promote the general nutrition by all available means, and then to improve the circulation by the administration of heart stimulants, particularly digitalis and alcohol. In cases of extensive œdema, alkaline diuretics, like the citrate of potash, may be combined with digitalis. The body-temperature must be carefully maintained by artificial heat. The principal complications are diseases of the lungs and of the intestines.

INANITION FEVER.

The term *inanition fever* is not altogether a satisfactory one; but, until these cases are better understood, it is adopted because it emphasizes the very close connection which exists between the rise of temperature and the condition of inanition or starvation. Under this heading are included cases seen during the first five days of life—generally from the second to the fourth day—in which there is an elevation of tem-

perature, apparently due to the fact that the infant gets very little, frequently nothing at all from the breast at which it is being suckled. It is further characteristic of these cases that the temperature falls when the milk is secreted in abundance, or when the child is put upon a full breast, or when artificial feeding is begun, or even when water is administered, if freely given.

So far as my knowledge goes, the first to call attention to this condition was McLane (New York), who in 1890 reported to one of the medical societies an extraordinary case of hyperpyrexia in a newly-born child. The infant was found on the sixth day with a temperature of 106° F., near which point it had remained for three days. The child was being suckled at a breast which was found to be absolutely dry. A wet-nurse was procured, the temperature fell to normal in a few hours, and the child, which when first seen was apparently in a hopeless condition, was soon perfectly well.

Since that time very extensive observations, extending to upward of three thousand cases, have been made at the Sloane Maternity and Nursery and Child's Hospitals, which have established the fact that a rise of temperature to 102° or even 104° F. is quite common in newly-born infants during the first few days. This fever is accompanied by no evidences of local disease, and ceases in nursing infants with the establishment of the free secretion of milk. The fall in temperature is often rapid, dropping to the normal in a few hours after having continued for three or four days, and in a large number of cases it does not rise again.

The following case is a fairly typical one of the more severe form: The patient was the second child, the first having died at the age of ten days, from no disease it was said, but simply from exhaustion. At birth the infant, a boy, weighed eight and a quarter pounds and was apparently vigorous. During the first forty-eight hours his loss in weight was five and a half ounces and his condition good. I saw him on the evening of the third day. In the preceding twenty-four hours he had lost eight ounces in weight, and the temperature had gradually risen, until at the time of my visit it was 102·8° F. The body was limp, the child making no resistance to examination. He cried with a feeble whine; the restlessness of the early part of the day having given place to complete apathy. The lips and skin were very dry, the fontanel sunken, the pulse weak. As the father, a physician, expressed it, "he had been wilting through the day like a flower in the sun." Although put to the breast regularly, the child had apparently got very little. It was, in fact, impossible to squeeze any milk from the mother's breasts. Water was freely given and a wet-nurse secured in a few hours. The first milk was taken from the wet-nurse at 11 P. M., and the temperature, which fell gradually during the night, was normal the next morning and did not rise again. (See chart, Fig. 21). During the succeeding four days the child gained

eighteen ounces in weight, and at the end of a week was as well as an average infant of his age.

The symptoms are so uniform and so characteristic that they make for these cases of fever a class by themselves. The frequency with which this is seen is shown by the following statistics: Among 200 infants taken successively at the Nursery and Child's Hospital, 20 had fever during the first five days, reaching 101° F. or over, which was not explained by ordinary causes and followed the course above described. In 500 successive children born at the Sloane Maternity Hospital, there were 135 with a similar fever. It was seen in vigorous infants as well as in those who were delicate. The usual duration of the fever was three days, the temperature generally touching the highest point upon the third or fourth day of life. In about two thirds of the cases the temperature did not rise above 102° F.; in 9 it was 104° F. or over, the highest recorded being 106° F. The fall was generally quite abrupt, although not always so. Daily weighings, which were made in these cases, showed that the infants continued to lose weight while the fever continued, and that the loss almost invariably exceeded by several ounces that of the children who had no fever. (See p. 16.) The maximum loss noted was twenty-eight ounces. In quite a large number of cases it exceeded twenty ounces. As a rule the infants began to gain in weight when the temperature remained at the normal point, but not until then.

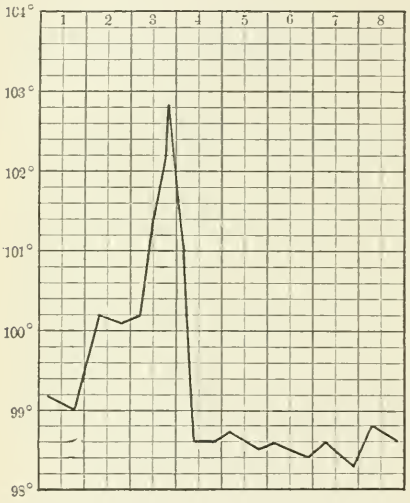

Fig. 21.—Temperature chart. Inanition fever.

The symptoms presented by these infants were a hot, dry skin, marked restlessness, dry lips, and a disposition to suck vigorously anything within reach. With very high temperature there were considerable prostration and weakened pulse. In the less severe cases there were only crying and restlessness. The rapidity with which the symptoms disappeared when the children were wet-nursed or properly fed, was very striking.

It is important that this fever should be recognised, because it gives at times the first warning of a condition which may prove fatal. The extra loss of ten or fifteen ounces in the first week, is a serious handicap to newly-born infants, the effect of which may last for several weeks. The temperature of every child should be taken during the first week. All the usual local causes of fever are first to be excluded by a physical examina-

tion. This fever can hardly be confounded with that due to pyogenic infection, which rarely begins before the fifth or sixth day.

The treatment is simple—viz., to give water regularly every two hours, in quantities up to an ounce at a time if required by the thirst of the child. This should be done in every case where the temperature reaches 101° F. When the temperature does not at once begin to fall, the infant should be put upon another breast or artificial feeding should be begun. Examination of the breasts from which the child has been nursing will usually reveal the fact that the secretion of milk is very scanty and often entirely absent.

Such a fever I have occasionally seen in older infants, usually in those who are nursing dry breasts or where fluid food and water have been withheld because of some gastric disturbance. It yields as promptly to treatment as does the same condition in the newly-born.

SECTION II.

NUTRITION.

CHAPTER I.

INTRODUCTORY.

Nutrition in its broadest sense is the most important branch of pædiatrics. At no time of life does prophylaxis give such results as in infancy, and no part of prophylaxis is worthy of more attention than the conditions of nutrition. This study is the first duty of physicians who practise among children. The importance of correct ideas regarding it can hardly be overestimated. The problem is not simply to save the child's life during the perilous first year, but to adopt those means which shall, during the plastic period of infancy, tend to the healthy and normal growth of the child, so that all the organs of the body shall have their normal development instead of impaired structure and deranged function, the effects of which may last throughout childhood or even throughout life.

The question whether a child shall be strong and robust or a weakling, is often decided by its food during the first three months. The largest part of the immense mortality of the first year is traceable directly to disorders of nutrition. The child must be fed so as to avoid not only the immediate dangers of acute indigestion, diarrhœa, and marasmus, but the more remote ones of chronic indigestion, rickets, scurvy, and general malnutrition with all its varied manifestations, since these conditions are the most important predisposing causes of acute disease in infancy.

One of the difficulties has always been that temporary success may mean ultimate failure. If the injurious effects of improper feeding were immediately manifest, there would be very much less of it than exists at the present time. It is because many things are valuable as temporary foods, which when used permanently are injurious. No better illustration is seen than in the too exclusive use of carbohydrates, like most of the proprietary foods. Infants so fed grow very fat, and for the time appear to be properly nourished. The absence from the food of some of those elements which are of vital importance may not be evident for months; hence the mistakes so often made by the laity, and even by the profession.

There are certain plain rules regarding the requirements of the growing organism which can not be ignored without serious consequences, which will sooner or later be evident. Another common mistake is in the prolonged use of predigested foods. These are sometimes continued until, as in a case under my observation, a healthy child at two-and-a-half years was totally unable to digest the casein of cow's milk. A great stumbling-block to many is the fact that there are some infants of robust constitution who, in good surroundings, have thriven exceptionally well in spite of very bad methods of feeding. But it should not be forgotten that there are a very much larger number of perfectly healthy infants whose lives are sacrificed every year, both directly and indirectly, as a result of improper feeding. A method of feeding is to be judged not by the few exceptional cases which may do well, but by the results obtained in the majority of cases.

Let no one think that he can secure the best results in infant-feeding without devoting both time and study to the problem. Close attention to details is indispensable to success in this as in all branches of medicine; but in none are more satisfactory results obtained.

THE FOOD CONSTITUENTS AND THE PURPOSES THEY SUBSERVE IN NUTRITION.

In infancy and childhood, as in adult life, the elements of the food are five in number: proteids, fat, carbohydrates, mineral salts, and water. The form in which they must be furnished to the child, and the relative quantities in which they are demanded, are different from those required by the adult. One of the reasons for this difference is the delicate condition of the organs of digestion in infancy, and the inability to assimilate certain forms of food. Another reason is that provision must be made not only for the natural waste of the body, but for its rapid growth, nearly trebling in size, as it does, during the first twelve months.

Proteids.—The proteids are essential to life, since they constitute the only kind of food which is capable of replacing the continuous nitrogenous waste of the cells of the body, upon the healthy condition of which the digestion and assimilation of the other elements of the food depend. Without the aid either of the fats or the carbohydrates, the proteids may sustain life and may even prevent a loss of weight for a time; but in so doing a great excess of such food is required, as twenty-two parts of proteids can do the work of only ten parts of fat. Such a diet taxes severely the digestive organs and the kidneys. When, however, fat and carbohydrates are added to the food, only one-half or one-third as much proteids are required to replace the nitrogenous waste, as in the case of an exclusive proteid diet (Munk).

The proteids are furnished by the casein and the other albuminoids present both in woman's milk and cow's milk, in the white of egg, muscle-

fibre, gluten of wheat, etc. The proteids easiest of digestion by infants are those of woman's milk. The greatest difficulty in artificial feeding has been to supply other proteids which can take their place. It is the difference in the digestibility of the proteids that causes most of the trouble in the substitution of cow's milk for woman's milk.

The average amount of proteids furnished in a good sample of woman's milk is 1·5 per cent. During the first few months, infants fed upon cow's milk should not receive a larger proportion than this, and on account of the difference in the digestibility of the two, the proteids of cow's milk must at first be reduced below this point, usually to 1 per cent, and in some instances to 0·5 per cent. Some infants fed upon milk appear to thrive normally for a considerable period, even with so small a proportion of proteids as 0·5 per cent, provided the other elements of the food are supplied in abundance. But all children fed on low proteids must be very closely watched. It is always hazardous to keep an infant long upon a food which is low both in proteids and fat.

The most constant symptom following insufficient proteids in the food is anæmia. Besides this, there may be feeble circulation, loss of strength, flabbiness of the tissues, and general failure of nutrition. Later there may follow difficulty in the digestion of other elements of the food. The vegetable proteids can not permanently take the place of the animal proteids in the food of young infants.

Fats.—As has already been hinted on the previous page, the uses of fat in the body are intimately associated with those of the proteids. Fat possesses the important property of saving nitrogenous waste, so that when this is supplied in the food in proper proportions, the entire energy of the proteids may be expended upon the growth and nutrition of the cells of the body without being used up in the production of animal heat. The demands made upon the proteids by the rapid growth of the body in infancy, make it desirable that, whenever possible, the fats should do the work of the proteids.

In addition to their use as a source of animal heat, the fats add to the body-weight by storing up fat in the body. They are needed for the growth of the nerve cells and fibres, and are essential to the proper growth of bone. Exactly what the part is which the fats take in the development of the osseous system is not altogether understood, but it is probable that their effect is due to their well-known and important function in aiding the absorption from the intestines of inorganic salts, especially the earthy phosphates. In a patient upon a milk diet, when the fats are withheld or greatly reduced, these salts appear in large quantities in the fæces. More fat is supplied in the food of the nursing infant than is used up in the body, as a very large amount is normally discharged in the stools. To this is due the soft consistence of the stools of the nursing infant. Fats thus seem to fill the rôle of a natural laxative; constipation being one of

the first and most striking symptoms following the reduction of fat in the milk.

The proportion of fat required in infancy, is therefore very much greater than at any other period of life. Probably the most common mistake in artificial feeding has been to give too little fat. The chief reason for the failure of most of the proprietary infant-foods is that they are too low in fat; but an excess of carbohydrates can not supply this deficiency.

Woman's milk of a good quality contains from 3 to 5 per cent fat, and this may be taken as representing the needs of the body under normal conditions. Infants who are fed upon cow's milk should get, on the average, 3 per cent fat for the first few months and 4 per cent during the latter part of the first year. Infants who are fed for a long time upon a food low in fat are very prone to develop rickets. Clinical experience also teaches that if the food at the same time is low in proteids this result follows much more readily. As such a diet is in most cases excessive in carbohydrates, children so fed are apt to be very fat, but usually anæmic. The importance of fats in nutrition does not end with the first year; they should be supplied liberally throughout childhood. The most convenient form of administration is cream, and next to this cod-liver oil.

Carbohydrates.—Although these, like the fats, can not replace the nitrogenous waste of the body, they are important aids to the proteids, and in this respect they are even more valuable than the fats. The carbohydrates are partly converted into fat, and may thus increase the body-weight. They are capable of replacing the fat-waste of the body. They are one of the most important sources of animal heat.

Carbohydrates are the most abundant of the solid elements of the food, although they form a smaller percentage of the entire quantity of food in infancy than in adult life. The form in which carbohydrates are furnished to the infant, and in fact to all young mammals, is milk-sugar. While this form of sugar is to be preferred, it is by no means so essential that it be given as that the fat and proteids of the food should be those of milk. Other forms of sugar may often take its place without interfering with nutrition. Sometimes, when there is difficulty in the digestion of milk-sugar, a temporary change to cane-sugar or to maltose may even be advantageous. The carbohydrates required by young infants can not, except to a very small extent, be supplied in the form of starch, owing to the feeble diastatic power of the digestive fluids during the early months, and in fact during the greater part of the first year. As a rule, there is less difficulty in the digestion of the carbohydrates in the form of sugar than of any other part of the food. A diet consisting too exclusively of carbohydrates leads often to a rapid increase in weight, but it is not accompanied by a proportionate increase in strength. Such infants have but little resistance, and many of them become rachitic. The easy digestion of a food consisting chiefly of soluble carbohydrates, and the rapidity

with which children so fed gain in weight, lead to a great misapprehension in regard to their value as foods. The ultimate results of such one-sided feeding, if long continued, are almost invariably disastrous.

In building up the cells of the body the proteids are first in importance, the carbohydrates second, and the fats third. In the production of animal heat the fats come first, the carbohydrates second; practically the proteids should never be called upon for this purpose. In a proper diet, all of these elements are represented.

Mineral Salts.—These are of greater importance in infancy than later in life, because of the building up of the osseous system which is going on with such rapidity during infancy and early childhood. The most important for this purpose are the phosphates of lime and magnesium. These are furnished in abundance both in woman's and cow's milk. These salts are also necessary for cell growth. The other inorganic salts furnish the elements from which the mineral constituents of the blood and digestive fluids are formed, and still others facilitate absorption, excretion, and secretion.

Water.—The food of all young mammals consists of from eighty to ninety per cent of water. This is needed for the solution of certain parts of the food, such as the sugar and some of the proteids, and for the suspension of the other proteids and the emulsified fat. All the food is thus dissolved or very finely divided so as to be more readily acted upon by the feeble digestive organs of the infant. Water is needed also in large quantities for the rapid elimination of the waste of the body. In proportion to its weight, an average infant during the first year requires a little more than six times as much water as an adult. During the time when the child is upon an entirely fluid diet, the addition of water other than that supplied by the food is unnecessary; but when the number of feedings becomes less frequent, and solid food is given in larger quantities, water should be given freely between the feedings at all seasons, but especially in the summer.

CHAPTER II.

THE INFANT'S DIETARY.

WOMAN'S MILK.

Woman's milk is the ideal infant-food. A thorough knowledge of its character, exact composition, and variations is indispensable, for upon this knowledge are based all our rules for the preparation of foods used as substitutes for woman's milk when this can not be obtained.

Woman's milk is a secretion of the mammary glands and not a mere transudation from the blood-vessels; although under abnormal conditions it may partake more of the character of a transudation than a secretion. A few drops may be squeezed from the breasts before parturition; generally speaking, however, it is only present after delivery. During the first two days the secretion is scanty. Usually upon the third or fourth day it becomes well established, although it may be delayed until the fifth or sixth day. During the period of lactation, milk is constantly formed in the mammary glands, but the process is more active while the child is at the breast.

Physical Characters.—Woman's milk is of a bluish-white colour and quite sweet to the taste. When freshly drawn its reaction is usually alkaline, sometimes neutral, but under healthy conditions never acid. The specific gravity varies between 1,027 and 1,032, the average being 1,031 at 60° F. On the addition of acetic acid only a slight coagulation is seen, this being in the form of small flocculi, and never in large masses as is the case in cow's milk. Microscopically, there are seen great numbers of fat-globules nearly uniform in size and some granular matter. Occasionally there are present epithelial cells from the milk-ducts or from the nipple.

Colostrum.—The secretion of the first two or three days differs quite markedly from the later milk. To this the name *colostrum* has been given. It is of a deep yellow colour, which is chiefly due to the colostrum-

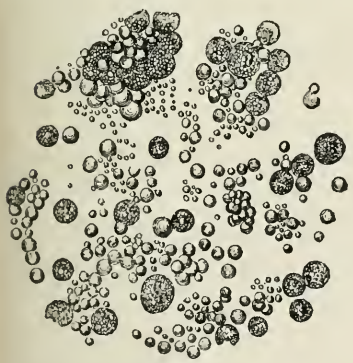

Fig. 22.—Colostrum. (Funke.)

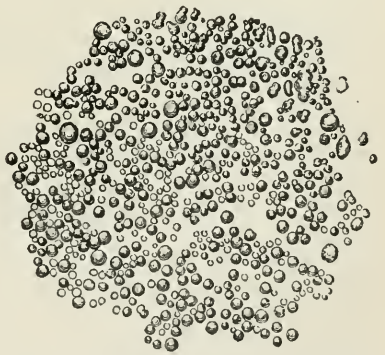

Fig. 23.—Woman's milk at a late period. (Funke.)

corpuscles. It is not so sweet as the later milk. It has a specific gravity of 1,040 to 1,046, a strongly alkaline reaction, and is coagulated into solid masses by heat, and sometimes coagulates spontaneously. It is very rich in proteids and in salts. Microscopically the fat-globules are of unequal size, and there are present large numbers of granular bodies known as colostrum-corpuscles (Fig. 22). These are four or five times the size of

the milk-globules (Fig. 23), and they are probably epithelial cells which have undergone fatty degeneration.

*Composition of Colostrum.**

Proteids	5·71
Fat	2·04
Sugar	3·74
Salts	0·28
Water	88·23
	100·00

The colostrum-corpuscles are very abundant during the first few days, but under normal conditions they are not found after the tenth or twelfth day.

Daily Quantity.—Exact information upon this point is difficult to obtain. There are recorded, however, extended observations made with great care upon five cases,† from which some deductions may safely be drawn. All were healthy infants, nursing exclusively and gaining steadily in weight.

From these observations, and others less extended, the average daily

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* From five analyses by Pfeiffer of milk obtained during the first three days.

† Haehner's cases (Jahrb. f. Kinderh., xv, 23; xxi, 314). Case I. Female; birth-weight 7 pounds 14 ounces (3,100 grammes). First week, lost 1½ ounce (41 grammes); after this gained steadily during the twenty-three weeks of observation; from second to ninth week, average weekly gain 8 ounces (241 grammes); from tenth to eighteenth week, average gain 4½ ounces (138 grammes); from nineteenth to twenty-third week, average gain 4 ounces (130 grammes); weight at the end of twenty-third week, 14¾ pounds (6,690 grammes).

Case II. Male; birth-weight 6½ pounds (2,950 grammes). Loss, first week, 3 ounces (80 grammes); after this gained steadily during the eleven weeks of observation; from second to eleventh week, average weekly gain 7½ ounces (214 grammes); weight at end of eleventh week, 11 pounds 2 ounces (5,045 grammes).

Case III. Female; birth-weight 3 pounds 9 ounces (1,620 grammes). Gain, first week, 1½ ounce (40 grammes); during the succeeding twenty-one weeks of observation, average weekly gain of 5 ounces (141 grammes); weight at the end of twenty-second week, 10 pounds 3 ounces (4,620 grammes).

Laure's case (Thèse, Paris, 1889). Female; birth-weight 8 pounds 13 ounces (4,000 grammes); loss, first week, 8 ounces (225 grammes); after this gained steadily during the nine weeks of observation, on an average 9½ ounces (268 grammes) weekly; at the end of ninth week, weight 13 pounds 3½ ounces (6,000 grammes).

Ahlfeld's case (Deutsch. Ztschr. f. Prakt. Med., 1878). Birth-weight 7 pounds 14 ounces (3,100 grammes). Observations continued from fourth to thirtieth week. During first ten weeks, average weekly gain 5¾ ounces (161 grammes); from eleventh to twentieth week, 7½ ounces (214 grammes); from twenty-first to thirtieth week, 6 ounces (168 grammes); at the end of thirtieth week, weight 18 pounds 9½ ounces (8,435 grammes).

In all these cases the amount of milk was determined by weighing the infant upon

quantity of milk secreted under normal conditions of health may be assumed to be pretty nearly as follows:

	Approximately.
At the end of the first week	10 to 16 oz. (300 to 500 grm.).
During the second week	13 to 18 oz. (400 to 550 grm.).
During the third week	14 to 24 oz. (430 to 720 grm.).
During the fourth week	16 to 26 oz. (500 to 800 grm.).
From the fifth to the thirteenth week	20 to 34 oz. (600 to 1,030 grm.).
From the fourth to the sixth month	24 to 38 oz. (720 to 1,150 grm.).
From the sixth to the ninth month	30 to 40 oz. (900 to 1,220 grm.).

It will be noted that the amount increases very rapidly up to about the eighth week, and after this much more slowly. The amount of milk varies also with the demands of the child in a very striking and uniform way.

A comparison of the daily amount of milk taken with the weight of the child at the different periods, shows that during the first ten weeks large children take on an average an amount equal to from fifteen to nineteen per cent of the body-weight; while smaller children, during the same period, take only from twelve to fourteen per cent of the body-weight. From the eleventh to the thirteenth week the large children take daily from thirteen to seventeen per cent of the body-weight, and the small ones from eleven to thirteen per cent, showing that the larger

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very delicate scales both before and after every nursing during the entire period of observation.

The following table gives in a condensed form the daily quantity of milk in these cases:

Time.	Haehner's 1st case.	Haehner's 2d case.	Haehner's 3d case.	Laure's case.	Ahlfeld's case.
	Grammes.	Grammes.	Grammes.	Grammes.	Grammes.
1st day	20	75	20	...	...
2d day	176	135	45	...	...
3d day	265	325	70	125	...
4th day	420	295	99	222	...
5th day	360	290	124	400	...
6th day	374	340	136	475	...
7th day	423	350	156	500	...
Average 2d week	497	423	229	556	...
Average 3d week	550	468	314	730	...
Average 4th week	594	531	379	810	576
Average 5th week	663	561	447	944	655
Average 6th week	740	661	472	978	791
Average 7th week	880	681	525	1,038	811
Average 8th week	835	730	568	1,024	845
Average 9th week	766	665	584	1,085	810
Average 10th to 13th week	796	...	600	....	869
Average 14th to 17th week	807	...	673	....	983
Average 18th to 23d week	870	...	709	....	1,029
Average 24th to 30th week	...	...	...	....	1,145

children take not only more food, but more in proportion to their size than the smaller ones.

The average quantity taken at one nursing by the five children previously mentioned was as follows:

		Approximately.
During the first week	⅝ to 1½ oz.	(18 to 50 grm.).
During the second week	1 to 3 oz.	(30 to 90 grm.).
During the third week	1½ to 4 oz.	(45 to 120 grm.).
During the fourth week	1½ to 4½ oz.	(45 to 140 grm.).
From the fifth to the seventh week	2 to 5 oz.	(64 to 150 grm.).
From the eighth to the eleventh week	2½ to 5½ oz.	(75 to 160 grm.).
During the fourth month	3 to 6 oz.	(90 to 180 grm.).
During the fifth month	3½ to 6½ oz.	(110 to 200 grm.).
During the sixth month	4 to 7 oz.	(120 to 220 grm.).

Between the limits mentioned the greater number of cases will undoubtedly fall. The amount taken at one time is, however, modified by the frequency of nursing, and is therefore not so good a guide to the amount of food required, as is the quantity taken in twenty-four hours.

Composition.—Many of the older analyses of milk gave erroneous results because of imperfect methods of examination. According to the most recent analyses of Pfeiffer, Koenig, Leeds, Harrington, and others, the composition of human milk is as follows:

	Average.	Common healthy variations.	
	Per cent.	Per cent.	
Fat	4·00	3·00 to 5·00	
Sugar	7·00	6·00 " 7·00	
Proteids	1·50	1·00 " 2·25	
Salts	0·20	0·18 " 0·25	
Water	87·30	89·82 " 85·50	
	100·00	100·00	100·00

In the older analyses, the percentage of proteids is almost invariably too high and the sugar too low.

There are certain variations in composition depending upon the age of the milk. Nearly all these changes take place during the first month, and principally during the first two weeks. During this period there is, according to Pfeiffer, a fall in the proteids from nearly 4 to below 2 per cent, in the salts from 0·45 to 0·20 per cent, a rise in the sugar from 2 to 6 per cent, and a very slight increase in the fat. After the first month the regular variations in composition are so slight that they may be practically ignored.

Proteids.—The proteids are not yet fully understood. Their separation is somewhat difficult, and they are usually considered together. The most abundant and the most important ones are casein and lactalbumen, although Hammarsten gives a third—lactoglobulin—and some other au-

thors even a fourth. The casein is not in solution but in suspension, by virtue of the presence in the milk of lime phosphate, with which it is probably in combination. The lactalbumen is in solution; it resembles serum-albumen. It is present in a larger proportion than in other varieties of milk. According to Koenig, lactalbumen is twice as abundant as casein.

The proteids are usually present in the proportion of 1·50 to 2 per cent in woman's milk, although the variations are quite wide (1 to 4·5 per cent). The amount of proteids is larger in the milk of the first few days. After the third week the proportion changes but little during the whole period of lactation.

Fat.—This exists in the form of minute globules, which are held in a state of permanent emulsion by the albuminous solution in which they are suspended. The old view, that the globules had an investing membrane, is now generally discarded. Like the proteids, the proportion of fat is subject to wide variations—4 per cent being taken as the average. In thirty-four analyses made for me at the laboratory of the College of Physicians and Surgeons, the fat varied between 1·12 and 6·66 per cent. In forty-three analyses by Leeds, the variations were between 2·11 and 6·89 per cent. The proportion is very little affected by the period of lactation.

Sugar.—The sugar is in complete solution. Its proportion is very constant, the average being seven per cent. The ordinary variations are usually within the limits of 6 and 7 per cent. The sugar being so important as a heat-producing element, Nature has wisely provided that this shall be the most constant ingredient of the milk. The amount of sugar is smallest in the milk of the first week; after the first month, however, the variations are slight.

Salts.—The average proportion of inorganic salts is 0·20 per cent, or about one fourth that of cow's milk. According to Rotch's analysis, the inorganic salts exist in the following proportions:

Salts in Woman's Milk.

Calcium phosphate	23·87
Calcium silicate	1·27
Calcium sulphate	2·25
Calcium carbonate	2·85
Magnesium carbonate	3·77
Potassium carbonate	23·47
Potassium sulphate	8·33
Potassium chloride	12·05
Sodium chloride	21·77
Iron oxide and alumina	0·37
	100·00

With the exception of calcium phosphate nearly all the salts are in solution. The milk of the first few days is very rich in salts—the propor-

tion being fully twice that of any later period. After the first month the variations are slight.

The Examination of Milk.—The exact composition of human milk is to be determined only by a complete chemical analysis. There are, however, many variations which the physician may readily ascertain for himself by simple methods of examination.

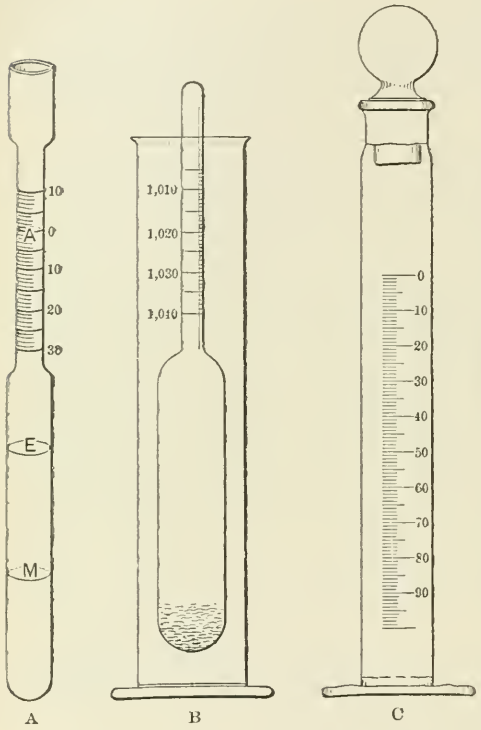

Fig. 24.—Apparatus for examination of woman's milk. A, Marchand's tube; B, C, the author's lactometer and cream-gauge.

The *quantity* of milk secreted by the breasts may be estimated by the quantity which may be drawn by a breast-pump, although this is not a very reliable test. If the child nurses habitually forty or fifty minutes, the probabilities are very strong that the quantity of milk is small. If the breasts at nursing time are full, hard, and tense, the supply is probably abundant. If they are soft and flabby, and the milk appears to run in only while the child is nursing, it is almost certain that the quantity is small. The most reliable of all tests is weighing the infant before and after nursing, upon an accurate pair of scales, sufficiently sensitive to indicate half-ounces. Two or three weighings will suffice to show conclusively whether an infant at three months, for instance, is getting habitually four or five, or only one or two ounces at a nursing.

The *reaction* of milk may be taken with ordinary litmus paper. When freshly drawn it should be alkaline or neutral, never acid.

The *specific gravity* may be taken with any small hydrometer graduated from 1,010 to 1,040 (Fig. 24, B). The specific gravity is lowered by the fat, but increased by the other solids. An ordinary urinometer will answer every purpose, the only difficulty being the quantity which is required to float the instrument.

Microscopical examination.—The microscope reveals the presence of colostrum-corpuscles, blood, pus, epithelium, and granular matter. Colos-

trum-corpuscles are abnormal after the twelfth day; pus and blood are always abnormal. All of these conditions necessitate the suspension of nursing, at least temporarily. But little importance can be attached to the size and appearance of the fat-globules as affecting the nutritive properties of the milk.

The determination of fat.—The simplest method is by the cream-gauge (Fig. 24, C), which is sufficiently accurate for ordinary clinical purposes. The glass cylinder holding ten cubic centimetres is filled to the zero mark with freshly drawn milk. This is allowed to stand at the temperature of the room (66° to 72° F.) for twenty-four hours, and the percentage of cream is then read off. Under these conditions, the relation of the percentage of cream to that of fat is very nearly as five to three; thus five per cent of cream will indicate that the milk contains three per cent of fat, etc. When an immediate determination of fat is desired, the most accurate instrument is the Babcock centrifugal machine. (See page 140.) Marchand's tube (Fig. 24, A) may also be employed. In this test the fat is extracted by ether and then precipitated by alcohol.* The various optical tests which have been suggested are much less satisfactory.

Sugar.—The proportion of sugar is so nearly constant that it may be ignored in clinical examinations.

Proteids.—We have no direct method for determining clinically the amount of proteids. If we regard the sugar and salts as practically uniform, or so nearly so as not to affect the specific gravity, we may form an approximate idea of the proteids from a knowledge of the specific gravity and the percentage of fat. We may thus determine pretty positively whether they are greatly in excess or very scanty. The specific gravity will then vary directly with the proportion of proteids, and inversely with the proportion of fat—i. e., high proteids, high specific gravity; high fat,

* Marchand's test: First put in five cubic centimetres of milk, up to the line M; then four or five drops of liquor sodæ; shake; add five cubic centimetres of ether, up to the line E; cork, and shake fifteen or twenty times; add ninety-per-cent alcohol, up to the line A. The tube is now tightly corked, shaken thoroughly, and placed upright in a tall bottle containing water at a temperature of 120° to 150° F. The fat separates and forms a distinct layer at the top, and after half an hour the amount is read off in degrees. By reference to the following table the exact percentage of fat is shown:

Degrees Marchand.	Percentage of fat.	Degrees Marchand.	Percentage of fat.
1	1·49	13	4·29
3	1·96	15	4·75
5	2·42	17	5·22
7	2·89	19	5·68
9	3·36	21	6·14
11	3·82		

Each additional degree on the tube corresponds to 0·23 per cent of fat. To insure accuracy the test should be repeated two or three times with the same specimen.

These tubes may be obtained from E. Greiner, 51 William Street, New York.

low specific gravity. The application of this principle will be seen by reference to the accompanying table.*

Woman's Milk.

	Specific gravity 70° F.	Cream—24 hours.	Proteids (calculated).
Average.....	1·031	7%	1·5%
Normal variations...	1·028 — 1·029	8% — 12%	Normal (rich milk).
Normal variations...	1·032	5% — 6%	Normal (fair milk).
Abnormal variations.	Low (below 1·028).	High (above 10%).	Normal or slightly below.
Abnormal variations.	Low (below 1·028).	Low (below 5%).	Very low (very poor milk).
Abnormal variations.	High (above 1·032).	High.	Very high (very rich milk).
Abnormal variations.	High (above 1·032).	Low.	Normal (or nearly so).

The specimen taken for examination should be either the middle portion of the milk—i. e., after nursing two or three minutes—or, better, the entire quantity from one breast, since the composition of the milk will differ very much according to the time when it is drawn. The first milk is slightly richer in proteids and much poorer in fat. The last drawn from the breasts is low in proteids and high in fat. The following analyses from Forster illustrate these differences:

	First portion.	Second portion.	Third portion.
	Per cent.	Per cent.	Per cent.
Fat.....	1·71	2·77	5·51
Proteids.....	1·13	0·94	0·71

Conditions Affecting the Composition of Woman's Milk.—*The age of the nurse.*—This has no constant influence. Other things being equal, the milk of very young women, and also of those over thirty-five years of age, is likely to be lower in fat than that of women between twenty and thirty-five years.

Number of pregnancies.—This has no constant influence except such as results from the effect upon the general health of the nurse.

Acute illness.—In the majority of cases of acute illness of a minor character and of short duration there is no perceptible effect upon the milk. In the acute febrile diseases of a severe type the quantity of milk is reduced, the fat is low, and the proteids are apt to be high. In septic conditions bacteria may appear in the milk.

Menstruation.—The effect of this is exceedingly variable, depending much upon the individual and the ease of menstruation. From observations upon 685 cases, Meyer noted disturbances in the child in over one half the number. My own experience accords rather with that of

* The author's apparatus for this examination, consisting of lactometer (Fig. 24, B) and two cylindrical graduated glasses (Fig. 24, C), may be obtained from Eimer and Amend, Eighteenth Street and Third Avenue, New York. With these the test can be made with half an ounce of milk. For a fuller discussion of the subject, see article by the author in Archives of Pædiatrics, March, 1893.

Pfeiffer and Schlichter, who consider it quite exceptional for the child to be visibly affected. Schlichter made observations upon infants during 233 menstrual days, noting the condition of the stools and digestion both before and after menstruation. In ninety per cent of the cases there was no perceptible influence. In only eight per cent were the stools bad, and in only three per cent was there disturbance of the stomach with vomiting.

The nature of the changes in milk produced by menstruation is illustrated by the following case taken from Rotch:

	Second day of menstruation. Bowels of child loose.	Seven days after menstruation. Bowels regular.	Forty days after menstruation. Child gaining rapidly.
	Per cent.	Per cent.	Per cent.
Fat	1·37	2·02	2·74
Sugar	6·10	6·55	6·35
Proteids	2·78	2·12	0·98
Salts	0·15	0·15	0·14
Water	89·60	89·16	89·79

At the present time sufficient observations have not been made to show whether the differences noted in the above case—low fat and high proteids—are the rule where disturbances are produced during menstruation. Monti's examinations lead him to the conclusion that the fat is not constantly affected. It is safe to say that the changes are not uniform, and that in very many cases none of importance are produced by menstruation.

Diet.—The fat and the proteids of the milk are much influenced by diet, the sugar but very little. A nitrogenous diet increases quite uniformly both the fat and the proteids. A vegetable diet diminishes both the fat and the proteids. A starvation diet diminishes the fat, while the proteids may be diminished or increased; if the latter, they are generally changed in character. An excessively rich diet increases the fat and usually the proteids also. All fluids tend to increase the quantity of milk. Alcohol in the form of malted drinks, and malt-extracts increase the quantity of milk and the amount of fat. The effect of alcohol upon the proteids is not constant, but they are usually increased. The following table gives the result of analyses of the milk of two women in the New York Infant Asylum before, while taking, and after taking an alcoholic extract of malt:

	I. Without malt.	II. After taking 8 oz. malt daily for 10 days.	III. No malt for 7 days.
	Per cent.	Per cent.	Per cent.
Case I:			
Fat	1·74	3·83	2·41
Proteids	1·93	1·58	2·95
Sugar	7·02	7·43	6·59
Salts	0·20	0·17	0·19
Case II:			
Fat	1·12	2·75	1·70
Proteids	1·57	2·34	1·26
Sugar	7·11	6·77	6·04
Salts	0·19	0·17	0·18

The child of Case I gained one ounce and a half during the four days preceding the first analysis; that of Case II did not gain at all. During the ten days while taking the malt, the first child gained twelve ounces, the second child eight ounces. During the seven days after the malt was discontinued, the first child gained eight ounces, the second child one ounce. There was a notable increase in the quantity of milk in both cases while taking the malt.

Klingemann has shown that the taking of alcohol of a poor quality (especially amylic alcohol) may cause it to appear in the milk, and may produce symptoms in the nursing infant, particularly if the amount taken is large. Seibert has called attention to very grave symptoms in infants produced by the ingestion of stale beer by nurses.

The nursing woman should have a generous diet of simple food, and should drink largely of milk or gruels made with milk. The diet should be a varied one, not excessive in nitrogenous food nor in vegetables. All salads and highly seasoned dishes should be avoided, not so much because they upset the child, although this may happen, as because they are likely to disturb the digestion of the nurse. All the common vegetables and fruits in season may be allowed in moderation. Strong tea and coffee should be prohibited, although weak tea or coffee may be allowed, each but once a day. Cocoa is less objectionable than either tea or coffee. In addition to her regular meals the nurse should have milk or gruel at bedtime. The diet should in all cases be adapted to her digestion. Great harm often results from over-feeding with its consequent indigestion. The taking of alcohol should be discouraged and its routine use forbidden.

Drugs.—The elimination of drugs through the milk is somewhat uncertain and variable. A large proportion of those popularly supposed to influence the child when taken by the nurse, have no effect whatever. The effect of drugs is more noticable when the milk is very poor in quality; it being at such times more of an excretion than a secretion. This is seen during the early colostrum period, also during the illness of the nurse or when from various causes, mental or physical, the secretion becomes disturbed. The more important drugs affecting the child through the milk are the following:

Belladonna: Effect quite constant under all circumstances when given in full doses.

Opium: Effect inconstant, although it is possible, when the milk is poor, for toxic symptoms to be produced when full doses are given to the mother. A fatal case is on record in a child a few days old.

Potassium iodide: Effect not uniform, particularly seen when the administration is long continued. Koplik and others have reported the production of iodism in nursing infants while the drug was taken by the mother.

Bromides: Effect similar to that of the iodides.

Mercury: Effect very feeble, and only after prolonged administration.*

Drugs occasionally eliminated in milk in sufficient amount to produce visible effects are the saline cathartics, arsenic, and the salicylates. Acids, chloral, and most other drugs are without effect.

Pregnancy.—The milk of pregnant women is generally small in quantity and poor in quality, especially in fat. (See chart, p. 168). It is not known, however, that there are any other differences.

Bacteria.—Under normal conditions human milk is practically sterile. In disease of the mammary gland of a suppurative character, bacteria are frequently found in the milk. They may also appear in considerable numbers during puerperal sepsis. In the milk of women suffering from acute fevers not of septic origin, Escherich found no bacteria. It has been shown that the bacilli of anthrax and tuberculosis may appear in cow's milk apart from any disease of the udder itself. This may fairly be assumed to be true in the case of human milk.

Nervous impressions.—These, when of a marked character, have a very decided and immediate effect upon the milk. Fatigue, exhaustion, great excitement, sudden fright, grief, or passion are likely to affect the secretion in a most marked manner. An infant who takes the breast under such circumstances may exhibit only the ordinary signs of acute indigestion, such as vomiting and undigested stools, or there may be in addition high temperature, great prostration, toxic symptoms, and sometimes even convulsions. The nature of the changes in milk from such causes is as yet but little understood. The probability is, however, that it is the proteids which are at fault, as these are very unstable and easily affected, and that instead of the normal proteids others are produced which possess toxic properties. In certain cases the secretion of milk may be almost entirely arrested by nervous influences.

COW'S MILK.

The only one of the lower animals whose milk is practically available for infant-feeding is the cow. Cow's milk being our main reliance in the artificial feeding of infants and the staple food of nearly all young children, it follows that everything relating to its production and handling is of great importance to the physician. In the feeding of children no one thing is more essential than a supply of pure cow's milk. Milk undergoes changes from such slight causes, that the physician should insist upon it that those who furnish milk for infant-feeding, whether in city or country, should be fully informed regarding this subject. In towns and cities phy-

* See Fehling, Arch. für Gynak., Bd. xxvii, H. 3.

sicians should co-operate to secure it for their patients in its best form.* The conditions to be fulfilled in good cow's milk are:

1. It must be fresh. There are certain changes which take place in cow's milk, even when handled in the best manner, during the twenty-four or seventy-two hours which often elapse between the time it is drawn from the cows and its consumption. These changes, although perhaps not actually causing disease, may still interfere with the digestibility of milk, particularly by very young infants. It is entirely practicable in every city and town for milk to be obtained for young infants before it is twelve hours old, and this should be insisted upon.

2. It must be from healthy animals. All herds furnishing milk for infant-feeding should receive the tuberculin test; they should be subjected to careful and regular medical inspection.

3. Preferably it should be the milk from a mixed herd rather than from a single cow. A milk is thus secured which is practically uniform in its composition, while that from a single cow may be subject to a considerable variation from day to day. A child fed upon the milk of a single cow is not infrequently made ill from changes in the milk, the result of food, temporary indisposition or other disturbance of the animal.† If the milk is the mixed product of several cows such a result is very much less likely to occur.

4. The milk must be clean. This is only to be accomplished by a dissemination of knowledge among dairymen in regard to the common sources of milk contamination. It is to be secured by more rigid cleanliness in the stables, in the animals themselves, in the hands of the milker, in pails, cans, bottles, and all utensils with which the milk comes in contact. The amount of filth—dirt, hair, etc.—which is removed from ordi-

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* As an illustration of what can be accomplished in the way of securing a proper milk supply for the use of infants, the work of the Medical Commission of Newark, N. J., may be cited. This commission, organized largely through the efforts of Dr. H. L. Coit, has entered into an agreement with a dairyman, the terms of which are that the selection of the cows, the details regarding their food and care, and the handling of the milk shall be under the supervision of the Medical Commission. All these matters are carried out according to the most improved methods. The animals are subjected to a regular inspection by a competent veterinary surgeon; a chemist and bacteriologist are employed to see that the milk is kept up to the standard both as regards composition and purity. In return, the milk, which is delivered only in bottles, is stamped with the approval of the commission as "certified milk," and is sold at a slightly higher price than ordinary milk. Although in operation now but a short time, this plan has proved eminently successful both from a medical and commercial standpoint. If in every city and large town physicians would co-operate in this or some similar way, great good would be accomplished.

† It is well known that the milk of a cow during the "bulling" period may be the cause of very severe attacks of indigestion in infants who get such milk as their principal or only food. Such milk apparently contains some toxic products.

nary milk by passing it through a separator is simply appalling, and shows how carelessly most of our milk is handled at the present time. Bacterial contamination will be considered later.

5. The animals should have fresh food, and not brewer's grains, which they are so likely to have in the neighbourhood of large cities.

6. Transportation should be as short as possible, in order to secure freshness and to diminish the liability to the other changes which occur when milk is carried long distances.* The milk should be cooled, then bottled and sealed at the dairy, and kept at a temperature at or below 45° F., until it reaches the consumer. In this way all chances of contamination by handling after the milk leaves the dairy are avoided.

Composition.—The following table † gives the composition of milk from different breeds of cows:

	Durham.	Ayrshire.	Holstein.	Jersey.	American grades.	Common natives.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
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
Proteids	4·17	4·01	3·99	3·99	4·06	4·09
Salts	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

It will be seen that the averages are remarkably uniform in all the constituents except the fat, the variations here being between 2·88 and 5·21 per cent. Leaving out the Jerseys, the following represents very closely the average composition of cow's milk, as the physician has to do with it in infant-feeding:

Average Cow's Milk.

	Per cent.
Fat	3·50
Sugar	4·30
Proteids	4·00
Salts	0·70
Water	87·00
	100·00

As to the relative advantages of the different breeds for infant-feeding, the difference has not seemed to me to be very great, provided all are equally healthy. It should be remembered that tuberculosis is rather more common in Jerseys than in other breeds. Practically it is necessary that the physician should know only the amount of fat in the milk he is using, as this is the variable factor.

* Very much of the milk consumed in New York has been transported one hundred miles, and some is even brought three hundred miles.

† These figures are compiled from over one hundred and forty thousand analyses, and have been collected by Mr. Gordon, of the Walker-Gordon Milk Laboratory; sixty thousand of these analyses refer to the American grades and the common natives.

The Examination of Cow's Milk.—For clinical purposes the reaction, specific gravity, and percentage of fat should be determined. The normal reaction of cow's milk is neutral or slightly acid; it should never be strongly acid. If it is strongly alkaline it is pretty certain that something has been added to it. The specific gravity is from 1,028 to 1,033. If the milk has been falsified by the removal of cream, the specific gravity is raised. The best of all ready methods of determining fat is the Babcock centrifugal machine.* By this the fat is brought to the surface by the centrifugal process after destroying the nitrogenous matter by sulphuric acid. This test is very accurate and can be made in five minutes. For institutions such an apparatus is indispensable; several specimens can be examined at the same time, and the composition of the milk and cream used can be determined each day. The optical test by means of Feser's lactoscope (Fig. 25) is a good one, and with a little experience in the use of the instrument is quite accurate.†

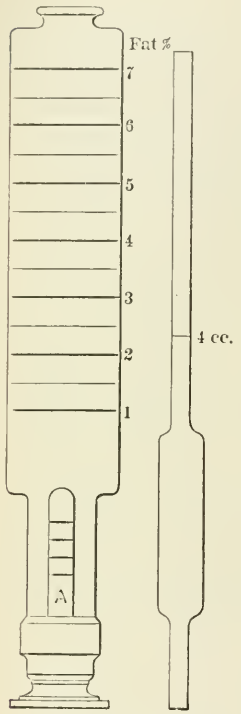

FIG. 25.—Feser's lactoscope.

The cream-gauge (Fig. 24, C) may be used as for woman's milk, but it is not very accurate. The milk while warm from the cow should be put into the cylinder and cooled rapidly by being placed in ice water. Under these conditions, if the reading is made at the end of eight or ten hours the percentage of cream to that of fat is about four to one. If the milk has been first cooled and afterward handled two or three times before the test is made, the cream rises much less regularly and the above ratio is not maintained.

The Differences between Cow's Milk and Woman's Milk.—The colour of cow's milk is more opaque than woman's milk, although the latter may

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* This can be obtained of any dairy-supply house in the country.

† The test is applied as follows: Four cubic centimetres of milk measured in a pipette is put into the tube and water slowly added, shaking from time to time until the black lines on the porcelain stem "A" are faintly visible through the milky water. The percentage of fat is then read off on the glass cylinder at the level of the water added. Thus, water up to the mark "4" indicates four per cent fat, etc. This test is not to be applied to human milk. For cow's milk it is pretty satisfactory if the instrument is carefully made. A little experience is necessary in order to know exactly at what point of translucency the reading is to be taken. The lactoscope may be obtained from Eimer & Amend, Eighteenth Street and Third Avenue, New York.

contain the larger proportion of fat. This is due to the fact that the colour of the milk depends not only upon the fat but also upon the calcium phosphate with which the casein is combined. This is so much more abundant in cow's milk than in woman's milk that even after the fat has been removed from the former, it is still of a deep white colour, while woman's milk under the same conditions is almost transparent. The total solids are usually greater in cow's milk, but the difference is slight. The sugar, as in woman's milk, is lactose in complete solution. At the present time there are not known to be any important differences in the fat.

The most striking variation is seen in the proteids. Not only are the proteid substances in cow's milk from two to three times as great in amount, but they differ also in their character. The amount of proteid substances in cow's milk coagulable by acid is about four times as great as the non-coagulable portion; while in woman's milk the non-coagulable portion is twice as great as the coagulable portion (Leeds). This is due to the fact that in cow's milk there is much more casein than lactalbumin, while in woman's milk there is less. This variation is shown most strikingly by the physiological test—its digestibility by the infant's stomach. Cow's milk in the stomach is coagulated into larger, firmer clots which dissolve slowly; woman's milk into loose, flocculent curds, which dissolve readily.

The inorganic salts of cow's milk are more than three times as abundant as those of woman's milk. In the composition of these salts the most important difference is that there is present in cow's milk a relatively larger proportion of calcium phosphate and sodium chloride with a smaller proportion of potassium chloride.

The Salts of Cow's Milk (Weber and Fleischmann).

Potassium	17·34 to 24·50
Sodium	7·00 to 11·00
Calcium	17·30 to 27·00
Magnesia	1·90 to 4·07
Iron oxide	0·33 to 0·62
Phosphoric acid	26·00 to 29·13
Sulphuric acid	0·05 to 1·00
Chlorine	15·6 to 16·34

The reaction of cow's milk is neutral or slightly acid, practically never alkaline; woman's milk is neutral or alkaline.

Cow's milk as used always contains a large number of bacteria, which increase directly in proportion to the age of the milk; the milk of healthy women is practically sterile.

Cream.—A great misapprehension exists as to its composition. It is often spoken of as if it were entirely different from milk. It should rather be regarded as a milk which contains an excess of fat.

Cream is obtained either by skimming—the gravity process—or by the use of a centrifugal machine known as a separator. The latter process has the advantage in point of time, as centrifugal cream can be put upon the market from twenty-four to thirty-six hours earlier than gravity cream. It is, however, attended by a slight disadvantage, as it may break up mechanically some of the fat-globules, so that after heating they may form a thin oily layer at the top of the bottle. This is more likely to occur where centrifugal cream has been transported a long distance.

The following table gives the composition of an average milk and of centrifugal cream of different densities removed from the same milk:

	Whole milk.	Cream.			
		I.	II.	III.	IV.
Fat	4·00	8·00	12·00	16·00	20·00
Sugar	4·30	4·30	4·20	4·00	3·80
Proteids	4·00	3·90	3·80	3·60	3·20
Salts	0·70	0·70	0·64	0·60	0·55

These will be spoken of hereafter as 8-per-cent cream, 12-per-cent cream, 16-per-cent cream, etc., as indicating the amount of fat which they contain. The richest centrifugal cream contains from 35 to 40 per cent fat.

From the table it will be seen that cream differs from the milk from which it is taken mainly in containing more fat. The reduction in the proteids, even in the 20-per-cent cream, is less than 1 per cent. The changes in the other constituents are so slight that they may be ignored. In common speech the term *cream* is applied to any of these. The physician should know, if he is using cream for infant-feeding, the approximate amount of fat it contains. The 40-per-cent cream is the very thick, centrifugal cream sold in cities; 20-per-cent cream is the ordinary centrifugal cream; 16-per-cent cream is the common skimmed or gravity cream. In infant-feeding it is convenient to make use of a cream containing 12 per cent fat, and one containing 8 per cent fat. They may be obtained directly from fresh milk by the gravity process. If one quart of average milk is put into a glass jar and this into ice water or upon ice, after four or five hours there may be taken from the top about ten ounces of 8-per-cent cream; after six hours, about six ounces of 12-per-cent cream (Fig. 26). Both of these may be removed by skimming, or, better still, the milk from the bottom of the jar may be siphoned off, leaving the amount men-

Fig. 26.—Twelve-per-cent cream.

tioned.* If the milk is richer than the average the time may be shortened to three and five hours respectively. If it is poorer than the average the time must be lengthened.

None of the methods described for determining the quantity of fat in milk are applicable to cream, except the Babcock centrifugal machine.

Milk Sterilization.—The term *sterilization* is widely and rather loosely used to signify the heating of milk for the destruction of germs. It should, however, be borne in mind that none of the methods commonly employed renders milk sterile in the bacteriological sense of the word, although this can be done by heating milk on two or three successive days as in preparing culture media. What is accomplished by the means commonly employed, is the destruction of such pathogenic germs as may be present, and a large number of the other bacteria, so as to retard for several days the ordinary fermentative changes. The preservation of milk for infant-feeding, by boiling it in small bottles, was advocated by Jacobi

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*A similar plan on a large scale may be followed in institutions by using an apparatus known as the "Cooley creamer." This consists of a wooden tank lined with metal, made of different sizes, holding two, four, or more cans of milk. The cans (Fig. 27) hold eighteen quarts, and are so covered that they can be submerged. The bottom of the can is inclined, and at the lowest point is placed a faucet. In the side is a glass window, so that the cream level can be distinctly seen. The cans are filled and placed in the tank of ice water; after six or twelve hours the lower portion is drawn off and the upper creamy layer left behind. In this way a cream of 8, 12, or 16 per cent may be obtained. The 8 and 12 per cent are those most convenient to use. If the milk is put in before the cream has risen once, after twelve hours from six to nine quarts of 8-per-cent cream may be obtained, and from four to six quarts of 12-per-cent cream; the variation being due to the difference in the milk employed. After six hours about two-thirds of the quantities mentioned can be obtained. The exact amount can be determined after a few experiments with any given milk by testing the strength of the cream each day with the Babcock machine. Then, with the same conditions of time, temperature, etc., the results will be quite uniform. If the milk is so old that the cream has already risen once, different results from those mentioned will be obtained. The plan is a simple one, involves very little trouble, and the milk during the time the cream is rising is kept at a low temperature.

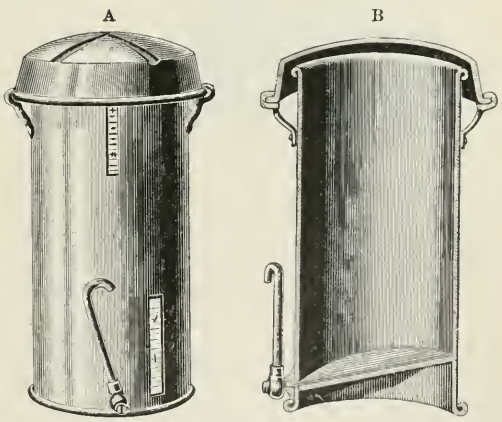

Fig. 27.—Cans of the Cooley creamer. A, external view; B, section view.

The Cooley creamer may be obtained at Bellows Falls, Vt.

many years ago. The adoption of systematic means for the destruction of germs in milk for infant-feeding has been largely due to the work of Soxhlet.

The most important of the germs in milk are the various saprophytic bacteria upon which are believed to depend a very large proportion of our diarrhœal diseases, the bacillus tuberculosis, which may be derived from the cow or may be an accidental contamination, and the germs of cholera, diphtheria, typhoid, and scarlet fever. All these flourish in milk at its ordinary temperature. There is pretty conclusive evidence that outbreaks of all the diseases mentioned have in certain cases been due to contaminated milk.*

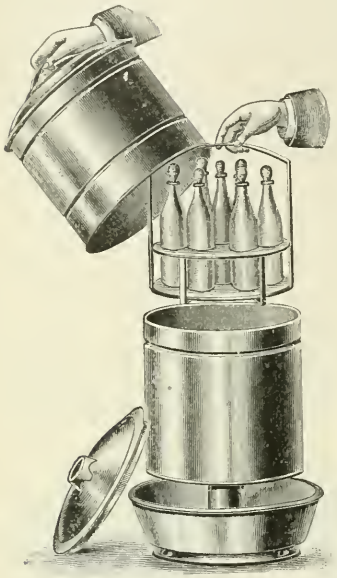

Fig. 28.—The Arnold sterilizer.

Following Soxhlet, all the earlier experiments in sterilization were made at a temperature of 212° F., continued for an hour and a half. So far as destroying germs was concerned this was quite enough. Such milk will keep for more than a week at ordinary room-temperatures. But it was soon found that some objectionable changes take place. The taste is that of boiled milk, to which many children strongly object; a certain proportion of the sugar is converted into caramel, causing a change in colour to a light brown; the casein is rendered less coagulable by rennet, and is acted upon more slowly and imperfectly both by pepsin and pancreatin. Certain changes probably take place in the fat also. Children fed

* The degree to which contamination takes place under ordinary circumstances may be judged from the investigations of Sedgewick and Batchelder in Boston in 1892. In fifteen specimens of ordinary country milk which were handled in the usual way and examined a few hours after it was drawn from the cow, the average number of bacteria to each cubic centimetre (about fifteen minims) was 69,143. The average number in fifty-seven samples of market milk as delivered from wagons in the spring of the year was 2,355,500. In sixteen samples of milk as sold by grocers—this being several hours older than the milk delivered from wagons—the average number of bacteria to each cubic centimetre was 4,577,000.

The principal source of contamination is undoubtedly from the cow and the stable during the process of milking. Dr. R. G. Freeman exposed for two minutes a Petri gelatin plate under a cow during milking and obtained 1,800 colonies. No doubt a great proportion of these germs are harmless, but with them others are often found which, if not strictly pathogenic, hasten fermentative changes in milk and greatly interfere with its digestibility.

upon "sterilized" milk are certainly more prone to constipation than others, this probably depending upon the difficulty in digesting the casein. There seems now to be little doubt that the nutritive properties of the milk are, to a certain degree at least, impaired by heating to 212° F. for an hour and a half. In a large city, with the milk supply which is available, it may be in summer a choice of evils whether infants shall be fed upon "sterilized" milk, with the disadvantages mentioned, or whether by giving contaminated raw milk we shall run the risk of introducing germs which produce diarrhœal diseases. The latter is certainly by far the greater danger.

The changes mentioned as occurring in milk are believed to begin at or about 180° F., and to be more marked the higher the temperature is carried and the longer it is maintained. Heating milk to 212° F. for an hour or an hour and a half, should be employed only in the hot weather and when it is necessary to keep the milk for a considerable time as in travelling, or when ice is out of the question, as among the very poor.

This method of heating milk is accomplished by the use of some apparatus by which steam is produced, the bottles being exposed on all sides in a close vessel. Probably the simplest and most satisfactory sterilizer is the "Arnold" (Fig. 28).

"Sterilizing" at a Low Temperature—Pasteurizing Milk.—To obviate the objections above referred to, the practice has come largely into use of raising the temperature only to 167° F. This is known as "Pasteurizing," and has been extensively used in and about New York and in Boston. The temperature of 167° F., maintained for twenty minutes, has been shown to be sufficient to destroy the bacilli of cholera, typhoid fever, diphtheria, tuberculosis, bacterium coli commune, and the ordinary pyogenic germs. It does not, however, destroy spores, and milk thus treated will keep at ordinary room-temperatures for two or three days only, but on ice for several days. A simple apparatus for this purpose (Fig. 29) * has been devised by Freeman, of New York. In this the temperature is

* Freeman's apparatus is used as follows: The pail is filled to the groove with water, which is then raised to the boiling point. The bottles of milk are dropped into their places in the cylindrical cups, sufficient water being poured into each cup to surround the bottle, this water acting as the conductor of heat. The pail is now removed from the stove and placed upon a board or other non-conductor, and the receptacle containing the bottles of milk is set inside and the cover replaced. The volumes of milk and water have been so calculated that in ten minutes they are both at a temperature of about 167° F. The water contains heat enough to maintain this, with very slight variations, for twenty minutes. In half an hour the bottles of milk are removed and cooled rapidly by being placed in a water-bath, the water being changed once or twice; or, better, by setting the pail in a sink and allowing the cold water to run from a faucet through a piece of rubber pipe into the pail, overflowing into the sink. This rapid cooling is very important. They are then put in the refrigerator. This apparatus may be obtained from James Dougherty, 411 West Fifty-ninth Street, New York.

raised by hot water, while cold water is used as the conducting medium. Milk heated to 167° F. has no objectionable taste, and according to Freeman's experiments with artificial digestion, the character of the curd and its digestibility do not differ from that of ordinary milk. This seems to be borne out by clinical observation.

The objections urged against heating to 212° F. do not hold against heating to 167° F., as most of the changes are thus avoided. However, the real question is whether there are any changes produced in milk so treated which detract from its value as an infant-food. Upon this point we must as yet speak somewhat guardedly, for experience with it is limited

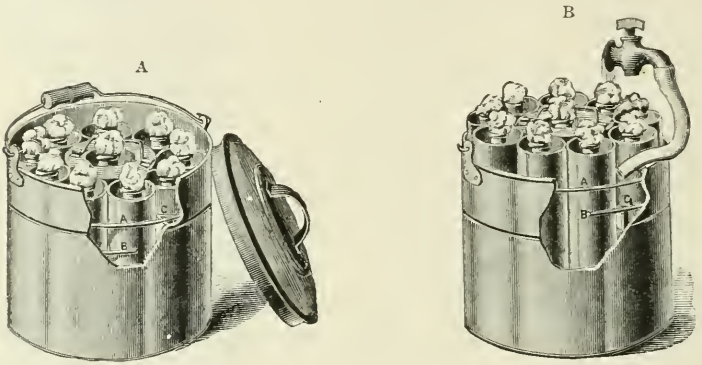

Fig. 29.—Freeman's Pasteurizer. A, bottles in position for heating; B, method of cooling.

to a few years. To my knowledge, no sufficient evidence has yet been adduced to establish the fact that milk so heated has lost any of its essential nutritive properties, or that children fed exclusively upon it exhibit signs of either of the two most marked disorders of nutrition—rickets or scurvy; although I have seen two cases in which scurvy seemed to be clearly due to the use of milk heated to 212° F. for over an hour.

It should be distinctly understood that sterilized milk requires the same modifications for infant-feeding as plain milk. There is no evidence to show that its nutritive properties or its digestibility are in any way enhanced by the process of heating. A great misapprehension seems to exist in the minds of many physicians with reference to this point. The opinion has gained a certain amount of currency that, if milk has only been "sterilized," it may be fed to a young infant without any further modification.

The sterilization of milk is not a therapeutic measure of much value in the gastro-enteric diseases of infancy. It is capable of causing just about as much disturbance as plain milk given in the same circumstances. Its chief value—and I think I may say almost its only value—is in preventing disease, first, by enabling us to feed infants upon milk in which, although it may be forty-eight hours old, no considerable fermentative

changes have taken place, and, secondly, by destroying pathogenic germs with which the milk may have become accidentally contaminated.

The danger of transmitting tuberculosis to the infant by means of cow's milk is one that has, I think, been very greatly exaggerated. Animal experiments show that this is certainly possible, and there are a few isolated instances on record in which this seems to have been the mode of infection in children, but these cases are extremely rare. In one hundred and nineteen autopsies of my own upon tubercular patients, nearly all of them infants, there was not found one with the primary lesion in the gastro-enteric tract. Northrup, in his large post-mortem experience, has seen but a single case. The danger of transmitting diphtheria, scarlet fever, and especially typhoid fever, by means of milk, is very much greater.

Summary.—Prolonged heating to 212° F. is objectionable and is not to be recommended for general use. It may be necessary especially in cities and in very hot weather, where ice is scarce and the milk very highly contaminated, also when the milk is to be kept for several days, as while travelling; for prolonged journeys, however, such as crossing the ocean, the milk should be heated to 212° F. for one hour on three successive days. Heating to 167° F. is quite sufficient for ordinary purposes. It is desirable that milk thus treated should be prepared daily, although it will keep on ice for four or five days. The fewer the germs in the milk at the time of heating, the shorter the time and the lower the temperature which will be necessary, hence the desirability of having the milk as clean and as fresh as possible. For the best results, the heating should be done at the dairy, so that the antecedent changes shall be reduced to the minimum. Without this precaution these changes are sometimes so great as to render the milk unfit for use. Heating milk for purposes of sterilization is at present imperative in cities during the warm months, as ordinary milk is from twelve to thirty-six hours old when received, and from twenty-four to seventy-two hours old before it is consumed. In the country it is a safeguard to be used when doubt exists in regard to the health of the cows or the handling of the milk; but where clean milk can be obtained fresh every morning from healthy cows, it is unnecessary. "Sterilized" milk requires the same modification for infant-feeding as plain milk. "Sterilization" is not to be regarded as a therapeutic measure; its value consisting in the prevention of disease. While I advise and constantly use milk which has been heated, my preference is strongly for that which is sufficiently pure, clean, and fresh to render this unnecessary. I believe that the direction in which we are to work is toward securing the greatest attention to the care and feeding of cows and to the handling of milk in order to prevent every possible contamination; and at the same time to have all cows whose milk is to be used for infant-feeding under close medical supervision. Until such a condition of things is realized, the heating of milk used for infant-feeding will be necessary.

Peptonized Milk.—Milk is peptonized through the agency of a substance derived from the pancreas, usually of the pig. This is known in the market as "extractum pancreatis," the active ferment being the trypsine. As this acts only in an alkaline medium, bicarbonate of soda should first be added to the milk. The purpose of peptonizing is a partial or complete digestion of the casein of milk before feeding.

Partially peptonized Milk.—This is done as follows:* One pint of fresh cow's milk and four ounces of water are put into a bottle, and a powder added containing five grains of extractum pancreatis and fifteen grains of bicarbonate of soda. This is kept at a temperature of 105° to 115° F. best by placing the bottle in water about as warm as the hand can bear comfortably. It should be shaken from time to time. For partial peptonization, the process is continued for from six to twenty minutes. The peptonizing powder is sold in glass tubes and in tablets. The tubes are to be preferred, as being less liable to deteriorate with age. Milk which has been peptonized ten minutes is not altered in taste; if, however, the process is continued for twenty minutes, a slightly bitter taste is noticed from the formation of peptone. This increases with the duration of the process of artificial digestion. If it is desired to arrest this after ten minutes, the milk may be raised to the boiling point, which destroys the ferment, or its activity may be stopped by placing the milk upon ice. If the milk is to be fed at once, neither of these procedures is necessary. If it is to be kept for several hours, scalding is more certain to arrest the change than lowering the temperature.

Completely peptonized Milk.—The process is exactly the same as the above, except that it is continued for two hours, which is generally required for the conversion of all the proteids into peptones. The addition of acetic acid to such milk produces no coagulation. Although completely peptonized milk is quite bitter, this is not an obstacle to its use for young infants, who after the first or second bottle do not usually object to its taste. For those who are a little older, the bitter taste may be covered by lemon-juice and sugar—one even teaspoonful of cane sugar and two teaspoonfuls of lemon-juice being added to each four ounces of the milk.

Peptonized milk is to be diluted according to the age of the child. It is usually better to peptonize a milk-and-cream mixture which has previously been diluted with the proper amount of water. Peptonized milk is a valuable resource in chronic cases where there is feeble casein-digestion, and during attacks of acute indigestion in infancy. In acute attacks, completely peptonized milk is usually preferable to that which has been partially peptonized. It is not advisable to continue its use in-

* Fairchild's process.

definitely; if this is done the stomach gradually becomes less and less able to do this work. At most, peptonization should be used only for a month or two at a time, as the case improves being gradually diminished the amount of the powder used and the time of peptonizing.

Condensed Milk.—This is prepared by heating fresh cow's milk to 212° F. to destroy the bacteria and then evaporating *in vacuo* at a low temperature to a little less than one fourth its volume.* It is preserved in tin cans, usually with the addition of cane sugar in the proportion of about six ounces to a pint. The changes, therefore, to which the milk has been subjected are evaporation of a part of the water, partial or complete sterilization, and the addition of cane sugar. Fresh condensed milk to which no sugar had been added is delivered daily in New York and in other large cities.

The composition of condensed milk is shown in the following table; also the results obtained when it is diluted with six, twelve, and eighteen parts of water, as usually fed:

	Condensed milk.†	With 6 parts of water added.	With 12 parts of water.	With 18 parts of water.
	Per cent.	Per cent.	Per cent.	Per cent.
Fat	6·94	0·99	0·53	0·36
Proteids	8·43	1·20	0·65	0·44
Sugar { Cane, 40·44 / Milk, 10·25 }	50·69	7·23	3·90	2·67
Salts	1·39	0·17	0·10	0·07
Water	31·30	90·49	94·82	96·46

The dilution with twelve parts of water is that most frequently employed, although eighteen is often used for very young infants.

The reasons both for the success and for the failure of condensed milk as an infant-food, are apparent from a study of its composition as it is ordinarily used. As a temporary food it is often useful, first, because it has been sterilized, and, secondly, because the casein of the cow's milk has been reduced by the usual dilution to such a point (about 0·6 per cent) that an infant with a very weak digestion can manage it, while it furnishes an abundance of sugar, the easiest thing for an infant to digest. During the first few months of life it is often apparently very successful for these reasons, but it can not be continued indefinitely without hazard. I have seen many infants reared exclusively upon it, but as yet not one who did not show, on careful examination, more or less evidence of rickets. Condensed milk fails as a permanent food, partly because it consists too largely of carbohydrates, but chiefly because it is lacking in fat. It is

* Process followed by the Borden Condensed Milk Company.

† Analysis made for the author by E. E. Smith, Ph. D., of Borden's Eagle-brand condensed milk.

admissible only for temporary use during attacks of indigestion, for very young infants during the first two or three months, or among the very poor, where the cow's milk which is available is still more objectionable. It should never be continued as a permanent food where good, fresh cow's milk can be obtained, nor should it be used as a permanent food without the addition of fat (cream). In travelling it is often the most convenient as well as the safest food to use. It should then be diluted twelve times for an infant under one month, and from six to ten times for those who are older.

The fresh condensed milk has not the disadvantage of the addition of a large amount of cane sugar, and requires essentially the same modification as ordinary cow's milk. For the poor in cities it is often the best infant-food available. For routine use it should be diluted with from eight to twelve parts of water, with the addition of sugar—preferably milk sugar—and if possible fresh cream.

Kumyss.—The original kumyss was fermented mare's milk, and has been extensively used by the Tartars for centuries both as a food and a beverage. In this country kumyss is made from cow's milk. The ferment used by the Tartars was kefir grains, consisting of two forms of the ordinary yeast plant and great numbers of lactic-acid bacilli.. The first kumyss made in the country was fermented by these grains, but they have now been discarded by most manufacturers of kumyss, as it is true that the bacteria which they contain are of no advantage and their effect may possibly be deleterious. Kumyss was formerly made chiefly from skimmed milk, but at present many manufacturers use the whole milk, with the addition of cane-sugar and a small proportion (about one sixteenth) of water. The process now most commonly employed is started with ordinary yeast, causing a vinous fermentation. This is carried on at a temperature of from 60° to 70° F. in corked bottles. At a little higher temperature the fermentation proceeds more rapidly, and may be completed in two or three days; but better results are obtained with the slower process, which requires a week or ten days.*

As thus manufactured, kumyss contains alcohol, carbon dioxide, lactic acid, and traces of butyric and acetic acids. The casein is first coagulated, and then broken up into minute particles by the agitation to which the kumyss is subjected during manufacture. Some of the casein is probably converted into albumoses or similar compounds.

Kumyss has an acid reaction and a peculiar taste somewhat resembling

* The following is perhaps the best formula for the domestic manufacture of kumyss: One quart of fresh milk, half an ounce of sugar, two ounces of water, a piece of fresh yeast cake half an inch square; put into wired bottles, keep at a temperature between 60° and 70° F. for one week, shaking five or six times a day, and then put upon ice.

buttermilk; at first often disagreeable, but a fondness for it is soon acquired by the majority of those who take it. Its composition is as follows:

Kumyss.

	Made from mare's milk (Koenig).	Made from cow's milk (Koenig).	Made from skimmed milk (Koenig).	Brush's kumyss (Doremus).
Fat	1·46	1·83	0·88	1·91
Proteids	2·24	2·66	2·89	2·04
Sugar	1·47	4·09	3·95	3·26
Alcohol	1·91	1·14	1·38	0·62
Lactic acid	0·91	0·55	0·82	....
Acid	....	....	....	0·30
Carbon dioxide	....	....	....	0·44
Salts	0·42	0·43	0·53	0·44
Water	91·29	89·30	89·55	90·99

The advantages of kumyss are due to the alcohol, carbon dioxide, and lactic acid which it contains, and to the changes which have taken place in the casein of the milk by which its digestibility is very much facilitated. It is more useful for older children than for young infants. It is a very valuable resource in many forms of acute and chronic indigestion. Kumyss is often retained when milk in any other form is vomited. In chronic cases it frequently stimulates the appetite and improves digestion.

For infants, kumyss should be diluted, generally with an equal quantity of water. Many take it better if the gas has been allowed to escape by standing a few minutes. When the stomach is very irritable it should be given, preferably cold, in small quantities and frequently—e. g., a tablespoonful every twenty or thirty minutes. It is important to secure a reliable article and one that is reasonably fresh.

Matzoon.—Matzoon is a form of fermented milk first used in Asia Minor. The process of the manufacture of matzoon is given by Dadirrian as follows: Cow's milk is employed, with the addition only of an imported ferment which consists probably of a form of yeast. The milk is first boiled half an hour for sterilization. The fermentation is begun at a temperature of about 105° F. and continued in an open vessel for twelve hours, the temperature being gradually reduced to about 70° F., after which it is cooled, bottled, and kept on ice. It is ready for use in twenty-four hours. A very slow fermentation continues after bottling, so that the older matzoon is more sour than that freshly made; older specimens contain also a little carbon dioxide. Matzoon keeps on ice for two or three weeks. It is a thick, curdy fluid with a taste somewhat resembling sour cream. For infant-feeding it should be diluted with water and fed with a spoon, as it is too thick to be drawn from a bottle.

The composition of Dadirrian's matzoon is as follows:*

Matzoon.

Proteids	3·48
Fat	3·49
Milk sugar	3·68
Lactic acid	0·90
Alcohol and other products of fermentation	0·13
Mineral salts	0·69
Water	87·63
	100·00

By the process to which the milk is subjected there is, as in the manufacture of kumyss, a decomposition of the milk-sugar into alcohol, lactic and carbonic acids. The changes in the proteids are quite similar to those in kumyss. In kumyss the fermentation goes on in the bottle, and consequently the carbonic acid is retained, while in matzoon the greater part of the gas escapes. The indications for the use of matzoon are the same as for kumyss.

Junket, Curds and Whey.—Junket is made as follows: To one pint of fresh lukewarm cow's milk is added one teaspoonful of essence of pepsin or liquid rennet. It is stirred for a moment and then allowed to stand until firmly coagulated. It may be flavoured with wine, which should be added to it before coagulation, and given cold. The only change which has taken place is the coagulation of the casein, such as occurs in the stomach as the first step in digestion. Junket is useful in the feeding of older children, but should not be given to infants.

Whey.—The milk is coagulated as above directed, the curd is then broken up with a fork, and the whey strained off through coarse muslin. To this whey may be added wine or brandy. From forty-six analyses Koenig gives the composition of whey as follows:

Whey.

Proteids	0·86
Fat	0·32
Sugar	4·79
Salts	0·65
Water	93·38
	100·00

Whey is especially valuable for infants suffering from acute indigestion. It may be given in small amounts frequently, and will often be retained when everything else is vomited. It should be given cold. Wine whey is made by the addition of sherry wine, usually in the proportion of one part to sixteen.

* Analysis of Leeds.

BEEF PREPARATIONS.

The nutrient properties of these preparations are to be measured by the amount of albumen they contain, their stimulant properties by the proportion of extractives.

Beef Juice.—Expressed beef juice is made as follows: A piece of lean steak is slightly broiled, and the juice pressed out by a meat-press or a lemon-squeezer. Two or three ounces can ordinarily be obtained from one pound of steak. This is seasoned with salt and given cold or warm, but not heated sufficiently to coagulate the albumen in solution.

Another excellent method of making beef juice without cooking, is by taking one pound of finely chopped lean beef and eight ounces of water and allowing this to stand in a covered jar upon ice from six to twelve hours. The juice is then squeezed out by twisting the meat in coarse muslin. It is seasoned with salt and given like the above. This is not quite so palatable as that obtained by the first method, because it contains a smaller proportion of extractives. It can be made so, however, by the addition of sherry wine or celery salt. If the raw juice is added to milk in the proportion of two or three teaspoonfuls to each feeding, the taste will not be noticed. The milk should not be warmed above 100° F. before the addition of the juice.

The composition of the two products is shown in the following table:

*Beef Juice.**

	I. Expressed juice from 1 lb., warm process; quantity, 2½ oz.	II. Cold process, 1 lb. beef, 8 oz. water; quantity, 8⅓ oz.
Proteids	2·90	3·00
Fat	0·60	....
Extractives	3·40	1·90
Salts	0·20	0·20
Water	92·90	94·90
	100·00	100·00

The only difference in the two preparations is that the first contains about twice as much of the extractives. The second process is much more economical, as more than three times as much juice can be obtained from a given quantity of beef. If a stronger juice is desired, the amount of proteids may be doubled by using only four ounces of water. This is preferable for all except young infants.

Beef extracts are not to be considered in any sense as foods. Kemmerich has shown that animals receiving nothing else died of starvation,

* Analysis made for the author by E. E. Smith, Ph. D.

and even sooner than when everything was withheld. According to Chittenden, they contain no nitrogen in the form of proteids, but only in combination with the soluble extractives. They are stimulants, and as such are often useful.

Of the other preparations of beef in the market probably the best are Mosquera's beef jelly, bovinine, the beef peptonoids of the Arlington Company, and Murdock's liquid food. These contain from ten to thirty-five per cent of proteids available for nutrition. They are valuable additions to milk in the artificial feeding of infants. They also furnish a proteid which can be used in many cases of indigestion where milk is not admissible. For infants they must be well diluted. They are valuable in older children in many cases of general malnutrition.

Raw scraped beef, or that which has been slightly cooked, is easily digested by most young children. There are many conditions in which other forms of proteid, particularly casein, are not well borne, and indeed can not be taken at all, where children even as young as twelve months appear to digest this beef-pulp without any difficulty. It should be made from very rare or raw steak, finely scraped and well salted. A tablespoonful may be given at one feeding to a child of eighteen months. In nutrient properties this far exceeds most of the beef preparations in the market. The alleged danger of tapeworm from the use of raw meat, is in this country so slight that it may be disregarded.

Broths.—Animal broths may be made from mutton, veal, chicken, or beef. A good formula for general use is the following: One pound of lean meat, one pint of water; stand for four or five hours, then cook over a slow fire for one hour down to half a pint. After it has cooled, skim off the fat and strain through a cloth. The composition of a broth so made is given by Cheadle as follows:

Beef Broth.

Proteids	1·02
Extractives	1·82
Fat	....
Salts	0·88
Water	96·28
	100·00

From its composition it will be seen that broths are not very nutritious; they are, however, quite stimulating, and are at times useful, particularly where milk is to be temporarily withheld; but they are not adapted to prolonged use. Broths which have been thickened with either barley or rice flour are useful for children in the second and third years.

CEREALS.

Barley Water.—This is to be made either from the grains or from the barley flour. When the grains are used, the following is the formula

which I have been accustomed to employ: To two tablespoonfuls of barley, add one quart of water, and boil continuously for six hours, keeping the quantity up to the quart by the addition of water; strain through coarse muslin. It is an advantage to soak the barley for a few hours, or even over-night, before using. The water in which it is soaked is not used. When cold this makes a rather thin barley jelly. Its composition by analysis is as follows:

Barley Water.

Starch	1·63
Fat	0·05
Proteids	0·09
Inorganic salts	0·03
Water	98·20
	100·00

Almost an identical product may be obtained by using either the prepared barley flour of the Health Food Company, New York, or Robinson's barley, two drachms—one even tablespoonful—to each twelve ounces of water, and cooking for fifteen minutes. This is certainly a simpler and easier method of preparation.

Rice Water, Oatmeal Water, etc.—These may be made in the same manner as the barley water, using the same proportions either of the flour or the grains. Salt should always be added to these gruels if used alone. These substances are useful, being a convenient form in which starch may first be added to the food of infants when old enough to digest it, i. e., about the eighth or ninth month. They may also be used, when more dilute, to allay thirst when the stomach is irritable, and when milk in all forms must be temporarily withheld. Rice water and barley water are usually preferable in cases of diarrhœa, and oatmeal water where there is a tendency to constipation.

INFANT-FOODS.

It is not possible, nor even desirable, for a physician to know all about the infant-foods with which the market is flooded. He should, however, at least know that they are not perfect substitutes for breast-milk, that as permanent foods they are greatly inferior to properly modified cow's milk, and that as often used by the laity, and even by the medical profession, they are capable of doing and have done much positive harm. There are two diseases—rickets and scurvy—which have so frequently followed their prolonged use, that there can be no escaping the conclusion that they were the active cause. This is the unanimous verdict of all physicians whose experience entitles them to speak with authority upon the subject of infant-feeding. On the other hand, there are times when some of these preparations may be of considerable value, but chiefly for temporary use in pathological conditions. Here they are to be prescribed like drugs,

but only with a very definite knowledge of exactly what they do and what they do not contain. The most commonly used infant-foods may be grouped as follows:

1. **The Milk Foods.**—Nestlé's food is perhaps the most widely known. The others closely resembling it in composition are the Anglo-Swiss, the Franco-Swiss, the American-Swiss, and Gerber's food. These foods are essentially, sweetened condensed milk evaporated to dryness, with the addition of some form of flour which has been partly dextrinized; they all contain a large proportion of unchanged starch.

2. **The Liebig or Malted Foods.**—Mellin's food may be taken as a type of the class. Others which resemble it more or less closely are Liebig's, Horlick's food, Hawley's food, and malted milk. Mellin's food consists principally (80 per cent) of sugar. This is derived from malted wheat and barley flour, and is composed of a mixture of dextrines, dextrose, and maltose, with a small amount of cane sugar.

3. **The Farinaceous Foods.**—These are imperial granum, Ridge's food, Hubbell's prepared wheat, and Robinson's patent barley. The first consists of wheat flour previously prepared by baking, by which a small proportion of the starch—from one to six per cent—has been converted into sugar. In chemical composition these four foods are very similar to each other, consisting mainly of unchanged starch which forms from seventy-five to eighty per cent of their solid constituents.

4. **Miscellaneous Foods.**—Under this head may be mentioned (1) Carnrick's soluble food, which is composed mainly of carbohydrates, more than one half being unchanged starch, the fat being chiefly cocoa butter; (2) lacto-preparata, which differs from the above chiefly in the fact that the starch has been replaced by milk sugar; (3) lactated food, which is composed of about seventy-five per cent carbohydrates, nearly one half of which is unchanged starch.

*The Composition of Infant-Foods.**

	Nestlé's food.	Mellin's food.	Malted milk.	Ridge's food.	Imperial granum.	Lacto-preparata.	Carnrick's soluble food.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Fat	5·48	0·31	2·66	1·11	1·04	12·35	7·54
Proteids	11·04	10·70	15·18	11·93	14·13	14·51	10·25
Dextrines	7·38	40·96	31·97†	1·23	1·38	.....	....
Dextrose and maltose	....	37·38	31·79	0·52	0·42	.....	....
Cane sugar	30·59	4·23	4·15	1·16	Trace.	.....	....
Milk sugar	7·60	.....	.....	....	....	63·68	....
Total soluble carbohydrates	45·57	82·57	67·91	2·91	1·80	63·68	27·08
Insoluble carbohydrates (starch)	29·95	...	...	77·96	76·11	...	37·45
Inorganic salts	1·72	3·20	3·34	0·49	0·39	3·66	4·42
Moisture	1·50	4·09	2·20	8·58	8·38	5·80	3·42

* With the exception of lacto-preparata and Carnrick's soluble food, which are taken from Leeds, all these analyses were made for the author by E. E. Smith. Ph. D. In general they correspond with those previously published by Leeds, Rach, Trimble, Stutzer, and others.

† Including milk sugar.

ERRATA.

On page 156, lines 12–13 from top, read "Meilin's food is composed principally (80 per cent) of soluble carbohydrates. They are derived from malted wheat and barley flour and are composed of a mixture of dextrines, dextrose, and maltose, with a small amount of cane sugar."

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	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
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Proteids	11·04	10·70	15·18	11·93	14·13	14·51	10·25
Dextrines	7·38	40·96	31·97†	1·23	1·38	.....	....
Dextrose and maltose	....	37·38	31·79	0·52	0·42	.....	....
Cane sugar	30·59	4·23	4·15	1·16	Trace.	.....	....
Milk sugar	7·60	.....	.....	....	....	63·68	....
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Insoluble carbohydrates (starch)	29·95	...	...	77·96	76·11	...	37·45
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† Including milk sugar.

PLATE III.

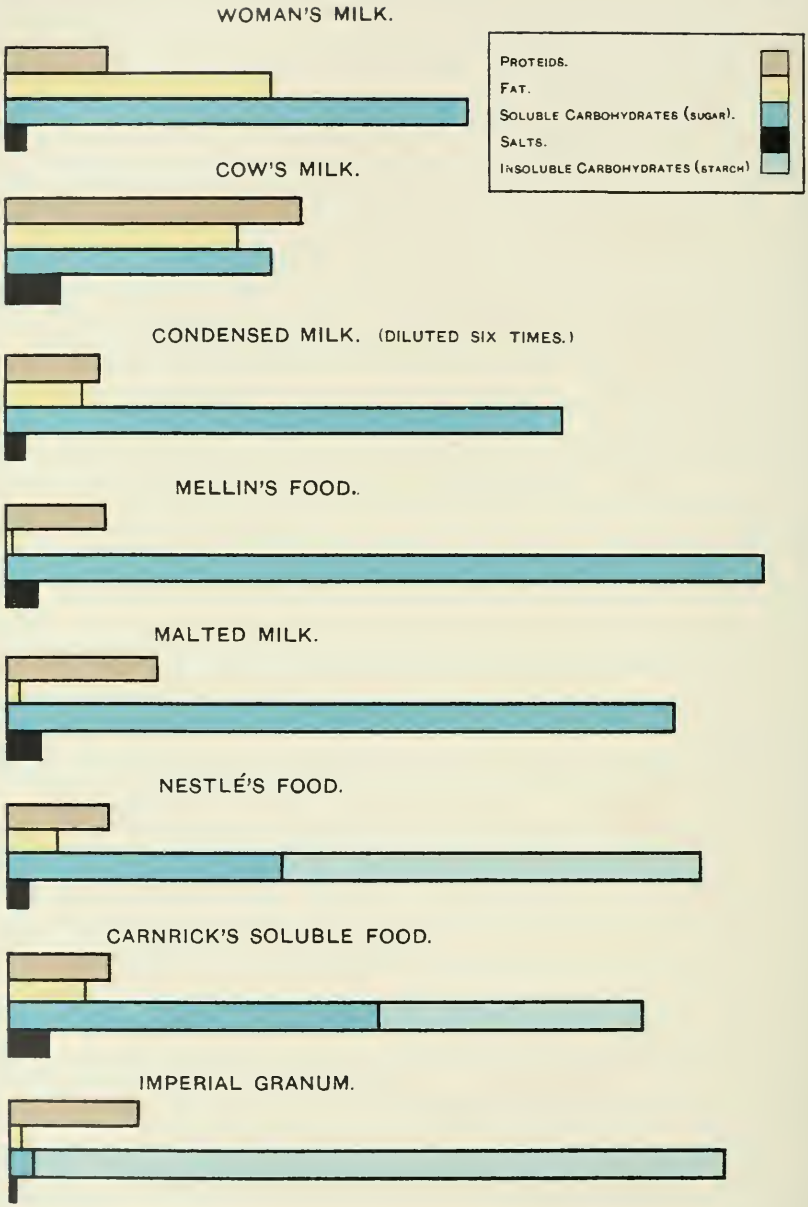

Chart showing composition of various infant foods compared with woman's milk.

A better idea can be obtained of these foods by the study of the following table, where they are diluted with water for comparison with milk:

Infant-Foods diluted with Water to compare with Milk.

	Breast milk.	Cow's milk.	Condens. milk, diluted 6 times.	Mellin's food.	Malted milk.	Nestlé's food.	Ridge's food.	Imperial granum.	Carnrick's soluble food.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Fat	4·00	3·50	0·99	0·04	0·39	0·76	0·16	0·14	1·12
Proteids	1·50	4·00	1·20	1·50	2·28	1·54	1·67	1·98	1·35
Soluble carbohydrates (sugars)	7·00	4·30	7·23	11·56	10·18	6 38	0·41	0·25	4·06
Insoluble carbohydrates (starch)	....	...	....	....	....	4·19	10·91	10·65	5·61
Inorganic salts	0·20	0·70	0·17	0·45	0·50	0·24	0 07	0·06	0·56
Water	87·30	87·50	90·41	86·45	86·65	86·89	86·78	86·92	87·30

The accompanying graphic chart (Plate III) shows in another form the same thing as the last table. In it are seen at a glance the essential features in the composition of most of the foods, viz., the large proportion of carbohydrates and the absence of fat. As a class then, infant-foods contain an excess of carbohydrates, and many of them a large percentage of unchanged starch. The proteids, though often sufficient in amount, are chiefly vegetable, and not animal proteids. Without exception they are lacking in fat, and therefore they do not furnish all that the growing organism requires. They should not be used except in those forms of indigestion where we desire temporarily to withhold fat and casein and to employ as food only carbohydrates. They can not be used as exclusive foods for any considerable period without disastrous results. Their continued use without some addition of fresh milk should never in any circumstances be countenanced. While some of them may furnish the additional carbohydrates required by an infant who is fed upon diluted cow's milk, they can not do more. The group of farinaceous foods, as they furnish starch in a convenient and palatable form, may often be advantageously used as an addition to milk after the ninth month and during the second year.

CHAPTER III.

INFANT-FEEDING.

The different methods of feeding which are available are:

1. Breast-feeding, either by the mother or by a wet-nurse.
2. Mixed feeding, or a combination of nursing and artificial feeding.
3. Artificial feeding exclusively.

In deciding which one of these methods shall be used, all the conditions, such as the health of the mother, the vigour of the child, and its surroundings, must be taken into consideration. The first choice should

always be maternal nursing. If it is not possible for the mother to nurse her infant entirely, nursing may be supplemented by feeding either from the outset or after the third or fourth month. If the conditions are such that maternal nursing is impossible or impracticable, the question to be decided is one of

Artificial Feeding *vs.* **Wet-nursing.**—Neither method of feeding is to be used exclusively. While recent advances made in artificial feeding have greatly diminished the necessity for wet-nurses, there are still many instances where, objectionable though they may be, they are indispensable for saving the life of the child, as the perfect substitute for good breast milk is as yet undiscovered.

If artificial feeding can be begun at birth and carried on according to the most approved methods, it is highly successful in the great majority of cases in which maternal nursing is impossible. In my experience, fully ninety per cent of the infants seen in private practice can with care be so reared. The remainder of the cases will require wet-nurses; these including chiefly infants who are prematurely born or those who are delicate from birth, and those with especially weak digestion, who are reared only with the greatest difficulty under any circumstances. This statement applies particularly to infants living in large cities. If, however, artificial feeding has been badly begun, and so carried on for two or three months that, when the child comes under observation, a condition of chronic indigestion is established, the difficulties in the way of artificial feeding are much increased, and the proportion of cases in which wet-nurses are required will be much larger. Whether or not a wet-nurse shall be employed at this juncture will depend upon the circumstances surrounding each case. If the child has steadily lost flesh so that it weighs only a little more than at birth, if it lives in a large city, or if the season is midsummer, the necessity for a wet-nurse is very much increased. In these circumstances, the great danger is the supervention of some acute disease of the stomach or intestines, to which a child in this condition is very liable, and which it may not be able to survive. Unless such a child begins very soon to improve with proper methods of artificial feeding, a wet-nurse should be secured. If the child lives in the country, if the weather is cool, and if the child is holding its own in weight, a faithful trial of proper feeding should be made before resorting to a wet-nurse. If the child, at the time of coming under observation, is suffering from an attack of acute indigestion, or from the symptoms of acute inanition, a wet-nurse should be obtained at once. I believe that the day will soon come when no physician will lay before his patient the choice of a wet-nurse or artificial feeding in the case of a healthy infant whose mother can not or will not nurse it; but that the general attitude of the profession will be, artificial feeding if possible, wet-nursing only if necessary. I am well aware that this practice is not followed by many of the leading

physicians in New York, who still adhere to the practice of employing wet-nurses in every instance in which maternal nursing is impossible. This is largely due to a want of familiarity with the methods and results of the best artificial feeding, while the results of improper artificial feeding are to be seen on every hand.

The disadvantages in the employment of wet-nurses are many, and almost as difficult to overcome as those attending artificial feeding. In the first place, good ones are difficult to obtain, and outside of a large city it is almost impossible to obtain one of any kind. While it is true that good breast milk is unquestionably the best infant-food, it is equally true that properly modified cow's milk is a far better food than the milk of many wet-nurses who are employed. The expense of wet-nurses—twenty to thirty-five dollars a month in New York—places them out of the reach of many who need them most; and, finally, the class of women from which most of our wet-nurses are drawn, are very undesirable inmates of a household, and are often the source of endless trouble and annoyance—a nuisance which must be tolerated for the sake of the baby. The danger of the transmission of disease from the nurse to the child is a real one. Numerous instances are on record of syphilis being communicated in this way, and some have come under my own observation. It is possible that tuberculosis may be transmitted through the milk, although, like syphilis, this is much more liable to result from other contact with the nurse, especially kissing.

The moral question involved in the subject of wet-nursing is one which neither the physician nor the family who employ the nurse can ignore, for it is no small thing to deprive an infant of its mother's breast when, as statistics show to be true of the children of wet-nurses, this fact reduces its chance of survival to one in ten. The family should be compelled by the physician to consider this aspect of the question, and to see to it that proper provision for the care of the wet-nurse's child is made, so as to give it the best possible chance with artificial feeding. If the wet-nurse's child is two months old, its chances of getting on without the mother are vastly improved, while her usefulness as a wet-nurse is not thereby diminished. It should therefore be required that, whenever circumstances permit, every woman who goes out as a wet-nurse should nurse her own infant for at least two months before she leaves it.

The unnecessary employment of wet-nurses is no doubt an evil, and has a bad influence upon those who make wet-nursing a business, as many women in cities are tempted to do on account of the large wages which they are able to earn for very easy work. If a wet-nurse were retained in her place only as long as the needs of the child required—i. e., until it had arrived at a sufficient age, and its digestion had sufficiently improved to enable it to thrive upon modified cow's milk—she could be dispensed with in a month or two months, and could then

seek another place. In this way a small number of nurses could be made to do duty for quite a large number of children. This is practically just what is done in several of our large institutions, where a delicate child is wet-nursed only long enough to give it a start, which may require two weeks, one month, or three months, as the case may be. And just in this way should wet-nurses be used in private practice, as furnishing an infant-food easy of digestion, and one without which sometimes we can not get along.

BREAST-FEEDING.

I. Maternal Nursing.—Maternal nursing is desirable whenever it is possible. Under the following conditions, however, it should not be attempted:

(1) No mother who is the subject of tuberculosis in any form, whether latent or active, should nurse her infant; it can only hasten the progress of the disease in herself, while at the same time it exposes the infant to the danger of infection. (2) Nursing should not be allowed where serious complications have been connected with parturition, such as severe hæmorrhage, puerperal convulsions, nephritis, or puerperal septicæmia. (3) If the mother is choreic or epileptic. (4) If the mother is very delicate, since great harm may be done to her, without any corresponding benefit to the child. (5) Where experience on two or three previous occasions under favourable conditions has shown her inability to nurse her child. (6) When no milk is secreted. With reference to the fourth and fifth conditions an absolute opinion can not always be given at the outset. In cases of doubt, nursing may be allowed tentatively, the effect upon both mother and child being carefully watched. In view of the great value of maternal nursing to the child, the physician should encourage it and use every means in his power to make it easy.

Care of the Breasts during Lactation.—For the safety of both mother and child it is essential that the most scrupulous attention be given to cleanliness. The nipples, and the breasts as well, should always be carefully washed after each nursing. Usually plain water is sufficient, or a weak boric-acid solution may be employed.

Nursing during the First Days of Life.—This is necessary, to accustom the child and the mother to the procedure, to promote uterine contraction, and to empty the breasts of the colostrum. All these results can be attained by putting the child to the breast on the first day once in six hours, on the second day once in four hours. It is unnecessary to repeat the process more frequently. The child gets from the breast only from four to six ounces a day during the first two days. Did it require more nourishment before the milk-flow is usually established, we may be sure that Nature would not have been so late with her supply. Considering how great are the changes taking place during these first days in the circulatory and respiratory systems, we are hardly surprised that two days pass

before the organs of digestion are given much work to do. The common practice of administering to an infant a few hours old all sorts of decoctions, with the idea that because it cries it is suffering from colic, can not be too strongly condemned. A certain amount of crying is proper and necessary. In exceptional circumstances, when an infant is unusually strong and robust and screams excessively, and especially when the temperature is elevated (see page 121), it may be necessary to give food before the third day; but this is not to be the rule. A little warm water, or a five-per-cent solution of milk sugar, should first be given; from two to four teaspoonfuls at a time are sufficient. This often satisfies the child; when it does not do so, regular feeding should be begun on the second day. Should the milk be delayed beyond the second day, feeding should then be begun at regular intervals, as in the cases which are to have no breast-milk.

Nursing Habits.—Good habits of nursing and sleep are almost as easily formed as bad ones, provided one begins at the outset. A vast deal of the wear and tear incident to the nursing period may be avoided if the child is trained to regular habits. Attention to these minor points often makes all the difference between successful and unsuccessful nursing. They should not be thought beneath the physician's notice, nor relegated entirely to the nurse. The physician must have a very clear notion of how often nursing is necessary, must give very explicit directions, and see that they are carried out. After the third day, for the first month, ten nursings in the twenty-four hours are quite sufficient, and no more should be allowed. An infant at this age can usually be depended upon to take at least one long nap of from four to five hours in the course of the twenty-four. For the rest of the day the child may be awakened, if necessary, at the regular nursing time, and put to the breast; this plan being continued until nine o'clock at night. It should then be allowed to sleep as long as it will, and but two nursings given between this hour and seven in the morning. In the course of two or three weeks a healthy infant can usually be trained to nurse and sleep with almost perfect regularity, frequently, when a month old, going six hours regularly at night without feeding. A trained nurse of my acquaintance states that out of thirty-three infants of which she had the care from birth, thirty-one were trained without difficulty in the manner described. In only one case was the training a failure—that of a delicate, highly nervous child. Of course, success in training must rest almost entirely with the nurse; but the physician should at least appreciate its importance and lend it his support. The great gain to the mother is, that she is enabled to have a quiet, undisturbed night. This is of the utmost importance, and has more to do with a good milk supply than any other single thing in connection with the mother's habits. So far as the child is concerned, regular habits of feeding and sleep, and regular evacuations from the bowels, which

nearly always go with them, are important factors in infant hygiene, especially in the prevention of gastro-enteric diseases.

Schedule for Breast-Feeding.

Age.	Number of nursings in 24 hours.	Interval during the day.	Night nursings between 9 P. M. and 7 A. M.
		Hours.	
First day	4	6	1
Second day	6	4	1
Third to twenty-eighth day	10	2	2
Fourth to thirteenth week	8	2½	1
Third to fifth month	7	3	1
Fifth to twelfth month	6	3	0

These rules can be carried into effect with but little difficulty, and with great benefit to both mother and child. It is to be remembered that we are here speaking only of healthy children. The possibility of training children to eat and sleep in the manner described will be doubted only by one who has not made a careful trial of it. Relieving the mother of night-nursing after the child is five months old is of the greatest value, and will often enable her to go on with lactation, when otherwise it would be brought to an abrupt termination. On no account should the child be allowed to sleep upon the mother's breast, nor in the same bed with the mother. The temptation to frequent nursing is in this way in great measure removed. No mere sentiment in regard to these matters should be allowed to interfere with the plain dictates of reason and experience.

Symptoms of Inadequate Nursing.—So frequently does it happen that a mother is anxious to nurse her child, and after two or three months it is discovered that lactation is a failure and artificial feeding must be resorted to, that it is important that the question of ability to nurse should be settled as early as possible. The lives of children are often jeopardized by the vain efforts of a conscientious mother to do what she is physically unable to do. The physician should be familiar with the symptoms of inadequate nursing, in order that valuable time may not be wasted. If artificial feeding is to be employed, the difficulties are much less when it is begun early than after the digestion has been deranged by several weeks of very poor nursing.

1. During the first four or five days of life the most important sign of insufficient food is the *temperature*. As a rule, a child who gets a proper amount from the breasts has a normal temperature. Very many who get little or nothing during this time have a temperature of 101° or 102° F., and, in extreme cases, 104° or even 106° F. If no obvious symptoms of illness are present, such a temperature from the second to the fifth day may be looked upon as indicating insufficient nourishment, or even starvation. (See page 118.)

2. *There is no gain in weight.* All infants, and particularly those whose nutrition is the subject of special difficulty, should be weighed twice a week during the first six months. No matter what other symptoms are present, the scales are an unerring guide by which we are to judge the results. A child need not gain rapidly, but should always gain steadily unless obvious signs of disease are present. One should not be satisfied unless the weekly gain is at least four ounces. In the great majority of cases a failure to gain in weight during the first six months, depends upon the nourishment, and upon that alone.

3. *The sleep is irregular and disturbed.* A healthy infant, after its appetite has been satisfied, usually goes to sleep at once and sleeps quietly for two or three hours; or, if awake, it lies in placid contentment, exhibiting all the signs of physical well-being. If, after being nursed, a child wakes habitually fifteen or twenty minutes after being put down, and rarely has a long sleep except from exhaustion, the probabilities are great that the food is insufficient in quantity or very poor in quality.

4. *There is frequent fretfulness or crying.* This may, of course, be due to many causes in infancy, but by all odds the most common one is lack of proper food or the indigestion which this produces.

5. *The stools are irregular and of an unhealthy appearance.* There may be constipation with dry, hard stools, or frequent green fluid stools, from four to twelve a day, often containing undigested food, and after a time mucus.

6. *The child nurses a long time before it is satisfied.* Usually the greater the milk supply, the shorter the time required to satisfy the child's appetite. Where the milk is abundant, five or six minutes are often sufficient. If the milk is very scanty, an infant will frequently nurse half or three quarters of an hour and then stop, more because it is tired out than because it is satisfied. If this is habitual, it is almost certain that the milk is very scanty. Sometimes a scanty supply is indicated by exactly the opposite symptom, viz., the child seizing the breast and nursing vigorously for a few moments, then dropping the nipple in apparent disgust and refusing to make any further efforts. This symptom is often seen where the breasts are practically empty.

7. *The symptoms during the later months* are stationary weight or a gradual loss, soft, flabby muscles, inability to sit alone or to stand at the proper age, delayed closure of the fontanel, delayed dentition, and frequently perspiration about the head. In addition, there are the general signs of malnutrition, anæmia, fretfulness, and irregular bowels, or there may be added the symptoms of incipient rickets.

The above symptoms are sufficiently characteristic to enable one to be quite sure of the fact that the child is not thriving. The proper course now is to examine the milk and see in what respect it is abnormal: whether it is simply the quantity that is at fault, or the quality, or both. While

such an examination does not always solve the problem, it is of very great assistance, and in the majority of cases two or three examinations of the milk, in connection with the other symptoms, will enable the physician to decide the question and apply the appropriate treatment.

The Management of Woman's Milk where Nursing Infants are not Thriving.—The milk examination usually discloses one of four conditions: (1) an over-rich milk, quantity usually abundant; (2) milk poor in quality and scanty; (3) quality good, amount scanty; (4) quantity abundant, quality poor.

Excessively rich milk.—This is usually found under the following conditions: The woman is in good health, has large, well-developed breasts, which are full and tense at nursing time. In most cases she is upon a very abundant diet, largely of nitrogenous food, getting little or no exercise, and frequently taking alcohol with the notion that because the child is not thriving the milk is poor. This is often seen in the wet-nurse after making a change from the simple life and habits of home to the more luxurious life and diet of the family to which she goes. The following analyses from Rotch are a good illustration of the exact composition of milk under such circumstances: Analysis I shows milk of a healthy but under-fed wet-nurse two days before change of food; II, the milk of the same nurse after one month of rich food with very little exercise; III, milk of the same nurse, the food and exercise being regulated:

	I.	II.	III.
	Per cent.	Per cent.	Per cent.
Fat	0·72	5·44	5·50
Proteids	2·53	4·61	2·90
Sugar	6·75	6·25	6·60
Salts	0·22	0·20	0·14

The effect of the diet and life is seen to be high fat and high proteids. As a result of the exercise, there is seen a very marked reduction in the proteids. The clinical examination shows the cream to be from eight to twelve per cent, and the specific gravity from 1,032 to 1,033. Instead of weaning the baby, or dismissing the wet-nurse because the child has indigestion or loses in weight, certain changes should be instituted. Alcohol should be entirely prohibited. The diet, especially the meat, should be reduced, and the nurse required to take daily exercise in the open air, particularly by walking. The improvement following such a regimen is often immediate, the child's symptoms disappearing in the course of a few days and a regular gain in weight beginning.

Scanty milk of a poor quality.—This is most often seen in a delicate or anæmic mother—one, perhaps, who has had a difficult or complicated labour, who is emotional, anxious, and careworn. In such cases it is often with the greatest difficulty that we can secure the necessary half ounce

required for examination. The milk is sometimes so poor that we can decide positively after two examinations that it is useless to continue lactation. In such cases we often find the specific gravity from 1,024 to 1,027, and the cream only two or three per cent. In other cases, where the variations from the normal are not so great—i. e., specific gravity 1,030, cream four per cent, and the quantity fairly abundant—we may be able so to improve the milk that lactation may be easily and advantageously continued. In the management of such cases the first thing is to secure to the nurse undisturbed rest at night. If possible, she should be entirely relieved of the care of the infant at this time, and if feeding is necessary the bottle should be given. She should have a certain amount of fresh air every day, driving if possible, or walking as soon as she is able to take more active exercise. One of the most powerful stimulants to the secretion of milk is massage of the breasts. A. M. Thomas (New York) places it above all others. It should be done with great care and gentleness, but most of all with every precaution against infection. The entire breast, including the nipple, should be rendered aseptic, as should the hands of the *masseuse*. Some mild antiseptic ointment may be used with the massage. It should be done two or three times a day for ten minutes. The diet should be abundant, with a large allowance of milk and meat, especially beef. If there is anæmia, iron should be given. Some of the alcoholic extracts of malt are useful. Every means should be taken to improve the general nutrition, for whatever benefits this improves the milk. If the conditions present are incident to the confinement or the convalescence, the prognosis is good; and in the course of a week or two very marked improvement may be evident, and lactation may be successfully continued. If, however, the conditions depend upon constitutional debility, or if the person has an exceedingly nervous temperament, the prognosis is much worse. Temporary improvement may take place, but it soon becomes evident that the experiment is a failure, both as regards mother and child.

Quantity deficient, quality normal.—This is often apparently the case, but really it is rarely so. If, in taking the specimen for examination, the child is first allowed to nurse for one or two minutes as has been suggested, there may be left only the final portion, or "strippings," which part is always much richer in fat than the whole milk. An examination of such a specimen often gives an excellent showing when the milk is really poor. In all cases of scanty supply, the entire quantity from the breasts should be secured for examination. If the only object in treatment is to increase the quantity, this can usually be accomplished by largely increasing the fluids, especially milk, and by taking alcoholic malt extracts.

Quantity abundant, quality very poor.—This condition is usually seen in women who, to improve the milk, have been taking large quantities of fluids, often with alcohol in some form. In such cases, instead of being a

formation from the epithelium of the glands, the milk is chiefly a transudation from the blood-vessels. Where the patient is very anæmic and the general condition poor, the glands act as little more than a filter. In such circumstances the breasts may be so full as to be painful, and the milk may often come away spontaneously. An examination usually shows low specific gravity and very low fat. Where these conditions exist nursing should be discontinued.

Summary.—Excessively rich milk is in most cases easily modified by a reduction in the diet and increase in exercise. Poor milk is usually low in fat and scanty in quantity, while the proteids may be either high or low. If the variations from the normal are only moderate, and the causes are such as can readily be removed, the prognosis is good. If the opposite condition exists, the prognosis is bad, and the chances of permanent improvement are slight. On the whole, artificial feeding gives so much better results than poor or doubtful nursing, that I am inclined, as a result of increased experience, to stop nursing and begin artificial feeding early, rather than waste time in prolonged efforts to improve the breast-milk. Nursing that is continued only by high pressure, by stimulants, and by deluging the mother with fluids, is rarely advantageous either for mother or child.

II. Wet-Nursing.—In the selection of a wet-nurse, it is by no means so essential as has generally been supposed, that her child shall be of about the same age as the child she is to nurse, for, after the first month, the changes in the composition of breast milk are insignificant. It is always desirable that the wet-nurse shall have nursed her own infant long enough to demonstrate the fact that she has an abundance of good milk; hence, taking a wet-nurse at the end of the first or second week is always fraught with considerable uncertainty. For an infant six weeks old, a wet-nurse whose milk is anywhere between one and five months old will usually answer perfectly well. For an infant only two or three weeks old, the milk should not be more than six weeks old.

A good nurse must, first of all, be a healthy woman, free from syphilitic or tubercular taint, and her throat, teeth, skin, glands, hair, and legs should be carefully inspected. She must have a good glandular development. Not much is to be expected of small flat breasts. The breasts must be full and hard three hours after nursing. They may be very large and yet supply very little milk, being composed almost entirely of fat. On the other hand, some smaller breasts may be almost all glandular tissue. The difference in the size of a breast before and after nursing, is one of the best guides to the amount of milk it is secreting. The nipples should be free from erosions or fissures, and long enough for the needs of the child. The nurse should not be anæmic, since it is impossible for a pale, anæmic woman to furnish good milk. Preferably she should be of a phlegmatic temperament, and of a good moral character.

This is desirable for personal reasons, although there is no evidence of moral qualities being transmitted through the milk. It is desirable that a nurse should be between twenty and thirty years of age, although much more depends upon the individual than upon the age. Other things being equal, a primipara should be chosen. The best evidence to be obtained of the character of a woman's milk is the condition of her own child; hence, if possible, it should be examined before she is accepted. It often happens that a woman who has had an abundant supply of milk for her own infant, has very little for another infant for the first few days in her new surroundings. This is usually the result of the nervous influences connected with parting from her own child, going to a new place, being carefully watched, etc. In such a case it should not be too readily decided that she is incompetent as a nurse, for, under most circumstances, with proper treatment her normal flow of milk will be re-established.

III. Weaning.—Weaning should always be done gradually, when possible, for the sake of both mother and child. Sudden weaning is apt to be followed by an attack of acute indigestion. This, however, is not an invariable result, and usually depends upon the fact that the child is given cow's milk with insufficient dilution. Weaning in hot weather is usually to be avoided, but the harm from this is not nearly so great as sometimes results where lactation is unduly prolonged because of a prejudice against a change of food at this time. While there are many women of the lower classes who are able to nurse their children to advantage for the entire first year, the number of such among the better classes is certainly very small. By the latter, nursing can rarely be continued beyond the ninth, and often not beyond the sixth month, without unduly draining the vitality of the mother and at the same time harming the child. The late months of lactation, like the early months, require close watching. It is a common mistake to continue both maternal and wet-nursing too long, owing to a dislike of making a change when things are going tolerably. It is a safe rule to make the ninth month the time to supplement the breast-feeding by other food. But here, as in the early months, the child's weight is the safest guide. In the absence of evident signs of disease, a stationary weight for several weeks makes weaning advisable; a steady loss makes it imperative.

The accompanying weight-chart from a private patient (see Fig. 30) illustrates this point. The infant was nursed by the mother, and did unusually well until the sixth month. As it did not seem ill, the parents were not disturbed by the gradual loss in weight, and I was not consulted until the loss had reached three pounds. Feeding was at once begun, and in a week all nursing was stopped and the child gradually regained its lost weight. It was subsequently discovered that the mother was pregnant at the time the loss was going on.

When a nursing infant has been accustomed from birth to take either

milk or simply water from a bottle once a day, as is the practice of many physicians to order, gradual weaning is generally an easy matter. Otherwise it is sometimes an impossibility, the child refusing all food except the breast so long as this is given, and nothing but starvation inducing it to take food either from a bottle or a spoon. Infants will sometimes refuse food until so weak as to make their condition serious.

Sudden weaning may be required at any time from the development in the mother of acute disease of a serious nature, such as typhoid fever or pneumonia, grave chronic disease, such as tuberculosis or nephritis, from the intercurrence of pregnancy, or from disease of the mammary gland. On no account should an infant be suckled at a breast which is

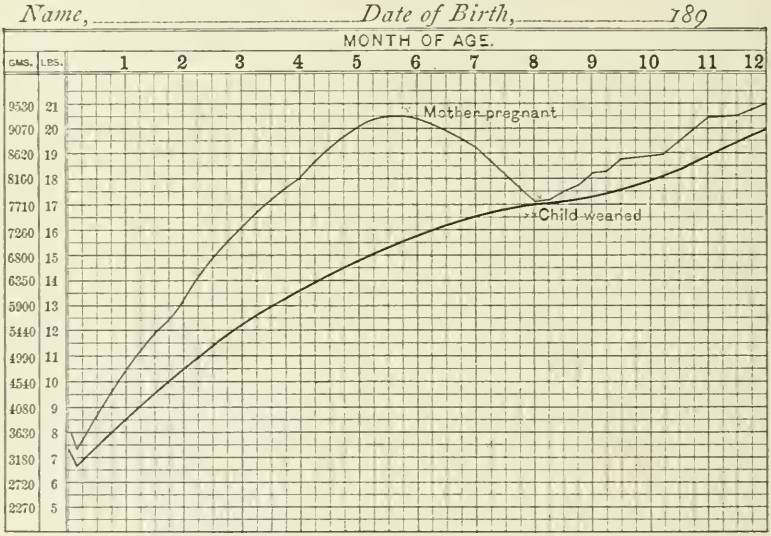

FIG. 30.—Chart showing the effect of pregnancy upon the weight of a nursing infant. The upper line is that of the patient; the lower one is the average line for the first year.

the seat of acute inflammation. Through many of the minor ills—mild attacks of bronchitis, pharyngitis, indigestion, and even malarial fever—mothers will frequently nurse their children without any seeming detriment to them or themselves. In acute illness of short duration, even if severe, it is usually better, unless we decide to wean altogether, to maintain the flow of milk by the use of the breast-pump rather than allow it to dry up. The breasts may be pumped three or four times a day.

In cases of sudden weaning, the food must in the beginning be very much weaker than for an artificially-fed child of the same age. If weaned at six months, the child should be put upon a food appropriate for a healthy child of one month; if at nine or ten months, upon a food appropriate for one of three or four months. If this is done, the change

can be made without causing much disturbance. When the infant has become somewhat accustomed to cow's milk the strength of the food may be gradually increased.

MIXED FEEDING.

By mixed feeding is meant a combination of breast- and artificial-feeding. This may be resorted to in any case in which the milk-supply of the mother is insufficient, or when the drain upon her health is unduly great. In most cases it is better than entire artificial feeding, and there is no objection to combining the two; but before allowing a mother partly to nurse and partly to feed her infant, one must be sure that the quality of the milk is good. This is to be determined by the principles given in the preceding pages.

It is well from the very outset to accustom the infant to take one of its feedings, or at least to take water, from a bottle each day. In maternal nursing, the occasional feeding which is usually necessary, becomes then an easy matter. If circumstances make it desirable to relieve the mother of night-nursing, or of one or more feedings during the day, this also can be accomplished without difficulty. If the child is being wet-nursed, the same plan is advisable, for it then becomes easy to put an infant upon the bottle entirely in the event of the wet-nurse leaving suddenly—a not uncommon occurrence. If at any time the mother's health begins to suffer, she should be relieved of two or more nursings a day, and the bottle substituted. In this way she may be able to continue lactation for some time longer. When, however, the nursings have been reduced to only two or three daily, the milk should be examined frequently, as it is apt to deteriorate rapidly in quality. Mixed feeding is also necessary in many cases during the first few weeks, while the mother's milk is insufficient in consequence of anything which has retarded convalescence after parturition. It often happens that the milk becomes abundant and of good quality when the mother is well enough to be up and out of doors, although it was previously scanty and of inferior quality. Two or three feedings a day from the bottle, help to bridge over this period and prevent the child's nutrition from suffering. In all cases of mixed feeding, the food should be the same as when the child is fed exclusively.

ARTIFICIAL FEEDING.

There are several fundamental principles which must be constantly borne in mind :

1. The food must contain the same constituents as woman's milk, viz., fat, proteids, carbohydrates, inorganic salts, and water.

2. These constituents must be present in about the same proportion as in good woman's milk.

3. As nearly as possible the different constituents should resemble those of woman's milk both in their chemical composition and in their behaviour to the digestive fluids.

4. The addition to the food of very young infants of substances not present in woman's milk (e. g., starch) is unnecessary, contrary to the best physiology, and, if used in any considerable quantity, may be positively harmful.

In the artificial feeding of infants, cow's milk is selected, as it furnishes all the necessary elements, although not in the proportions required by young infants. In adapting cow's milk to infant-feeding, it is necessary, first, to know the differences in the composition of cow's milk and woman's milk; and, secondly, to devise the simplest means of overcoming these differences, in order to secure an infant-food which closely resembles average woman's milk in its percentages of fat, sugar, proteids, and salts. But this is not all. We can not feed all infants exactly alike, even though they are of the same age and weight. Their food must be adapted to their powers of digestion. In breast-feeding it has long been a matter of common observation that an infant might thrive perfectly on the milk of one woman, and suffer immediately from indigestion when put upon that of another, although both were equally healthy. In the selection of a wet-nurse it has sometimes been necessary to try a dozen before one could be found whose milk agreed with the infant, or, in other words, whose milk contained the different ingredients—fat, sugar, and proteids—in proportions exactly suited to the child's condition. Hence it is necessary to vary the proportions of the different constituents in order to meet exactly the requirements of the individual infant. If cow's milk disagrees with an infant, the proper method of procedure is to try and discover which of the elements of cow's milk is causing the disturbance, and to change the proportions until we have a milk which the child can easily digest. Reduced to its lowest terms, the problem of infant-feeding consists, first, in obtaining the elements of the food separately; and, secondly, in so combining them as to meet the needs of the case in hand. For this simplification of the problem the world is indebted to Rotch.

In feeding infants according to this plan, it is necessary to have a method of expressing in exact terms the composition of the food used. This can be done only by giving the percentages of the fat, sugar, proteids, and salts which the milk contains. The mere statement of the amount of milk or cream used conveys no definite idea, as these differ so much in their composition. Only by stating percentages can we record our own experience or compare our results with those of others. This new nomenclature, although perhaps a little difficult at first, is easily mastered, and is absolutely necessary in scientific infant-feeding.

The Modification of Cow's Milk for Healthy Infants during the First Year.—In modifying cow's milk for infant-feeding, our cal-

culations are based upon the composition of good breast-milk, as determined by the latest analyses:

	Woman's milk, average.	Cow's milk, average.
	Per cent.	Per cent.
Fat	4·00	3·50
Sugar	7·00	4·30
Proteids	1·50	4·00
Salts	0·20	0·70
Water	87·30	87·50
	100·00	100·00

We have, therefore, in cow's milk, an excess of proteids and salts, too little sugar, and of fat about the quantity required. Other conditions which must be considered are the presence of bacteria in cow's milk, its acid reaction, and the fact that its proteids are more difficult of digestion. The same is probably true of the fat in the condition in which we feed it, but to a much less degree.

Fat.—The average amount of the fat of cow's milk which a healthy infant can digest varies from 2 to 4·5 per cent. It is rarely necessary in health to go either above or below these proportions. Beginning with 2 per cent in the early days of life, the amount may be increased to 3 per cent at one month, and to 4 per cent at four or five months. No other modification in the fat is necessary.

Sugar.—In woman's milk the percentage of sugar is remarkably constant under all conditions—between 6 and 7 per cent. In feeding cow's milk it is seldom required to have the sugar less than 5 and never more than 7 per cent. This is the simplest part of the modification. As the sugar in milk is simply lactose in solution, it is only necessary to calculate the amount required to be added to bring this up to the 6 or 7 per cent desired. The milk sugar should be first dissolved in boiling water, and, when it contains impurities, filtered through absorbent cotton. It should be prepared at least every second day, and in summer daily. It is more rational in theory, and certainly better in practice, to use milk sugar rather than cane sugar, since the former supplies what exists in woman's milk. It should be distinctly understood that the purpose of adding sugar to milk is not to sweeten the food, but to furnish the proper proportion of a soluble carbohydrate necessary for the infant's nutrition. When, however, good milk sugar can not be obtained, cane sugar may be substituted; the amount added must be but little more than half that of milk sugar on account of its sweeter taste, and greater liability to ferment in the stomach.

Proteids.—The modification of the proteids is the most important change necessary in cow's milk, for it is the proteids which give most of the trouble to the infant digestion. In ordinary cases in health, a reduc-

tion in the amount is all that is necessary. But for very young infants it is not enough to reduce the proteids to the proportion present in average woman's milk—1·5 per cent. In the beginning, and even during the first months, we must go considerably below this point, usually to 1 per cent, and for the first few weeks to 0·75 or even 0·50 per cent. The secret of success in feeding cow's milk, is to reduce the proteids at the start to a proportion which the infant can easily digest, and then gradually increase the amount. By the end of the first month the average child can take 1 per cent, by the fourth month 1·5 per cent, and by the sixth month 2 per cent.

This reduction in the proteids is effected by dilution with water. In the following table is shown the result of various dilutions upon the proteids and inorganic salts:

	Cow's milk.	Diluted once.	Diluted twice.	Diluted three times.	Diluted four times.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
Proteids	4·00	2·00	1·33	1·00	0·80
Salts	0·70	0·35	0·23	0·18	0·14

Inorganic Salts.—These, like the proteids, are excessive in cow's milk, and nearly to the same degree. When, therefore, milk is diluted as required by the proteids, the salts will be nearly in their proper proportion, and they may be dismissed from separate consideration.

Reaction.—The acidity of cow's milk may be overcome by the addition either of lime water or bicarbonate of soda. Of the former there is required about one ounce to each twenty ounces of the food; of the latter, about one grain to each ounce of the food.

The subject of heating milk for the destruction of bacteria has been considered in a previous chapter (page 143).

Milk Laboratories.—There have been established in Boston, New York, and Brooklyn, milk laboratories which undertake to furnish "modified milk" of any desired proportions, upon the prescription of physicians, exactly as drugs are dispensed by an apothecary. The elements used by these laboratories are: (1) cream containing 16 per cent fat; (2) separated milk from which the fat has been removed by the centrifugal machine; (3) a standard solution of milk sugar, 20 per cent strength. These contain fat, sugar, and proteids in the following proportions:

	Cream.	Separated milk.	Sugar solution.
	Per cent.	Per cent.	Per cent.
Fat	16·00	0·13	....
Sugar	4·00	4·40	20·00
Proteids	3·60	4·00	....

By combining these it is possible to vary the percentages of fat, sugar, and proteids in the milk to almost any degree desired, and to do this with very great accuracy. At the present time a separate modification of the inorganic salts is not attempted. The physician, in ordering the food, simply writes for the percentages of fat, sugar, and proteids desired, with the number of feedings for twenty-four hours and the quantity for each feeding. The food-supply for an entire day is delivered each morning in the bottles from which it is to be fed. The laboratory also undertakes to heat milk to any temperature that may be desired. The following is the form in which prescriptions are written:

℞	Fat	3 per cent.
	Sugar	6 "
	Proteids	1 "
	Alkalinity, limewater	5 per cent.
	Number of feedings	8
	Amount for each feeding	4 ounces.
	Heat to 167° F., 25 minutes.	

The establishment of the milk laboratory, for which the profession it indebted to Rotch, is a great stride in advance in infant-feeding, as it enables the physician to know what his patient is taking, at the same time making it possible to vary any one of the constituents of the food separately, even to a fraction of one per cent, until the combination is reached which is exactly suited to the infant's digestion. With the assistance of the milk laboratory, infant-feeding can be done with something like scientific accuracy. The laboratory company has the direct oversight of the breeding, care, and food of cows and the handling of milk, to insure its purity, freshness, and cleanliness. The practical workings of the milk laboratories are so satisfactory that we shall doubtless see them established in all large cities. The only drawback is the expense.

After two years' experience I have found the laboratory of great value in difficult cases of infant-feeding, and it soon becomes almost as much of a necessity to the physician practising among young children, as does the apothecary shop to the general practitioner.*

As a general guide to the modification of milk for an average infant the following table is introduced, showing the changes required with the age of the child:

* For fuller details regarding the milk laboratory, see Rotch, Archives of Pædiatrics, February, 1893.

Schedule for feeding an average healthy infant from birth upon modified cow's milk, showing percentages of fat, sugar, and proteids, and the daily quantity.

No.	Age.	Fat.	Sugar.	Proteids.	Daily quantity.	
		Per cent.	Per cent.	Per cent.	Ounces.	Grammes.
I	First and second day.....	...	5·0	...	4– 8	125– 250
II	Third to seventh day.....	2·0	6·0	0·60	10–15	310– 460
III	Two to four weeks.....	2·5	6·0	0·80	20–30	620– 930
IV	One to three months.....	3·0	6·0	1·00	22–36	680–1,110
V	Three to four months.....	3·5	6·0	1·25	28–38	870–1,180
VI	Four to six months.....	4·0	6·0	1·50	32–38	990–1,180
VII	Six to nine months.....	4·0	7·0	2·00	34–42	1,050–1,300
VIII	Nine to twelve months.....	4·0	6·0	2·50	38–45	1,180–1,400
IX	Twelve to fifteen months....	4·0	5·0	3·00	40–50	1,240–1,550
X	Fifteen to eighteen months..	4·0	5·0	3·50	45–50	1,400–1,550
XI	Eighteen months (whole milk)	3 5	4·3	4·00	45–50	1,400–1,550

In ordering milk for an infant, not only its age but its weight must be taken into account. One that at four months weighs as much as the average child at eight months, will usually be found able to take the quantity of food and also the percentages advised for the latter age. Again, there are some cases where the percentages of the milk may be increased more rapidly than in the schedule. As a rule, it is wise to increase the strength of the food just as fast as the child's digestion will permit.

Modification of Milk at Home.—Inasmuch as milk laboratories are as yet accessible to but very few physicians, the problem presented is how to secure similar results by simple methods when milk is "modified" at home. If directions are followed, results may be obtained sufficiently accurate for practical purposes in the great majority of cases. However, considerable care and intelligence are necessary.

The elements with which the formulæ desired are most conveniently obtained are: (1) a 12-per-cent cream—i. e., one that contains 12 per cent fat; (2) an 8-per-cent cream; (3) solutions of milk sugar of 5, 6, 7, 8, and 10 per cent strength.

The 12-per-cent cream may be obtained in the city by using equal parts of ordinary (20 per cent) centrifugal cream and plain milk; in the country, by using two parts of ordinary skimmed or gravity (16 per cent) cream* and one part of plain milk; or by taking the top layer of milk after standing five or six hours, in the manner described on page 142.

The 8-per-cent cream may be obtained in the city by using one part of centrifugal (20 per cent) cream and three parts of plain milk; in the country, by using one part of gravity cream and two parts of plain milk;

* This is the ordinary cream twelve hours old. It should be set at night and used in the morning.

or by using the top layer of milk after standing five or six hours, as described on page 142.

The sugar solutions are obtained as follows:

A 5-per-cent solution: Dissolve an ounce of milk sugar* in twenty ounces of water, or one even tablespoonful† in seven and a half ounces of water.

A 6-per-cent solution: Dissolve one ounce of sugar in sixteen and a half ounces of water, or one even tablespoonful in six and a half ounces of water.

A 7-per-cent solution: Dissolve one ounce of sugar in fourteen ounces of water, or one even tablespoonful in five and a half ounces of water.

An 8-per-cent solution: Dissolve one ounce of sugar in twelve and a half ounces of water, or one even tablespoonful in four and a half ounces of water.

A 10-per-cent solution: Twice the strength of a five-per-cent solution.

With these ingredients it is a comparatively easy matter to make up with approximate accuracy the various formulæ required. Formulæ II to VI inclusive may be obtained from the 12-per-cent cream by simply diluting this five, four, three, two and a half, and two times respectively with a 6- or 7-per-cent sugar solution. This will be plain from the following table:

Formulæ obtained by diluting Twelve-per-cent Cream.

Diluting	5	times‡	with	6%	sugar	solution	= II:	Fat 2·0%;	sugar,	6%;	proteids,	0·60%.
"	4	"	"	6%	"	"	= III:	" 2·5%;	"	6%;	"	0·80%.
"	3	"	"	7%	"	"	= IV:	" 3·0%;	"	6%;	"	1·00%.
"	2½	"	"	7%	"	"	= V:	" 3·5%;	"	6%;	"	1·20%.
"	2	"	"	7%	"	"	= VI:	" 4·0%;	"	6%;	"	1·30%.

In all these formulæ it will be seen that the ratio of the fat to the proteids is three to one. Not only these formulæ, but any intermediate ones with this ratio, may be derived by varying the dilution. The sugar may be easily modified, if desired, by using weaker or stronger solutions than those mentioned. With these formulæ an average infant may be carried through the first six months, the period when accurate modification is most needed.

Formula VII is obtained from an 8-per-cent cream by diluting once with a 10-per-cent sugar solution; and in a similar way are derived other formulæ in which the fat and the proteids bear the relation of two to one:

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* A convenient method is, to obtain from a druggist a box holding exactly one ounce of milk sugar.

† One even tablespoonful may be calculated as three drachms.

‡ By diluting five times is meant one part of the cream and five parts of the sugar solution, etc.

Formulæ obtained by diluting Eight-per-cent Cream.

Diluting once	with	10%	sugar	solution	= VII:	Fat, 4%;	sugar, 7%;	proteids, 2·00%.
"	1½ times	"	7%	"	"	= XII:	" 3%;	" 6%;	" 1·50%.
"	3 times	"	7%	"	"	= XIII:	" 2%;	" 6%;	" 1·00%.
"	7 "	"	5%	"	"	= XIV:	" 1%;	" 5%;	" 0·50%.

It is in many cases desirable to use a lower percentage of fat than in the foregoing formulæ without reducing the proteids. This may be done simply by diluting plain milk with a sugar solution. In these formulæ the fat and proteids are nearly in the same proportions, viz.:

Formulæ obtained by diluting Plain Milk.

Diluting once	with	8%	sugar	solution	= XV:	Fat, 1·80%;	sugar, 6%;	proteids, 2·00%.
"	3 times	"	5%	"	"	= XVI:	" 0·90%;	" 5%;	" 1·00%.
"	7 "	"	4%	"	"	= XVII:	" 0·45%;	" 4%;	" 0·50%.
"	11 "	"	4%	"	"	= XVIII:	" 0·30%;	" 4%;	" 0·34%.

From the three fundamental formulæ—12-per-cent cream, 8-per-cent cream, and plain milk—we may readily derive almost any desired formula in which the proportion of fat is to that of the proteids as three to one, two to one, or where they are about equal.

Following out the directions given in the preceding pages, the preparation of an infant's milk should be somewhat as follows: The first thing to be decided is the formula to be used, then the size of each feeding and the number of feedings; as it is always preferable to prepare at one time the entire amount of food required for twenty-four hours. Let us suppose we wish to give a milk containing fat 3 per cent, sugar 6 per cent, and proteids 1 per cent (formula IV), and that we require nine feedings of four ounces, or thirty-six ounces of food to be prepared. By referring to page 175 we see that this formula can readily be obtained by diluting a 12-per-cent cream three times with a 7-per-cent sugar solution. There will thus be required, nine ounces of the 12-per-cent cream and twenty-seven ounces of the 7-per-cent sugar solution. The cream may be obtained by taking four and a half ounces of centrifugal (20 per cent) cream and four and a half ounces of milk, or six ounces of skimmed (16 per cent) cream and three ounces of milk. For the sugar solution there will be required two ounces, or five and a half even tablespoonfuls, of milk sugar, to be dissolved in the twenty-seven ounces of boiling water; or, if lime-water is to be added, one and a half ounces of limewater and twenty-five and a half ounces of boiling water. The full directions, written out for the guidance of a nurse, will then be as follows:

Centrifugal cream,	4½ ounces,	or	skimmed cream,	6 ounces.
Plain milk,	4½ "		plain milk,	3 "
Milk sugar,	2 "	or	5½ even tablespoonfuls.	
Boiling water,	25½ "	or	boiling water,	27 ounces.
Limewater,	1½ ounce,		bicarbonate of soda,	36 grains.

Dissolve the milk sugar in the boiling water, filter through cotton, add the milk and cream, and mix all in a pitcher; then add limewater or soda, and divide in nine bottles, stopping them with cotton.

If the milk is to be heated for purposes of sterilization, directions for this should follow; if not, the bottles should be rapidly cooled by standing in cold water for fifteen minutes, during which the water should be changed once or twice, or kept cold by adding ice. The food should now be placed in an ice-chest, where it is kept until required. It should be warmed by placing the bottle in warm water, and shaken before it is fed.

Although at first glance the preparation of food in the manner indicated may seem too complicated for general use, such is really not the case. The labour involved is not greater than when milk is prepared in a more irregular way, and any intelligent mother or nurse is fully competent to carry out all the directions given when once they have been fully explained.

To save the physician the trouble of calculating the exact quantity of each of the ingredients required for the formulæ most used—viz., II, IV, and VII—there are given in the subjoined table the amounts needed for the preparation of twenty-four, thirty-two, forty, and forty-eight ounces respectively of food:

No.	Formula.	Ingredients.	QUANTITY OF EACH INGREDIENT REQUIRED TO PREPARE THE FOLLOWING AMOUNTS OF FOOD.			
			24 oz.	32 oz.	40 oz.	48 oz.
II.	Fat, 2·0% Sugar, 6·0% Proteids, 0·6%	Milk	1½ oz.	1⅞ oz.	2¼ oz.	2⅞ oz.
		Cream (skimmed, 16%)	2½ "	3½ "	4½ "	5½ "
		Water	20 "	26⅔ "	33½ "	40 "
		Milk sugar, ounces	1⅕ "	1⅗ "	2 "	2⅖ "
		Or milk sugar, even tablespoonfuls	3 "	4 "	5½ "	6½ "
IV.	Fat, 3·0% Sugar, 6·0% Proteids, 1·0%	Milk	2 "	2⅔ "	3⅓ "	4 "
		Cream (skimmed, 16%)	4 "	5½ "	6⅔ "	8 "
		Water	18 "	24 "	30 "	36 "
		Milk sugar, ounces	1⅕ "	1⅗ "	2 "	2⅖ "
		Or milk sugar, even tablespoonfuls	3 "	4 "	5½ "	6½ "
VII.	Fat, 4·0% Sugar, 7·0% Proteids, 2·0%	Milk	8 "	10⅔ "	13⅓ "	16 "
		Cream (skimmed, 16%)	4 "	5½ "	6⅔ "	8 "
		Water	12 "	16 "	20 "	24 "
		Milk sugar, ounces	1⅕ "	1⅗ "	2 "	2⅖ "
		Or milk sugar, even tablespoonfuls	3 "	4 "	5½ "	6½ "

If the centrifugal (20 per cent) cream is used, equal parts of milk and cream should be taken for formulæ II and IV; while for formula VII the proportions should be one-fourth cream and three-fourths milk. When limewater is to be added, it should replace the same quantity of plain water. The same is true of barley water, if used with formula VII, as is sometimes desirable.

For older infants, able to take a stronger milk than formula VII, proportions similar to formula VIII (p. 174) may be obtained, thus:

Milk, 24 oz.; cream (16%), 7 oz.; water, 19 oz.; sugar, 2 oz. = 50 oz.

Bottles and nipples.—The best style of bottle is that which can be most readily cleaned. The cylindrical bottles with wide mouths are now generally preferred. Some trouble in measuring the food is avoided if graduated bottles are used. On no account should bottles with any complicated apparatus be allowed. The best nipples are those of plain black rubber, which slip over the neck of the bottle. Those with a long rubber tube going to the bottom of the bottle should not be used, as it is practically impossible to keep them clean. The hole in the nipple should be large enough for the milk to drop rapidly when the bottle is inverted, but not so large that it will run in a stream. When not in use, nipples should be kept in a solution of borax or boric acid. The most scrupulous care is necessary of both bottles and nipples. Bottles should first be rinsed with cold water, then washed with hot soap suds and a bottle-brush. When not in use they should stand full of water. Before the milk is put into them they should be sterilized by lying for twenty minutes in boiling water.

Rules for artificial feeding.—A bottle should not be warmed over for a second feeding. A child should not be more than twenty minutes in taking its food, and should not be allowed to sleep with the nipple of the bottle in its mouth. It is preferable to have the child held in the arms of the nurse while taking its bottle. If this is not done, the bottle should at least be held in such a position that the child gets milk, and not air, from the bottle. It is even more necessary than in breast-feeding that rules as to frequency and regularity of meals should be observed. The following table gives the size of the meals, and the daily quantity of food, as well as the number of meals and intervals of feeding. This is constructed for an average infant in health. An infant much above the average in weight must usually have its food graded accordingly.

Schedule for Feeding Healthy Infants during the First Year.

Age.	No. of feedings, 24 hours.	Interval between meals, by day.	Night feedings (10 P. M. to 7 A. M.).	Quantity for one feeding.		Quantity for 24 hours.	
		Hours.		Ounces.	Grammes.	Ounces.	Grammes.
3d to 7th day	10	2	2	1 –1½	30– 45	10–15	310– 460
2d and 3d weeks	10	2	2	1½–3	45– 90	15–30	460– 930
4th and 5th weeks	9	2	1	2½–3½	75–110	22–32	680– 990
6th week to 3d month	8	2½	1	3 –4½	90–140	24–36	740–1,110
3d to 5th month	7	3	1	4 –5½	125–170	28–38	870–1,080
5th to 9th month	6	3	0	5½–7	170–220	33–42	1,020–1,300
9th to 12th month	5	3½	0	7½–9	235–280	37–45	1,150–1,400

Modification of Milk required by Particular Symptoms.—Regarding the exact indications according to which the fat, sugar, and proteids of milk are to be varied in infant-feeding, much is yet to be learned. The following are the points which experience has thus far led me to depend upon:

If the sugar is too low, the gain in weight is apt to be slower than when it is furnished in proper amount. The symptoms most frequently indicating an excess of sugar are colic, or thin, green, very acid stools, sometimes causing irritation of the buttocks. In some cases, where the sugar is in excess, there is much eructation of gas from the stomach, and regurgitation of small quantities of food.

An excess of fat is indicated by the frequent regurgitation of food in small quantities, usually one or two hours after feeding. It is sometimes shown by frequent passages from the bowels, which are nearly normal in appearance. In some cases the stools contain small round lumps somewhat resembling casein, but really composed of masses of fat. In rare cases an excess of fat may be the cause of colic. The most constant indication that too little fat is given, is constipation with dry, hard stools; but it should not be forgotten that such stools are sometimes seen when the fat is not too low. To increase the fat above 4·5 per cent in feeding infants under six months old, simply because of constipation, is, I think, a mistake. In point of fact, I have rarely seen any advantage in carrying the fat above 4 per cent.

The most reliable indication that the proteids are in excess is the presence of curds in the stools. This condition is also a frequent cause of colic—indeed, of most of the colic of early infancy. Sometimes there is diarrhœa, but more frequently there is constipation, especially when the excess of proteids is great. This condition may be the cause of vomiting or the regurgitation of small quantities of food from time to time. Imperfect digestion of the proteids may cause the same symptoms as when they are in excess, and the same may be true of the fat and of the sugar. Often the difficulty may be, not that the proportion of the different elements of the food is actually in excess, but that more is given than the infant can digest at the time, and in any event the amount should be reduced.

It is not practicable, even were it possible, to modify the milk so as to meet every temporary symptom of discomfort an infant may have. In general the most important indications may be summarized as follows: if not gaining in weight without special signs of indigestion, increase the proportions of all the ingredients; if habitual colic, diminish the proteids; for frequent vomiting soon after feeding, reduce the quantity; for the regurgitation of sour masses of food, reduce the fat, and sometimes also the proteids; for obstinate constipation, increase both fat and proteids.

The Use of other Food than Milk during the First Year.—In the discussion up to this point, nothing but the elements of milk has been considered. Upon these alone the infant can best be nourished during the greater part of the first year. The addition of other food should usually be deferred until the ninth or tenth month. At this period the power of digesting starch is sufficiently strong for the infant to receive some of its carbohydrates in this form, instead of all of it in the form of sugar, as has been previously the case. As starch is added, the sugar should be gradually reduced. The form of starch used may be a gruel made of barley, oatmeal, or arrowroot, or some of the farinaceous foods (page 156). If barley is used, the proper proportion to begin with, is to make the food about one third its volume of barley water of the strength mentioned on page 155. This will take the place of the same quantity of boiled water in the preparation of the food. It will then be added to each one of the feedings. By the eleventh or twelfth month the quantity of barley may be further increased by making the barley water stronger, rather than by using a larger quantity. The choice between the different cereals will depend upon the case. Where there is a tendency to constipation, oatmeal water is to be preferred; at other times barley. The only other thing to be advised during the first year is beef-juice (for preparation, see page 153). This may be begun in the tenth or eleventh month. At first only half an ounce should be given daily, either alone or added to the milk. Later the daily quantity may be increased to two ounces, given with two of the feedings.

Feeding in Difficult Cases.—Thus far we have dwelt upon the management of the food for healthy infants of average digestion, or, in other words, normal cases. There remain to be considered the modifications required for infants with feeble digestion—the difficult cases. This group is quite a large one. Some of these are delicate children with feeble digestion from birth, a class more numerous in the city than in the country; but there is a much larger number with chronic disturbances of digestion due to previous bad methods of feeding, or, what may be just as serious, improper nursing. In other cases the condition of feeble digestion is the result of unhygienic surroundings. In still others it is the consequence of previous attacks of acute disease of the digestive organs or of some general disease, such as influenza, whooping-cough, or pneumonia. In all the problem is essentially the same: to adapt the food to an infant whose powers of digestion and assimilation are very feeble and easily disturbed. Time, patience, a careful study of individual cases, and close attention to details are necessary to secure the best results. The general care required by these children is equally as important as their food. This, however, is considered in the chapter on Malnutrition, and only the dietetic treatment will be discussed in this connection.

The difficulties are always greatest in the early months—viz., in giving the infant a start. When this has once been done, future progress is generally easy. A food weakened to correspond to the child's power of digestion, may be able to do no more than repair the waste of the body, and sometimes not even that. The most common mistake is to use in the beginning a food so strong as to disturb the digestive organs. When once this has been done, all progress is difficult. These cases demand all our resources, and the difficulties are usually increased in proportion to the duration of the disorder. It may have existed so long that no form of artificial feeding, or even wet-nursing, will succeed. While these cases differ widely and each one must be studied by itself, there are certain principles of general application.

1. The strength and quantity of the food are better gauged by the weight than by the age of an infant, but best of all by its power of digestion. This can only be determined by careful experimentation in each individual case.

2. A larger quantity of a dilute food is usually better borne than a smaller quantity of one more concentrated.

3. Up to the third month the rules as to frequency of meals should be the same as those for healthy infants. After this time the intervals should usually be shorter.

Modification of Milk in Difficult Cases.—In the early months the usual symptoms presented by these cases are that they do not gain in weight, and that they show to a more or less marked degree the following signs of indigestion: the stools contain undigested food, usually lumps of casein; there may be diarrhœa or constipation, usually the latter; there is frequently a regurgitation of small quantities of food, sometimes actual vomiting; there are usually flatulence and colic. In consequence of the foregoing conditions, sleep is disturbed, and the infants are cross and fretful much of the time.

No proper gain in weight is to be expected until the indigestion is overcome, and this should be the first purpose in the management of such cases.

So far as the elements of milk are concerned, it should be remembered that the sugar is least likely to be a cause of trouble, and it need rarely be reduced below 4 per cent, and never below 3 per cent. It is the proteids which give the most trouble, the fat coming next. For young infants with feeble digestion the proteids should always be reduced to 1 per cent, and usually to 0·5 per cent; it may even be necessary to reduce to 0·25 per cent for a short time. The fat can usually be taken in the proportion of 1 or 2 per cent, rarely more than the latter. For a short time it may be necessary to reduce the fat below 1 per cent. The proportions to be used under these conditions may be those of formula II, page 175: fat, 2 per cent; sugar, 6 per cent; proteids, 0·6 per cent; or,

if the 12-per-cent cream (page 174) is diluted with eleven parts of a 5-per-cent sugar solution, we obtain :

Formula XIX	Fat	1·00 per cent.
	Sugar	5·00 "
	Proteids	0·30 "

If we desire a relatively lower proportion of fat, we may use formula XIV (page 176) : fat, 1 per cent ; sugar, 5 per cent ; proteids, 0·50 per cent ; or, diluting the 8-per-cent cream (page 174) with fifteen parts of a 4-per-cent sugar solution (one ounce to twenty-five ounces), we obtain :

Formula XX	Fat	0·50 per cent.
	Sugar	4·00 "
	Proteids	0·25 "

Usually, then, we should begin with one of the formulæ having the low percentages mentioned, and with improvement in the symptoms gradually increase the fat and proteids by making the dilution less ; if we began with formula XIX, instead of eleven parts of the sugar solution, using ten, nine, seven, five, etc. ; or, in a similar way, varying formula XX. The rapidity with which these changes can be made will of course vary with the progress of the case.

For infants from four to ten months old presenting similar symptoms, a somewhat different modification must be made, particularly in cases of the marasmus type with long-standing trouble. As much difficulty may be experienced by them with the fat as with the proteids, and in some cases even more. But by most of these, as well as by the younger infants, sugar is well tolerated. We may begin with formula XVIII (page 176) : fat, 0·30 per cent ; sugar, 4 per cent ; proteids, 0·34 per cent ; after a time the strength of the food being gradually increased to formulæ XVII, XVI, and XV by diminishing the dilution of the milk. Sometimes, however, we may succeed better by beginning exactly as with younger infants, making the increase in strength usually with somewhat greater rapidity.

The Use of Peptonized Milk.—Another plan which may be followed with infants who have great trouble in digesting the proteids of cow's milk is that of peptonizing the milk. For a description of the process, see page 148. It is important that a proper formula should likewise be used in these cases. For young infants such proportions as those of formula XIII, page 176, are appropriate—fat, 2 per cent ; sugar, 6 per cent ; proteids, 1 per cent. In the beginning, the process may be continued for an hour ; later, with improvement in the symptoms, reducing the time to half an hour, and then to fifteen and even ten minutes. It is preferable that the bottles of milk should be peptonized separately just before each feeding. The amount of the powder required is one grain of the extractum pancreatis and three grains of bicarbonate of soda to each three ounces of the milk. The partial digestion of the milk may be continued

for several weeks, or until the stomach has in a measure regained its digestive power. There is a serious objection to its use for as long a period as four or five months, for in such a case the stomach gradually becomes less and less able to do its proper work. Which of the two methods of procedure—greatly reducing the amount of proteids or predigesting them—is the better one, will depend upon the individual case.

The Addition of other Substances to Milk.—The opinion has long prevailed that the addition to milk of some mucilaginous substance, such as a gruel made from barley, oatmeal, or arrowroot, or gelatine and water, facilitates the digestion of the proteids of cow's milk by preventing in the stomach the coagulation of the casein in large solid masses which are dissolved with such difficulty. The method of preparation has been to use these substances in the place of water, simply as diluents for milk, or more frequently to cook the milk with them for a short time—two to fifteen minutes—in order to obtain a more intimate combination with the casein. The substance most commonly employed has been a thin barley gruel. (For preparation, see page 155.) This may take the place of some of the plain boiled water in any of the formulæ previously given, the usual proportion being to make the food from one fourth to one half its volume of the gruel.

The recent experiments of Rotch and others throw a good deal of doubt upon the traditional belief in regard to the effect upon the casein of this treatment, and it is really questionable whether anything more is accomplished than by diluting with water. This method of preparing milk is certainly of much less value than the careful modification of the milk constituents which has been previously considered. Still, it is a method which is useful in certain cases, whether the explanation which has been offered be the correct one or not. It should, however, be remembered that the starchy substance, whatever it may be, plays but a very small part in the nutrition of the infant; first, because the amount of starch used is considerably below one per cent of the food, the other elements of the gruel being in such small proportions that they may be almost ignored; and, secondly, because of the very feeble power of transforming starch into sugar which exists in the young infant.

The Use of other Sugars than Milk Sugar.—It has been already stated that it is rare that there is difficulty in the digestion of sugar; but such is sometimes the case. It is also true that there are exceptional instances in which milk sugar is not well borne, where cane sugar or even maltose (as in some of the malted foods) may be taken. Both of these are so sweet they must be used in proportions considerably smaller than those of milk sugar, and generally as temporary substitutes only.

The addition of Beef Juice (page 153) to the milk where the digestion is so feeble as to require a great reduction in the proteids, is at times advantageous. From one half to two tablespoonfuls may be added to

each feeding. Instead of beef juice, some of the beef peptonoids mentioned on page 154 may be used.

The number of cases which can not be managed by simply varying the different elements of cow's milk, is small. In private practice, if the child can be taken in hand at the outset, the number is very small, the exceptions being premature and delicate infants, which are reared under any circumstances only with the greatest difficulty. The difficulties are much increased where the disordered digestion has already lasted several weeks or months. They are greatest in institutions where many infants are brought together. As the weight is our most important guide to the success of any method of feeding, we must have accurate scales and weigh the infants twice a week, in order to determine as soon as possible what progress is made, so that a useless experiment may not be unduly prolonged. For the first week or two no more than an arrest of the previous loss in weight is to be expected. There can be no material gain until the symptoms of indigestion, colic, bad stools, restlessness, and vomiting are greatly lessened or entirely gone. Until this is the case the food can not be increased in strength. The gain is almost always slow at first, amounting perhaps only to two or three ounces a week; but it should be steady. Later, under favourable conditions, it should increase to six or eight ounces, or even more.

For those children who do not thrive with an intelligent modification of cow's milk according to the plan above outlined, the thing most likely to succeed is the employment of a wet-nurse, although if the condition of malnutrition has become firmly established even this often fails. Sometimes condensed milk succeeds, although its composition after dilution (page 149) is similar to that which we have been employing (formula XVII or XVIII, page 176), the chief difference being the substitution of cane-sugar for the milk-sugar. In rare cases infants seem unable to digest raw milk, but improve when put upon milk that has been sterilized. Sometimes there is an advantage in withholding for a short time all milk constituents, and giving one of the malted foods with water, or animal broths. In apparently hopeless cases the most unpromising food or combination may occasionally succeed. I have lately seen an infant thrive upon plain milk undiluted, where all scientific modifications and additions had failed utterly. In every instance the general principle must be to begin with something which the child can digest and assimilate, and return to the usual proportions of the milk ingredients gradually, but just as soon as possible. We must often begin by doing what we can, not what we would like to do. We must avoid the danger of keeping an infant for a long time upon completely peptonized milk, also upon milk containing very low percentages of fat and proteids, like some of those referred to, and the continuance of food composed almost entirely of carbohydrates where all milk has been withdrawn.

CHAPTER IV.

FEEDING AFTER THE FIRST YEAR.

HEALTHY INFANTS DURING THE SECOND YEAR.

The physician should not relax his vigilance in the feeding of a child after the first year has passed. The ideas of the laity in regard to what a child can digest after it has outgrown an exclusive milk diet, are very erroneous. The majority of infants are given solid food too early and in too large quantities. Most of the attacks of indigestion during the second year are directly traceable to such gross dietetic errors. The diet of a healthy child during the second year should consist of milk, some farinaceous food, bread, a small amount of animal food, such as beef or mutton, beef juice, eggs, and fruit.

Milk should be the basis of the diet. There are a few infants for whom no modification of the milk is necessary, as they are able to digest without difficulty that containing 4 per cent proteids. The great majority of infants do better if the proteids are kept at 3 or 3.5 per cent during the first half of the second year. If the fat is 4 per cent, chronic constipation, usually so troublesome at this time, may often be avoided. Since the child is now able to take a considerable proportion of its carbohydrates in the form of starch, it is not necessary to continue the large quantity of milk sugar given during the first year, and in many cases the sugar may be omitted altogether. However, where starch-digestion is so feeble that only a small quantity of farinaceous food can be allowed, it may be necessary to continue the milk-sugar during the entire second year. The formulæ most generally useful during this period are:

IX. At 12 months: Fat, 4·0%; sugar, 5·0%: proteids, 3·0%.
X. " 15 " " 4·0%; " 5·0%; " 3·5%.
XI. " 18 " " 3·5%; " 4·3%; " 4·0% (i. e., plain milk).

We may obtain approximately these formulæ by using the following proportions for one feeding of ten ounces:

Formula IX. Milk, 6 oz.; cream (16%), 1 oz.; water, 3 oz.; sugar, 2 even teaspoonfuls.
" X. " 8 " " " ½ " " 1½ " " 1 " teaspoonful.

Instead of plain water in these formulæ, we may use the same quantity of barley or oatmeal gruel or jelly.

Farinaceous food: The easiest plan is to add this in the form of a gruel made of one of the cereals or farinaceous foods (page 156); the latter being partly dextrinized, require but ten to fifteen minutes' cooking. If these prepared flours are used, one even tablespoonful should be added to one pint of water, to make a gruel of about the proper strength. We may

use with equally good results a gruel or jelly made from oats, wheat, or barley. If the grains themselves are used, they should first be soaked for six hours or over night in water which is thrown away, and then cooked for from four to six hours and strained through muslin. Two tablespoonfuls of the grains to one quart of water, cooked down to one pint, gives a jelly of about the desired consistency. Salt should always be added to make it palatable.

During the first half of the second year children require from forty to fifty ounces (1,240 to 1,550 grammes) of fluid food daily; during the second half of the year from forty-five to fifty-five ounces. This quantity should be given in five feedings; four of these being of equal size, one—usually the midday feeding, which is given in connection with the meat or meat juice—being smaller.

Beef juice may be given as directed for the feeding during the latter part of the first year, the amount allowed being from one to three ounces daily. After the eighteenth month, if most of the teeth are present, rare scraped beef or mutton may be given at times in place of the beef juice. Not more than a tablespoonful should be allowed daily. After the eighteenth month, a soft-boiled fresh egg may also be given in place of the meat or meat juice, once or twice a week.

A small piece of stale bread dried in the oven, or a piece of zwieback may be given, usually with the midday meal, after the child has most of its teeth.

Fruit is a part of the diet too often omitted. Orange juice may be begun as early as the fifteenth month; from half an ounce to two ounces may be given daily. A little later one or two tablespoonfuls of baked apple or two or three stewed prunes may be added. Both should be cooked until they are very soft. The baked apple should be given without sugar, and the prunes should be put through a sieve to remove the skins. The best time for giving fruit is about an hour before one of the milk feedings.

The daily diet for a child of eighteen months should be arranged somewhat as follows: The first, second, fourth, and fifth meals should each consist of ten or twelve ounces of milk prepared with gruel, as above described, the fruit being given an hour before the second feeding. The third meal should consist of six or seven ounces of the milk and gruel, with beef juice, scraped beef, or egg, and dried bread. The form of farinaceous food may be varied from day to day, according to the child's taste. All other food may be advantageously omitted. Water only is to be allowed between the feedings.

The milk for the twenty-four hours is best prepared at one time. The quantity needed for the different feedings should be put in separate bottles, as during the first year. What was said regarding the heating of milk during the first year for sterilization, applies also to the second year.

Children can usually be taught to drink from a cup at from twelve to fifteen months.

DIFFICULT CASES DURING THE SECOND YEAR.

The number of children whose nutrition is a matter of difficulty during the second year is much smaller than during the first year; yet there are cases in which the difficulties are just as great. Some of these are infants that have been very delicate from birth, and carried through the first year only by the greatest effort. Others are healthy at birth, but their digestion has been badly deranged in consequence of improper feeding during the first year. Some are infants who did well until they were weaned, but from that time began to suffer from constant indigestion and malnutrition because they were put upon improper food, often undiluted cow's milk. In some the symptoms are the result of a severe attack of acute disease of the stomach or intestines during the first year. Many of them are rachitic. A frequent cause of trouble is that children have been put too early upon solid food, the mother often thinking that a child who is delicate is only to be built up by giving "strong food." Very often the difficulty is that the food has been excessive in starch, especially in the form of potato or oatmeal.

Whatever may be the cause of the symptoms, all cases of feeble digestion or chronic indigestion of the second year are to be managed very much in the same general way. Usually the first thing to be done is to stop all solid food except the rare scraped meat. Starches must be reduced to the minimum or prohibited altogether. In most cases milk, meat, and a little suitable fruit must constitute the diet. While it is undoubtedly true that the use of plain cow's milk often fails entirely, it is certain that nothing is more likely to succeed than cow's milk when properly modified. This must be continued as the principal diet, sometimes as the sole diet, for the greater part of the second year. The milk must be modified as for healthy infants who are from eight to twelve months younger than the patient under treatment. Thus a child of twelve or fourteen months, should be given milk prepared as for a healthy child of four or five months (formula VI, page 175); one of twenty to twenty-four months, as for a healthy child of from ten to twelve months (formula VIII, page 178). Milk containing a larger quantity of casein than in these formulæ, is rarely digested unless partly peptonized, and this may be required even with the lower percentages. The daily quantity should generally be somewhat larger than for a young, healthy infant taking food of the same strength. The regular intervals of feeding should never be shorter than three hours, and in many cases four hours is to be preferred. The number of meals usually required in the twenty-four hours is five.

From few things is more striking improvement seen in these patients

than from the administration of rare meat-pulp, especially to those who are over eighteen months old. From one to two ounces may be given daily. Generally the proteids in the food have been previously deficient. Many of these children digest meat when given in this way better than they do the casein of the milk. Raw beef juice may be used with the meat, or from time to time may take its place.

The same fruits should be allowed as for healthy infants, the quantity being smaller. Inasmuch as it is with the starches that the greatest difficulty is usually experienced, the carbohydrates must be administered either in the form of milk-sugar or some of the malted foods. When starch is first allowed it should be given with some reliable preparation of malt.

When the child is once well started and gaining steadily, the food may be gradually modified, until the diet recommended for healthy infants is reached. All changes must, however, be made very gradually, and it should never be forgotten that there is a constant disposition on the part of all mothers and nurses greatly to over-feed these children.

FEEDING FROM THE THIRD TO THE SIXTH YEAR.

Articles allowed.—From the following list the diet of a healthy child may be arranged :

Milk.—This should be the basis of the diet; most children require about one quart daily. This usually needs no modification, but if somewhat difficult of digestion, it should be prepared as for the second year—six ounces of milk, one ounce of cream, and three ounces of water. The milk should usually be given warm.

Cream.—This is of great value, especially when there is a tendency to constipation. From two to eight ounces may be given daily. It may be used upon cereals, upon potato, in broths, and mixed with milk. In many cases it is advisable to withhold milk and give only cream.

Eggs.—These are a valuable form of proteid. They should be fresh, soft-boiled or poached, but never fried. Usually eggs should not be given oftener than every other day, as children readily tire of them.

Meats.—Some form of meat should be given once a day. The best forms are beefsteak, mutton chop, and roast beef or lamb; next to these the white meat of chicken, or fresh fish, which should be boiled or broiled. Beef and mutton should be given rare.

Vegetables.—Potato may be given once a day, preferably baked, with the addition of cream or beef juice rather than butter. Of the green vegetables the best are asparagus tops, spinach, stewed celery, string beans, and fresh peas. One of these vegetables should be given daily—always well cooked and mashed.

Cereals.—Nearly all these may be used—oatmeal, wheaten grits, hominy, rice, farina, and arrowroot. The most important part of the preparation is thorough cooking. If the grains are used, cereals should be

cooked at least three hours, after having been previously soaked several hours. They should always be well salted, and given with milk or cream, but with little or no sugar.

Broths and soups.—The meat broths are preferable to the vegetable broths. Nearly all varieties may be given. Plain broths are not very nutritious, but when thickened with arrowroot or cornstarch, and when cream or milk is added, they are very palatable, and at the same time a valuable addition to the diet. Beef juice may be used as directed for the second year.

Bread and biscuits (*crackers*).—In some form these may be given with nearly every meal, better without butter until the fourth year, as for young children cream is a better form of fat. All varieties of bread may be allowed when stale; also dried bread, zwieback, and oatmeal, Graham, or gluten biscuits.

Desserts.—The only ones that should be allowed up to the sixth year are junket (page 152), plain custard, rice pudding without raisins, and, not oftener than once a week, ice-cream. Of the last three, the quantity given should be very moderate.

Fruits.—An effort should be made to give fruit in some form every day. Oranges, baked apple, and stewed prunes are the most to be depended upon. Raw apples in most cases should not be given. Peaches, pears, and grapes (with seeds removed) may be given when thoroughly ripe and fresh, but only in moderate quantity. Special care should be exercised in the use of fruits in very hot weather, and in cities where they may not always be fresh. Berries are best deferred until children are six or seven years old, and even then should be given very sparingly.

Articles forbidden.—The following articles should not be allowed to children under four years of age, and with few exceptions they may be withheld with advantage up to the seventh year:

Meats.—Ham, sausage, pork in all forms, salt fish, corned beef, dried beef, goose, duck, game, kidney, liver and bacon, meat stews, and dressings from roasted meats.

Vegetables.—Fried vegetables of all varieties, cabbage, carrots, potatoes (except when boiled or roasted), raw, or fried onions, raw celery, radishes, lettuce, cucumbers, tomatoes (raw or cooked), beets, egg-plant, and green corn.

Bread and cake.—All hot bread and rolls; buckwheat and all other griddle cakes; all sweet cakes, particularly those containing dried fruits and those heavily frosted.

Desserts.—All nuts, candies, pies, tarts, and pastry of every description; also all salads, jellies, syrups, and preserves.

Drinks.—Tea, coffee, cocoa, wine, beer, and cider.

Fruits.—All dried, canned, and preserved fruits; bananas; all fruits out of season and stale fruits, particularly in summer.

From the third to the sixth years four meals should usually be given daily and at regular intervals—e. g., 7 and 10.30 A. M.; 1.30 and 6 P. M. The second meal should, in most cases, be smaller than the others.

The following is a sample diet for a child of four years:

First meal.—Half an orange, two tablespoonfuls of some cereal well salted, with two or three tablespoonfuls of cream, a glass of milk, one piece of bread with a little butter.

Second meal.—A glass of milk or cup of broth with bread or two or three biscuits (crackers).

Third meal.—Two tablespoonfuls of finely divided steak or chop, one tablespoonful of baked potato, one tablespoonful of spinach, bread and butter, a cup of junket, water to drink.

Fourth meal.—Milk with bread, or milk toast.

From the list of articles given above, a sufficient variety in the diet can be secured. The only way for the physician to be sure that proper food is given to young children, is to write out for the guidance of the mother or nurse two lists somewhat similar to the above, of articles forbidden and articles allowed. This plan I have followed for several years with the happiest results. It is rarely safe to trust anything to the judgment of the mother.

There are a few simple rules in feeding which should always be followed:

A child must be taught to eat slowly and thoroughly masticate his food. The food must always be very finely divided, for, as a rule, mastication is very imperfect even up to the sixth or seventh year. If the child is fed by the nurse, plenty of time should be taken for the meal. It is almost always the case that the food is given too rapidly. It is unwise continually to urge children to eat when they are disinclined to do so at the regular hours of meals, or when the appetite is habitually poor, and under no circumstances should children be forced to eat. Indigestible articles of food should not be given to tempt the appetite when ordinary simple food is refused, nor should these be allowed because of the notion that "the child must eat something." Food should not be allowed between meals when it is habitually declined at meal-time. If a child refuses to eat, and examination reveals no fault with the food prepared, it should seldom be offered again until the next feeding time. In all cases of temporary indisposition, no matter of what nature, and during periods of excessive heat in summer, the amount of solid food should be reduced and more water given. If milk is the food, it should be diluted.

FEEDING DURING ACUTE ILLNESS.

Infants.—This is an important part of the treatment of every acute disease in childhood, but especially so in infancy. Whether the illness be one of the eruptive fevers, diphtheria, pneumonia, or influenza, all

cases must be fed in about the same way. It is much easier by proper feeding to prevent disturbances of digestion in acute disease, than to allay them when they have been excited. In infancy this complication often turns the scale against the patient. One of the most important conditions which must be taken into consideration is, that in every severe acute illness, especially if it is of a febrile character, the power of digestion is much diminished. One evidence of this is the onset with vomiting; another is the anorexia which accompanies the early stage of nearly all acute diseases, the child often refusing everything in the way of nourishment. We should respect this inclination and make it our guide in the treatment. On the other hand, there is great thirst from existing fever, and water is needed; withholding this will often cause the temperature to rise even higher than before.

In all acute febrile diseases the fundamental principle is, less food and more water. The total amount of food given in the twenty-four hours should be considerably less than in health. For infants the character of the food may generally be the same as in health, but should be given in very much greater dilution. For nursing infants this may be accomplished by making the nursing time shorter—four or five minutes, instead of the customary eight or ten—or a single breast, instead of both, may be given. Nursing children should be given water freely from a spoon or bottle. For those who are artificially fed, the amount of the ordinary food should be reduced by one third, or even one half, and this made up by adding water, at the same time allowing water freely between the feedings. In many cases the food must be not only diluted, but partly digested.

The food should be given at regular intervals, never less than two hours, even if the amount taken at a single time is small; otherwise the interval should be three hours. Regularity should always be adhered to. If food is given oftener than every two hours, vomiting and indigestion almost invariably result. The water allowed between the feedings should be boiled, given frequently, and in liberal quantity. When stimulants are required, they may be mixed with the water given. The foregoing rules apply to the early stage of most of the acute diseases of infancy, and in many cases this plan may be followed throughout.

Forced feeding—gavage.—Not a few cases, however, are seen in which, after a child has been several days sick, in consequence of delirium, stupor, sepsis, or some other serious condition, it may refuse all food or take so little that it is in danger of death from inanition. At this juncture forced feeding or gavage (see page 62) serves a most excellent purpose. Both food and stimulants can thus be introduced at regular intervals with slight disturbance, and lives saved which would otherwise be lost. If gavage is employed, the stomach should be first washed. The intervals of feeding should be made at least one hour longer than is customary in health, and usually predigested foods given.

In Older Children.—The same or similar conditions exist with reference to digestion in acute disease. These patients, however, are not so easily disturbed, and the disturbance of digestion is not so likely to be serious as in the case of infants. Even here the physician should direct the food to be given at regular intervals, usually not oftener than every three hours, but should never—as is so often done—order milk to be given to the child every time it asks for a drink. In most cases, for children under five years old, milk should be somewhat diluted, usually with limewater, and partly peptonized if the child's digestion is feeble. Children who do not take milk readily may be given beef tea, broth, gruel, or kumyss, but rarely ice-cream or jellies so frequently prescribed, as these, if given in any considerable quantity or very often, are likely to disturb the stomach and take away what little desire for food the child may have. Raw eggs are palatable when beaten up with sherry, a little sugar, and cracked ice. Fruits, particularly oranges, grapes, and grape fruit, may be allowed in almost every febrile disease, but never given within two hours of a milk feeding.

The water given may be plain boiled water, but better, in most cases, are some of the carbonated waters, Vichy, Seltzer, or Apollinaris, these being less likely to disturb the stomach.

It is certainly a mistake to force food upon older children in any disease in which their condition is not dangerous. But when there is sepsis, delirium, or coma associated with other dangerous symptoms, gavage may be resorted to with but little more difficulty, and with no less satisfactory results, than in infants.

CHAPTER V.

THE DERANGEMENTS OF NUTRITION.

The derangements of nutrition form a distinct and a very large class in the ailments of infancy, particularly during the first year. The symptoms are sufficiently definite and characteristic for them to be regarded as separate diseases, and to be discussed as such. In adults such symptoms are seldom seen except in connection with organic disease. These cases are often very puzzling, and in a large number of them a diagnosis of some constitutional disease, such as hereditary syphilis, or tuberculosis, or organic disease of the stomach or intestines, is erroneously made. At other times the symptoms resemble those of acute toxæmia. The essential condition in all these cases is the inability of the infant to get from its food what its system needs. It can not digest or assimilate enough to support life. It is unable to replace from its food the daily waste of its tissues. The constructive metabolism is not equal to the

destructive metabolism of the body; the process is, therefore, essentially starvation, which may be rapid or slow, according to circumstances.

The fault in these cases is partly with the digestion, but principally with the food. The problem is, to adapt the food to the digestion of the particular child under consideration. The solution is often very easy at first, but the difficulties multiply rapidly the longer the condition has lasted. It is therefore essential that the true explanation of the symptoms should be recognised at the earliest possible moment. Changes occur so rapidly in very young infants that a mistake in diagnosis and a consequent delay of a few days, may be sufficient to determine a fatal result. The outcome in cases of imperfect nutrition depends almost entirely upon their management. The condition is not one which tends to right itself. Spontaneous improvement or recovery rarely takes place. In order to recognise the condition and anticipate the result, nothing is so important as a close observation of the body-weight. A child whose nutrition is a matter of difficulty should be weighed regularly, in the early months twice a week, and once a week throughout the first year. If this is done, the first symptoms of failing nutrition are unerringly detected. If a child does not gain in weight something is wrong, and a steady loss in weight in an infant is a warning which should never be unheeded; for, unless the conditions are changed, it is practically certain to continue, and generally with increasing rapidity, until the infant's vitality has been reduced to such a point that no means of treatment can restore it. The younger the child, the more rapid the loss, and the longer it has continued, the greater is the danger.

For convenience of description these derangements of nutrition have been divided into three groups, differing, however, rather in degree than in kind.

1. Cases of acute inanition, which are quite rapid, generally lasting from a few days to a few weeks. They are rare except in young infants, being most frequently seen in the first three months.

2. Cases of malnutrition, in which the symptoms are much less severe than in the other groups, although they may be of long duration. While it is most common in the first two years, malnutrition may be seen at any age.

3. Cases of marasmus. This is similar to inanition, but a much slower process, lasting usually for several months. It may be seen in infants of any age.

ACUTE INANITION.

Inanition, or starvation, is a condition depending upon lack of assimilation. It is common in early infancy, when it often simulates serious organic disease. In older children it is not so frequent, and not usually so obscure. In all the acute diseases of the digestive tract many of the symptoms are due to inanition. The cases considered in the present

chapter, however, are those in which there is no such association, or where the digestive symptoms, strictly speaking, are not prominent.

Etiology.—The essential cause of inanition is that the child does not get sufficient food, or that the food taken is not assimilated. It usually develops under one of the following conditions: (1) When a child refuses all food, whether from the breast or the bottle, or can be made to take only so small an amount that it is not enough to support life. The cause of this it is often impossible to discover. I have seen it in a variety of circumstances—once recently in an infant five months old, previously healthy, who was suffering from whooping-cough. This infant utterly refused the breast, and from the spoon would take less than two ounces a day. This continued for four days, at the end of which time its symptoms were quite alarming. Gavage was then begun, and its life, I think, saved by this procedure. (2) When the food given is entirely inadequate, as when an infant is nursing upon a dry breast, or one in which the milk supply is so scanty that the child gets practically nothing. This is most frequent during the first two weeks of life. (See page 118.) I have occasionally seen it later, when an infant was put upon the breast of a wet-nurse whose milk, for some unexplained reason, had suddenly failed. (3) Where the character of the food is improper. Breast-milk may be not only scanty, but of very poor quality. On account of extreme poverty, the infant may be getting only tea, as I have known to be true in several cases before admission to the hospital. In some cases a very young infant may be fed entirely on starchy food. (4) Where the infant at birth has such feeble powers of digestion, beause premature or delicate, that it is unable to digest enough of the food given to maintain life. Sometimes this food is breast-milk, which, though abundant, is of inferior quality and can not be assimilated. Very often it is some proprietary food. (5) When a sudden change of food is made to one so difficult of digestion that the child is unable to assimilate it. This may happen after sudden weaning. In such cases the symptoms of inanition are mingled with those of acute indigestion, but the former usually predominate.

In children over one year old, and sometimes in younger ones also, the symptoms of inanition follow those of some acute disease, such as influenza, malaria, pneumonia, or even otitis. Although they may recover from the acute process, the general vitality is so much lowered that assimilation is not sufficient to replace the waste of the body.

Symptoms.—The mode of development depends upon the antecedent condition. In young infants inanition often follows malnutrition where perhaps there has been nothing noticeable except a gradual loss in weight; and if the weight has not been watched, it may be observed only that the infant has not been doing well. Severe symptoms may come on quite suddenly, and if the nature and the gravity of the condition are not appreciated the case may terminate fatally in two or three days. The

loss in weight is now rapid, amounting often to three or four ounces a day. The temperature is variable: in the newly-born it is often high, but it may be subnormal, or it may be normal. The pulse is always weak and rapid. The extremities are usually cold and the peripheral circulation poor. There is marked general prostration. The skin may be dry, or it may be covered with a clammy perspiration. There is extreme pallor, and in the most severe form there is cyanosis. This may be marked and may last for two or three days, gradually deepening until death occurs, or it may disappear entirely and recovery follow. Cyanosis may be present in children who have previously cried well and in whom there is no suspicion of atelectasis. The respirations are rapid and may be irregular. There may be constant worrying and fretfulness, or a condition of semi-stupor, in which the child makes no sign of wanting food. The fontanel is sunken and the pupils are often contracted. The stools contain undigested food, or if predigested foods are given they seem to pass through the intestines unchanged. The bowels usually move frequently, although in rare cases there may be constipation. When all food is refused for two or three days the stools may resemble meconium, as I once saw in a child six months old. While no desire for food is manifested, infants will sometimes swallow food when it is offered, retaining everything given for several feedings, when the whole quantity is vomited.

The course of the disease depends much upon the age of the infants. Those under one month succumb most quickly. In them the symptoms sometimes last but two or three days, seldom more than a week or ten days, the children simply drooping steadily until death occurs. With proper treatment complete recovery may take place in a week. In older infants the progress, whether upward or downward, is usually less rapid.

Prognosis.—The outcome of these cases is always uncertain. In few conditions is it more so. It is hard for one who is not familiar with the condition to appreciate the great and even the immediate danger in which a young infant may be from inanition, especially in the absence of both vomiting and diarrhœa. It is difficult to estimate the gravity of an individual case except after twenty-four hours' observation. The best of all guides is perhaps the weight. Where the loss is several ounces each day the chances of recovery are small. The presence also of frequent vomiting or of diarrhœa makes the outlook very bad. A high temperature, very marked relaxation, copious perspiration, cold extremities, and cyanosis are all bad symptoms.

Diagnosis.—Inanition is distinguished from malnutrition by its greater severity, and from marasmus by its more acute character. The usual mistake is that of confounding inanition with some local or constitutional disease. It may be mistaken for acute indigestion, meningitis, gastro-enteritis, pneumonia, and for some of the fevers. The temperature when

elevated is especially likely to mislead. This is not often seen except where little or no food is taken or retained.

Treatment.—The existence of inanition in young infants presupposes only the feeblest powers of digestion and assimilation. If possible, a good wet-nurse should be secured, for in most of the cases the time for action is so short that there is no opportunity to experiment with artificial feeding. This is one of the few conditions in which wet-nursing is almost indispensable. If a wet-nurse can not be obtained, a diluted milk like formula XIV (page 176) may be given after being peptonized for two hours. If food is not readily taken, it should be given by gavage. This is frequently necessary, as very many of these infants will not take food at all, or only in such small quantities as to be insufficient for nourishment. If there is vomiting, even greater dilution may be required. If food so prepared is not retained, kumyss, whey, animal broths, and malted foods may be tried in succession. Wherever the symptoms have come on very rapidly, temporary improvement sometimes results from the hypodermic use of a one-per-cent saline solution, two ounces every five or six hours. The amount of food actually taken in the twenty-four hours should be noted, as it is often found to be only one fourth that which is actually needed for the child's nutrition.

The general treatment includes stimulants and the careful regulation of the body temperature. If there is fever, sponging with tepid water, cold to the head and heat to the extremities may be employed. If the temperature is subnormal, the child should be rolled in cotton and surrounded by hot-water bottles, or put into an incubator. Stimulants are required in most cases, the best form being some of the beef peptonoids with wine, given in frequent, small doses. As soon as the child begins to improve, one must be careful about increasing the food too rapidly, for renewed vomiting with an aggravation of all the other symptoms, is almost certain to follow such a mistake.

In older infants the symptoms of inanition may develop when a child who is suddenly taken from the breast absolutely refuses all other forms of nourishment. This may continue for three or four days until the symptoms are quite alarming. For such cases gavage may be employed, and formula XII or XIII (page 176) given, peptonized two hours.

When inanition develops in children over a year old it is usually after an attack of some acute disease. They lie in a dull, apathetic condition, sometimes with subnormal temperature, showing no desire for food. The circulation is poor, the skin dry; there may be small petechiæ upon the abdomen; bedsores form with great rapidity over the heels, sacrum, or occiput. There may be no vomiting, and the stools may appear quite good. Something seems to be needed here to arouse the slumbering cells to activity, and massage, external heat, hot baths, together with careful feeding, temporarily upon predigested foods, are means by which a few

of these cases can be saved; but the majority sink gradually and die of exhaustion, the autopsy showing no sufficient explanation of the symptoms.

MALNUTRITION.

Cases of malnutrition are exceedingly common, and occupy a large part of the time and attention of one engaged in practice among children. Although these children can not be said to be actually ill, they are very far from well, and their condition is often the cause of the greatest solicitude on the part of anxious parents, not only from the existing state of health, but from the apprehension of the development of some serious organic or constitutional disease, especially tuberculosis.

Etiology.—Malnutrition may depend upon inherited conditions. Certain children are delicate from birth, possessing only feeble physical vitality, but without giving evidence of any actual disease. They are often the offspring of parents of delicate constitution, or of those with inherited tuberculosis, gout, syphilis, or alcoholism. Very many city children are included in this group. They are a product of modern life, in whom is seen a too highly developed nervous organization with a corresponding amount of physical deterioration. In another group of cases the children are premature or very small at birth, weighing perhaps only three or four pounds. Many cases are traceable to improper feeding or equally poor nursing during the first few months. These children get a bad start in life, and on that account are handicapped throughout infancy. In many cases malnutrition develops as a result of the patient's surroundings. While this is common among the poor, it is not rare among the better classes. One of the most frequent causes is the pernicious custom of keeping infants in close apartments where the thermometer ranges from 72° to 78° F., and where the greatest anxiety is constantly felt lest the children take cold. Such infants may lose in weight, become anæmic, and exhibit all the signs of malnutrition where nothing else is wrong except the conditions mentioned. In infants, malnutrition often depends upon some previous acute disease, especially of the stomach and intestines, and sometimes of the lungs.

In children who are over two years old the condition of malnutrition may be due to any of the factors above mentioned—inherited feebleness of constitution, bad feeding and its resulting indigestion, too little fresh air, and close confinement indoors. It is, however, at this period much more frequently than in infancy, dependent upon some previous acute disease. This may have been acute broncho-pneumonia, acute ileo-colitis, influenza, malaria, or any of the eruptive fevers. As a result, an impression is left upon the child's constitution which lasts for months, often for years, and which manifests itself not by any special local symptoms, but by a general condition of debility or malnutrition. Sometimes such diseases, instead of being directly the cause of the symptoms, are

the occasion which brings out some latent inherited taint or constitutional weakness in children who up to this time, perhaps, have appeared exceptionally healthy. In other cases malnutrition depends upon faulty methods in education, especially upon overpressure in schools.

Symptoms.—*In infants.*—In weight these children are much below the average, and the weight is stationary or the gain very slow, often only five or six ounces a month at a period when it should be from one to two pounds. In a case recently under treatment, a child at fourteen months weighed but eight and a half pounds. This infant at birth weighed three and a half pounds, but in the course of a few weeks the weight dropped to two pounds. Not only is the weight low in these cases, but the growth of the body in every respect is delayed. At one year, the length is often only four or five inches more than at birth. Dentition is usually but not invariably delayed. I have repeatedly seen children suffering from a very marked degree of malnutrition in whom dentition was normal. In muscular development such children are always very backward, often not sitting alone until they are a year old, making no attempt to stand until the middle of the second year, and not walking alone until the end of the second or the middle of the third year. The muscles are soft and flabby and the ligaments weak.

Anæmia is invariably present, and varies much in degree, being rarely extreme. The circulation is commonly poor, the hands and feet are frequently cold. In many children the skin is unnaturally dry; in others there is a disposition to excessive perspiration, particularly about the head. Nervous symptoms are usually present. These children are restless, fretful, and irritable; they sleep badly during the day, and often worse at night. Enlargement of the lymph glands is common, especially in the neck. The cervical adenitis may have started from a slight catarrhal cold, but the glands continue to swell after this has subsided and may remain enlarged for months.

One of the most characteristic things about these infants is their feeble powers of digestion and assimilation. Unremitting care and constant watchfulness are required to keep them up even to a moderate standard of health. The most trivial changes in food may upset them. Attacks of acute indigestion are usually brought on by overfeeding—the mistake which is almost invariably made by mothers who are discouraged with the slow progress made, and are anxious to make their children grow fat and strong. The balance is so delicately adjusted that the slightest deviation from proper rules of feeding, either as to the quality of the food or quantity given, is immediately followed by an attack of acute indigestion, often by severe diarrhœa. As a result, the child may lose as much in two or three days as it has gained in a month or more. These acute attacks in summer not infrequently prove fatal. Not only do these patients have but little resistance to acute disturbances of the stomach

and intestines, but any acute disease is serious—measles, whooping-cough, and pneumonia being especially fatal.

Among the poor or in institutions, cases of malnutrition like those described, if they are under nine months old, are almost certain to go on from bad to worse until they have reached the condition described as marasmus. Between this and malnutrition no sharp line can be drawn; they are rather different degrees of the same general process. In private practice, where it is possible to have the best care and surroundings, with the co-operation of an intelligent mother or nurse, a very large number of these infants can be reared. After the second year has passed the problem becomes a much simpler one, and if infectious diseases and other forms of acute illness can be avoided, the probabilities are in favour of the child's growing to maturity and becoming stronger each year.

In older children.—In general appearance these children are thin, spare, and very often undersized, particularly if the condition is constitutional or hereditary. In other cases they are taller than the average for their age, and their symptoms are often attributed to too rapid growth. One of the most striking things about children suffering from malnutrition is their vulnerability. They "take" everything. Catarrhal processes in the nose, pharynx, and bronchi are readily excited, and, once begun, tend to run a protracted course. There is but little resistance to any acute infectious disease which the child may contract. One illness often follows another, so that these children are frequently sick for almost an entire season. Their muscular development is poor, they tire readily, are able to take but little exercise, and their circulation is sluggish. Nervous symptoms are usually present. Many of these would be called nervous children. They are cross, fretful, and any unusual excitement produces an effect which lasts for some time; for example, after a children's party or a Christmas tree they may lie awake half the succeeding night, and may be really ill for two or three days. Their sleep is usually disturbed and restless; they waken frequently, and occasionally suffer from night-terrors. At a later age they are favourable subjects for chorea, neuralgia, and all functional nervous disorders.

Digestive symptoms, if not constant, are very easily excited. In fact, they do not suffer so much from chronic indigestion as from a delicate or feeble digestion, which is easily upset by the slightest deviation from the regular routine. Children of five or six years have to be fed as carefully as infants of eighteen months or two years. The appetite is usually poor, and mothers are distressed because their children eat so little, yet, when food is urged upon them, attacks of indigestion follow with singular uniformity. The tongue is slightly coated the greater part of the time. The bowels are apt to be constipated, apparently more from lack of muscular tone than from anything else. From time to time, from slight

causes, such as exposure to cold, or even fatigue, there may be large quantities of mucus in the stools for two or three days at a time, although this is not a prominent feature of most of these cases. When they are not fed with the greatest care these children suffer constantly from indigestion. A moderate amount of anæmia is always present, and in some cases this is one of the most striking features of the disease. In very many children with a marked disturbance of nutrition, there is an excessive elimination of uric acid.

The duration of these cases depends very much upon the cause. If the cause is constitutional or inherited, the condition may last throughout childhood. Where it follows some acute illness it commonly lasts for a few months only; but the effect of an acute attack of broncho-pneumonia or of ileo-colitis may last for years. If the malnutrition is the result only of the child's surroundings, like the confinement incident to city life, very rapid improvement and prompt recovery may follow a removal to the country.

Diagnosis.—The physician should not be too ready to make a diagnosis of simple malnutrition. Before accepting such a diagnosis, he should examine the child with the greatest care, to exclude the common organic and constitutional diseases of children. Much regarding inherited constitutional tendencies can be learned from the family history and from the condition of the other children. In the first place, tuberculosis, syphilis, and rickets should be excluded; then chronic malaria and the diseases of the blood; and, finally, organic diseases of the lungs, heart, stomach, intestines, liver, and kidneys. Even malignant disease, though rare, should not be overlooked. It may take careful observation for several days, and sometimes for weeks, with repeated physical examinations, before all these conditions can positively be excluded.

The next step in the diagnosis is to discover upon which one of the many possible causes, malnutrition depends. In my own experience in private practice the proportion in infancy has been about as follows: sixty per cent due to improper feeding or nursing; twenty per cent to improper surroundings, particularly to hot rooms and want of fresh air; and twenty per cent to inherited constitutional conditions. In other words, most of these children are born healthy, but become ill or delicate in consequence of improper management.

In older children, after excluding constitutional and local diseases, the whole life of the child must be investigated to discover the fundamental condition which is at fault. It is often difficult, and sometimes impossible, to get at this primary factor, for in cases of long standing there may be symptoms connected with almost every function of the body. One should scrutinize closely the quality and quantity of food given, the amount of sleep, the hours of study and recreation, the amount of exercise in the open air, and the psychical conditions sur-

rounding the child. Usually we can decide which is the most important factor in the case.

Prognosis.—An accurate diagnosis carries with it the data for prognosis. If the cause can be discovered, and if it is one which can be removed, the prospects are good for improvement, and usually for complete recovery. The longer the cause has been operative, the more profound will be the general disturbance of nutrition, and the longer the time required for improvement. Cases due to improper feeding or surroundings usually improve immediately when a proper *régime* is instituted, and the worse the previous management of the case has been the more marked is the improvement to be expected. In these cases everything depends upon the fidelity with which the directions given in regard to diet and surroundings can be carried out. The cases which offer the greatest difficulties are those in which the condition of malnutrition depends upon an inherited delicate constitution; although these may improve, they require the closest attention throughout childhood. Without the cooperation of an intelligent and devoted mother, or an experienced nurse, very little progress can be made.

Treatment.—This is a problem of nutrition to be solved by diet and general management, drugs occupying a very small place.

In infants.—In very young infants treatment is chiefly a question of feeding. If possible a wet-nurse should be secured. If this is impossible, artificial feeding should be carried on according to the rules given in the chapter upon the feeding of delicate children and those with feeble digestion. (See page 180.) These children often do fairly well during the first year, but after this time has passed mistakes are most frequently made, on account of the failure to appreciate the fact that, although over twelve months old, these children in point of development resemble healthy infants of four or five months, and are to be managed as such. If possible, weaning should be deferred until the sixteenth or eighteenth month, or at least partial nursing should be continued until that time. When cow's milk is begun it should always be very largely diluted, usually modified as for a healthy infant a month old. (See formula IV, pages 174, 175.) It is surprising to see with what uniformity the giving of cow's milk, pure or slightly diluted, will produce attacks of indigestion in these infants. I have seen a single feeding in which one ounce of milk was given, and that diluted three times, produce a violent attack of acute indigestion which proved well-nigh fatal. Feeding during the entire second year should be carried on very much as in ordinary healthy children from the sixth to the twelfth month. A deviation from this rule almost invariably results disastrously. One must be guided in the amount and character of the food not so much by the child's age as by its digestive capacity, and in most cases this is much feebler than the mother or even the physician supposes. In many of these cases, cow's milk—for them the most

valuable of all foods—has been excluded from the diet, when the only trouble is that it has not been given in sufficient dilution. For some children it must be partially peptonized during periods when digestion is especially feeble.

Next in importance to diet is the question of fresh air. Oxygen is the best of all tonics for these children. Often they will not improve with any variation in diet until fresh air is allowed. Then increased digestive power is seen in the course of a few weeks, sometimes in a few days. The natural tendency of a mother who has a delicate infant, or one suffering from malnutrition, is to house it closely and never allow it a breath of fresh air. Even in winter this may be obtained by changing apartments, or by airing in the room with the windows open. In the beginning this should be done for a few minutes only, the time being gradually increased to two or three hours each day. The child should be clothed as for the street, and, if necessary, hot bottles should be placed at the feet. Experiments which I have lately made in the hospital with these delicate infants, have proved conclusively the value and safety of this plan.

Cold sponging is another valuable tonic. After the morning bath is given, at 90° F., the entire body should be sponged for a moment with water at a temperature of 60°, or even 55° F. This produces a certain amount of shock and causes loud crying, which is of itself beneficial. How frequently this should be used will depend upon the reaction following it. If the child remains blue and cold for some time afterward, the cold sponging should not be repeated. If there is a good reaction and improved colour, it may be used daily.

Friction and massage are useful in many cases. The child should be laid upon the lap of the nurse, if possible before an open fire, and should always be covered with a blanket. The entire body may now be rubbed for ten or twenty minutes with the bare hand, or, better, with cocoa butter. Simple rubbing may be used, or the usual movements of massage employed. If the latter, they should be very gentle at first, and only for a short time. Professional operators are inclined to be too energetic for little children. There is no advantage in rubbing with cod-liver oil instead of cocoa butter, while the odour makes it decidedly objectionable.

The only tonics I have found of much value are alcohol, nux vomica, and cod-liver oil. Alcohol may be given in the form of port or sherry wine. Nux vomica may be given alone or with the wine. Cod-liver oil is too much used in these cases, and in too large doses. Many of these infants can not take it at all. It should rarely be given when the tongue is coated and the appetite very poor. The dose should always be small—e. g., ten drops of the pure oil three times a day, or twice as much of an emulsion. In these doses it may be given for a long time without disturbance.

The secret of success in treating cases of malnutrition is, to hold the

patient to a regular routine in feeding, sleep, and in everything relating to his life. Experiments are nearly always unfortunate. The physician should lay down in writing for the guidance of the mother, specific rules with regard to the amount of food, the time at which it is to be given, the hours of bathing, sleep, and airing, and should insist upon their rigid enforcement. Good results are obtained only by constant watchfulness, and although they may not be seen at once, they are in most cases sure to come if the mother will co-operate. In my own experience no class of patients have given me so much satisfaction as cases of malnutrition in infancy.

In older children.—The same general principles are to be applied to them as to infants. The diet is of the first importance. Only the simplest, plainest, and most easily digested articles of food should be given. Milk, beef, eggs, bread, and fruit should form the staple diet. All sweets, pastry, highly seasoned food, candy, nuts, tea, and coffee should be absolutely prohibited, and, in fact, none of the articles mentioned as "forbidden" on page 189 should under any circumstances be permitted. When the appetite is poor and simple food not well taken, the child should not be allowed to take indigestible articles for the sake of eating something. Nothing should be given between meals, and regular hours of feeding must be followed. Usually I have found three meals a day, for children over three years old, better than the practice of giving more frequent feedings. But this is not always the case. Under no circumstances should children be coaxed, urged, or hired to eat; much less should they be forced to do so. There is a popular misapprehension in regard to the variety in diet which children need. Most cases do better when a very simple and fairly uniform diet is continued.

The general habits of children should be directed; there should be regular and early hours for retiring, freedom from undue excitement, and interest should be awakened in out-of-door amusements. Children should be kept as much as possible in the open air; usually they do much better if they can be in the country during the entire year. Only a limited amount of reading and study should be allowed; and if children are at school, care should be taken that overpressure is not the cause of the symptoms, particularly in an ambitious child. The cold sponging given in the morning, as described on page 55, is extremely beneficial to children who are prone to take cold readily. Massage is useful for the benefit which it affords to the chronic constipation which is so frequently a symptom of malnutrition.

Of the tonics, iron, arsenic, and cod-liver oil are required in most cases, and the amount and combination may be varied from time to time, with the season of the year and the condition of the child's digestion.

MARASMUS.

Synonyms: Athrepsia, infantile atrophy, simple wasting.

Wasting is a symptom of many conditions in infancy. It occurs in tuberculosis, in infantile syphilis, and also as a result of acute or chronic disease of the stomach and intestines. Cases of wasting dependent upon such causes are not included in this chapter.

Marasmus is the extreme form of malnutrition seen in infancy, occurring, so far as is now known, without constitutional or local organic disease. It is a vice of nutrition only.

Etiology.—Marasmus is not often seen in the country or in private practice. It is frequent in dispensary practice in all large cities, and is especially common in institutions for young infants. In my own experience in four hospitals for infants, more than one half the deaths were directly or indirectly from this cause. Marasmus is a very large factor in the immense infant mortality of large cities in summer. Although the cause of death is usually reported under some other name, the determining factor in the fatal result is the previous marantic condition of the patient. The primary cause may be an inherent weakness of constitution which may depend upon heredity. It is often seen in premature children and in the illegitimate offspring of girls of sixteen or eighteen. In the vast majority of cases, however, it depends upon two factors—the food and the surroundings. Among the poor who live in tenements, infants who are artificially fed almost invariably do badly. This is due to ignorance in regard to the proper methods of infant-feeding and inability to procure what the child requires, especially pure cow's milk. A country infant may be neglected in many respects, and is often badly fed; but it has plenty of pure air, and usually thrives. In the city, as long as an infant has a plentiful supply of good breast-milk it continues to do well in most instances, in spite of the fact that its surroundings are bad. When there are not only bad feeding and unhealthful surroundings, but also an inherited constitutional vice, we have all the factors required to produce marasmus in its most marked form. The odds are so against the infant that its feeble spark of vitality flickers for a few months only and gradually goes out.

Another prominent factor in the production of marasmus is the overcrowding of infants in institutions. Even though artificially fed after the most approved methods, I have seen scores of infants who were plump and healthy on admission lose little by little, until at the end of three or four months they had become wasted to skeletons—hopeless cases of marasmus, dying of some mild acute illness, such as an attack of indigestion or bronchitis, the essential cause, however, being marasmus. The common mistake is that of placing too many children in one ward, with

no chance of obtaining a proper amount of fresh air. No house-plant is more delicate or sensitive to its surroundings than an infant during the first few months of life.

Lesions.—The post-mortem findings in cases of marasmus are exceedingly unsatisfactory, and throw little if any light upon the disease. Every now and then general tuberculosis is discovered in patients dying apparently of marasmus, the existence of which was not previously suspected. In perhaps one third of the marked cases there is found a fatty liver. The organ is enlarged, often sufficiently so to be made out during life; its weight may exceed the normal by one half, or it may be doubled in size. Both to the naked eye and under the microscope, it presents the usual changes of fatty degeneration, often to an extreme degree. The significance of this lesion I do not know. It is to be compared with the similar condition seen in tuberculosis and other chronic wasting diseases. It may be looked upon either as a cause or a result of the pathological process.

With these exceptions the autopsies show nothing of importance, and I have had opportunity to make at least two hundred of them. The lesions usually found are the following: The brain is commonly anæmic, with dark fluid blood in the sinuses, marantic thrombi being rare. A strip of hypostatic pneumonia, from one to two inches wide, is seen along the posterior border of both lungs, involving the lung to the depth of half an inch, or less. In the younger infants there are frequently areas of atelectasis in the lower lobes. The pleura is almost invariably normal. The heart is pale, with perhaps a slight increase in the pericardial fluid. The spleen and kidneys are pale, but otherwise normal. The stomach may be dilated; the mucous membrane is usually pale, often coated with tenacious mucus. The intestines contain undigested food, sometimes mucus. The solitary follicles of the colon and small intestine, and sometimes Peyer's patches, are slightly enlarged, the mucous membrane in other respects being normal. The mesenteric glands are often slightly enlarged. In addition to the above, there may be evidence of some recent disease from which the patient has died—acute bronchitis, bronchopneumonia, or a slight intestinal catarrh.

The above lesions represent what has been found in the great majority of the cases, and very disappointing they are to one who sees them for the first time. Nor does the microscopical examination of the organs throw any light upon these cases. I have personally examined with care the stomach and intestines of more than a dozen cases, several of them in which autopsies were made only two or three hours after death, without finding anything of pathological importance. The theory advanced by certain German writers, that atrophy of the intestinal tubules is the explanation of marasmus, has found no support in my observations.

The true pathology of marasmus seems to me to be a failure of assimilation from imperfect digestion, due to improper food, unhygienic sur-

roundings, or feeble constitution. As a result, there is a progressive loss in weight, feeble circulation, imperfect lung expansion, imperfect oxidation of the blood, lowered body temperature, and, finally, a deterioration of the blood itself. Each of these effects becomes in turn a cause aggravating all the others, continuing until a condition is reached which is

FIG. 31.—Marasmus: a patient in the Babies' Hospital, ten months old, weight six pounds. Weight at birth reported to have been nine pounds.

incompatible with life, for resistance becomes so feeble that the slightest functional disturbance proves fatal.

Symptoms.—The general history of these cases is strikingly uniform. The following is the story most frequently told at the hospital: "At birth the baby was plump and well nourished, and continued to thrive for a month or six weeks while the mother was nursing it; at the end of that period, circumstances made weaning necessary. From that time the child

ceased to thrive. It began to lose weight and strength, at first slowly, then rapidly, in spite of the fact that every known form of infant-food has been tried." As a last resort the child, wasted to a skeleton, is brought to the hospital.

The most constant symptom is a steady loss in weight. The general appearance of these patients is characteristic. They have an old look; the skin is wrinkled, has lost its tone, and hangs in folds upon the extremities (Fig. 31). The legs are like drumsticks; the abdomen is prominent; the temples are hollow; the eyes large; the features sharp; and the hands resemble bird-claws. Often the children are reduced literally to skin and bone. Anæmia is a very marked and almost a constant symptom, the amount of hæmoglobin being frequently reduced to 30 per cent., and in one case of mine to 18 per cent. Anæmic heart-murmurs are frequently heard. The body temperature is usually subnormal, unless artificial heat is used. A rectal temperature of 96° or 97° F. is very common, and one of 94° or 95° F. is occasionally seen. In addition to the pallor of the face, there may be a leaden hue due to congenital or acquired atelectasis. An occasional symptom is general œdema, depending upon the condition of the blood or blood-vessels. The first thing which calls attention to this is often an unexpected gain in weight. The œdema may increase until the cellular tissue of the whole body is affected. I have never, however, seen effusions into the large cavities. Œdema is usually associated with marked anæmia, and is generally a very bad symptom. The stools are sometimes normal, but usually contain undigested food, and are large in proportion to the amount of food taken. No matter how carefully fed, these patients are easily upset. Now and then mucus is seen in the discharges, but this is not a constant or a marked feature. Vomiting is excited from the slightest cause, and often food is regurgitated almost as soon as swallowed. The appetite, in a severe case, is almost entirely lost; children refuse to take food from the bottle or spoon, and unless fed by gavage they die of inanition. In the earlier cases there may be an unnatural hunger, so that the children cry much of the time, and are relieved only when the bottle is given.

The complications are thrush, erythema of the buttocks, and bed-sores, sometimes over the sacrum and heels, but most frequently upon the occiput. Occasionally there is seen a reflex spasm of the muscles of the neck, producing a marked opisthotonus, which may last for several days or weeks.

The course of the disease in most cases is steadily downward. It may be cut short at any time by acute disease. Frequently these infants die suddenly when they have apparently been as well as for several weeks. In many instances the autopsy reveals no explanation of this sudden death; but in other cases it is due to the regurgitation of food, and its aspiration into the larynx, the patient being too weak to cough. Rarely, death occurs

from convulsions. In summer, these children wilt with the first days of very hot weather, and die often in a few hours from a slight functional derangement of the stomach and bowels.

Diagnosis.—No sharp line can be drawn between marasmus and malnutrition. In the wasting which follows chronic disease of the stomach and intestines there is usually a history of an antecedent acute attack. The chief difficulty in the diagnosis of marasmus is to exclude tuberculosis. In some cases a differential diagnosis is impossible during life. Not infrequently tuberculosis is found at autopsy, even in infants of a few months, in whom there have been no symptoms except those of marasmus. Even when the signs in the lungs are present, if situated posteriorly, they may be due either to tuberculosis or to the hypostatic pneumonia which is present. Signs in front are more significant; and consolidation anteriorly makes tuberculosis almost certain. In simple wasting there is often a history that the child was in splendid condition at birth, and continued so until it was weaned, from which date it has gone down steadily. In tuberculosis no such definite cause may be present; the children are often very delicate from birth. Simple wasting is so much more common that the chances are always in its favour.

Prognosis.—This depends on the age of the infant and the extent and duration of the disease. If the child is over eight months old, the chances of recovery are much better than in one under four months, for the fact that it has lived so long is generally evidence of pretty strong vitality. Very young infants are always difficult subjects to deal with. They go down more rapidly, and build up more slowly than those who are older. In most other circumstances the prognosis is much worse in cases of long duration. In a given case much depends upon whether everything possible can be done for the child—whether a wet-nurse can be secured or artificial feeding done in the best manner, and whether the patient can have the benefit of the best surroundings, in the country in summer and a warm climate in winter where it can be kept out of doors the greater part of the time. In institutions cases under four months old are usually hopeless. Of those over eight months quite a proportion can be saved by proper treatment, even though the body-weight is reduced to eight or nine pounds. When recovery occurs it may be complete, and the child at three years may be as vigorous as any child of its age. All these statements refer only to cases of simple marasmus. The presence of organic disease puts the case in another category.

Treatment.—The most important is that which relates to prophylaxis. This, for large cities, may be summed up in a single sentence: giving the poor the opportunity to obtain pure cow's milk and teaching them how to feed it to young infants, and at the same time giving ample opportunities for obtaining fresh air. In institutions the most important thing is to give adequate air-space for each child. Often only four or five hundred

cubic feet are allowed, when at least eight hundred are necessary, even with the best ventilation. Children should be changed from one apartment to another and opportunities given for thorough airing, and there should be perfect ventilation, not only in the daytime but at night.

As far as possible, wet-nurses should be obtained if the infants are under four months old. For these very young patients success by artificial feeding is not often possible. With those of six months and over, good artificial feeding is very frequently successful. In modifying cow's milk for these cases the formulæ most likely to agree are those with low fat, low proteids—partly peptonized in many cases—and relatively high sugar. Such are obtained by formulæ XV, XVI, and XVII, page 176. Starting with the lower percentages, they may be gradually increased to the highest; then the fat may be increased to that in formula XIII. Further suggestions will be found in the chapter on Feeding in Difficult Cases (page 180). In institutions we are not likely to succeed very often without wet-nurses.

For very young infants, with a temperature which is habitually subnormal, the incubator should be used. If this is impossible, children should be rubbed with oil, rolled in cotton, and surrounded with hot-water bags or bottles. The general management should be much the same as described in the chapter on Malnutrition. At least once every day—by means of spanking, mild flagellation, or, better, by the alternate use of the hot and cold baths—children should be made to cry vigorously, in order to keep the lungs expanded. They require no drugs, but a great deal of careful nursing.

CHAPTER VI.

DISEASES DUE TO FAULTY NUTRITION.

The diseases due to faulty nutrition are really numerous. There are, however, two which have been so clearly shown to originate in this way that they may be singled out and put in a class by themselves. These are scorbutus and rickets. The prevailing opinion of the medical profession is that both of these are essentially "food-diseases." The purpose of considering them in connection with the disturbances of nutrition is to emphasize this relationship.

SCORBUTUS (SCURVY).

Scorbutus is a constitutional disease, due to some prolonged error in diet. It is characterized by spongy, bleeding gums, swellings and ecchymoses about the joints, especially the knee and ankle, hæmorrhages from the nose, and occasionally from other mucous membranes, extreme hyper-

æsthesia, and often pseudo-paralysis of the lower extremities. Added to these local symptoms there is usually a general cachexia with marked anæmia. While scorbutus and rickets are very frequently associated, they are not necessarily connected, and can hardly be considered as different forms of the same disease; although cases of scorbutus have been described in older writings under the title of Acute Rickets. The course of the disease is somewhat chronic, lasting for weeks or months; and while it usually yields immediately to proper treatment, if unrecognised and if the original error in diet is continued, it not infrequently proves fatal. It is only within the last twelve or fourteen years that infantile scurvy has found a distinct place in medical literature. For our present understanding of the disease, the profession is indebted chiefly to the work of the English physicians Cheadle, Gee, and Barlow, especially the last named, who in 1883 made a full report upon thirty-one cases of scorbutus in infants and young children, in which publication the etiological factors and clinical history were worked out so fully that but little has since been added to the subject. In Germany it still passes to-day under the title of Barlow's Disease. To Northrup is due the credit of bringing the subject prominently before the minds of the profession of this country.*

Etiology.—Scorbutus is not uncommon in infancy, but it is frequently unrecognised. During the past two years twelve cases have come under my own observation. All of these were under two years of age, as were also all of Cheadle's twenty cases and twenty-five of Barlow's original thirty-one. The great majority of cases occur between the eighth and twentieth months. There is no preference for sex or season. Since the essential cause of scorbutus is dietetic, it may be found in all surroundings. Of the reported cases, the majority have occurred in private practice and among the better classes of society, in the country quite as often as in the city. The previous diet of most of the patients who develop scurvy has been either some of the proprietary foods or condensed milk, or a combination of the two. Scurvy may be induced by the giving of proprietary foods, even when a small amount of cow's milk has been added. In one reported case (Delafield's), scurvy was produced in a child three years old by an exclusive diet of rare meat, continued for three months.

Since the introduction of the practice of heating milk used in infant-feeding, the question has been raised in many quarters whether this may not be a cause of scurvy. I have carefully investigated this question in the records of three institutions in which for five years "sterilized" milk was the standard food for all artificially-fed infants. The number of children under eighteen months who have had this diet is nearly one

* See paper by Northrup and Crandall, New York Medical Journal, May 26, 1894, in which will be found thirty-six tabulated cases.

thousand. During this period but two cases of scurvy were observed, and in neither case had the child been upon a diet of "sterilized" milk. However, I have recently seen in private practice two cases of scurvy in which the cause seemed to be prolonged sterilization at a high temperature —i. e., 212° F. for over an hour. In some of the cases in which the "sterilized" milk is supposed to have been the cause of scurvy, it is undoubtedly the milk-formula employed which was at fault, and not the process of heating. In two patients under personal observation, who developed scurvy while taking "sterilized" milk and a proprietary food, the food was discontinued and the patient recovered, although heating the milk was continued. In four cases observed by Winters no other treatment was employed than the substitution of "sterilized" milk for the previous diet, which in three instances had been proprietary foods. All the patients promptly recovered. In these cases the milk was heated to 212° F.

Scurvy in nursing infants is very rare. In one of Northrup's cases, a fatal one, the foundling was wet-nursed by a woman whose own child thrived. The presumption here was that the scurvy was induced by insufficient food. Southgate* has reported a fairly typical case of scurvy in an infant of fifteen months, who had been nursed exclusively up to that time. The child was rachitic and quite markedly cachectic, but recovered immediately when weaned and placed upon a diet of cow's milk, orange-juice, potato, etc. The probabilities are that in this case the scurvy was due to the poor quality of the breast-milk, coupled with the bad surroundings of the child.

From all the above evidence it would appear that scurvy may be induced by the continued use of any food which either lacks some elements needed for the child's nutrition, or which furnishes them in such a form that the child can not assimilate them. Clinical experience is overwhelming in support of the view that it is the proprietary infant-foods which are most certain to produce scurvy, especially when they form the exclusive diet.

Symptoms.—The following cases illustrate the chief clinical types of the disease:

The most serious form with fatal termination.—A case of extreme marasmus came under observation in the Babies' Hospital, in 1892, in an infant who for two months had been upon an exclusive diet of a well-known proprietary food. At the end of that time there was observed a swelling about the left knee, which slowly increased in size, and was accompanied by an extreme degree of tenderness about the joint. The swelling was diffuse, spindle-shaped, and accompanied by a purplish discoloration of the skin. A little later the gums became spongy and bled easily at the margin of the teeth. In places where the next teeth were

* Archives of Pædiatrics, vol. xi, p. 505.

expected, the gum was purple and swollen, evidently from submucous ecchymoses. There were very marked cachexia and anæmia. The swelling extended up to the middle of the thigh, and gradually increased in size until the limb was fully four inches in diameter. An aspirating needle was introduced, but only blood was found. The child wasted steadily, and died of exhaustion two months after the appearance of the first symptoms. During the last few weeks slight fever was present.

The autopsy in this case showed the typical lesions of scorbutus. The periosteum of the femur was stripped from the bone throughout the lower two thirds of its extent by subperiosteal hæmorrhage. There were also extravasations of blood between the muscles and into the subcutaneous tissue, and to these hæmorrhages the swelling was mainly due. There was complete separation of the lower epiphysis from the shaft. No other bones were affected.

In most of the cases, however, that have come to autopsy other bones also have been involved with lesions of a similar character; the other long bones most frequently affected are the tibia and humerus; of the flat bones, the scapulæ and cranium. Epiphyseal separation may take place near any of the large joints, hæmorrhages may be found between the muscles, in the subcutaneous tissue, and occasionally in the lungs, spleen, and kidney. The lesion in the mouth is a hæmorrhagic gingivitis.

A typical case of the severe form, ending in recovery.—The patient was a boy fourteen months old, of healthy parents and good surroundings, living in a country town near New York. At birth it was said he weighed fourteen pounds. The mother being unable to nurse him, he had been fed exclusively upon condensed milk and proprietary foods. He had never thriven, but the symptoms of malnutrition and anæmia had been the only ones present until four months before coming under observation. The evolution of the symptoms in this case is interesting because it is so typical. There was first noticed tenderness about the ankles, then about the knees, this being so acute that the child screamed whenever the legs were handled, but at other times he gave no evidence of pain. A little later, boggy swellings were discovered about one knee and both ankles. Soon after this the gums were noticed to bleed frequently, and at times they were so much swollen as to conceal the teeth. All these symptoms had continued up to the time the child was brought for treatment. He had been growing gradually worse, each day becoming more anæmic and cachectic. Several attacks of epistaxis had occurred, and once there had been hæmorrhage from the ear. In one of the best general hospitals of New York the diagnosis of ostitis of the knee had been made, and a plaster-of-Paris splint applied.

On examination, the child presented the signs of rickets of moderate severity. There were irregular swellings about the left knee and ankle, but no discoloration of the skin. Slight swelling was seen also upon the

lower part of the right leg. The limbs were exquisitely tender, the slightest movement causing the child to scream with pain. It was several months since voluntary movement had been seen, and the legs now lay absolutely motionless, apparently owing to the pain which any attempt at motion excited. The gums were like those in the preceding case, but the condition was more marked, and ulceration was seen along the incisor teeth.

Under treatment exclusively dietetic, the symptoms, which had been unchanged for three months, were wonderfully improved in three days; and at the end of two weeks the child was kicking his legs about, the swelling and tenderness were gone, the gums entirely well, and the general condition greatly improved. The case went on to a rapid and complete recovery.

The mildest type seen without either swellings or mouth-symptoms.— These cases are not often recognised as scurvy, but they are probably the most common form. This child was seen in the country, in private practice. It was an exceedingly healthy infant in appearance, nine months old; the diet from birth had been milk "sterilized" at 170°, with the addition of a well-known infant-food. At the time of his attack he was apparently in the best of health, with bright red cheeks. He was first noticed to cry out sharply as if in pain when lifted in a certain way. It soon became evident that the trouble was located about the left knee. Nothing could be discovered upon examination except a very great amount of tenderness. This symptom continued for six weeks; on some days the tenderness was extremely acute, and on others scarcely noticeable. After three weeks a slight ecchymosis was discovered over the head of the tibia of the affected limb. About this time tenderness and a disinclination to move the right shoulder were noticed, and soon an ecchymosis like a small bruise was seen in front of the shoulder joint. The diet at this time was a liberal amount of milk, a small quantity of the infant-food daily, with beef juice. The ecchymoses about the knee and shoulder, with tenderness, pain, and disability, sufficed for a diagnosis of scurvy, in spite of the fact that the gums were normal, although two teeth were through, and that no swelling existed about the joints. The proprietary food was now discontinued, the amount of beef juice increased, and in three days the symptoms entirely disappeared. No change in heating the milk was made.

I have seen several other cases presenting symptoms in all respects identical with the above, but lacking even the ecchymoses about the joints, which were immediately relieved by dietetic treatment after having lasted from two to six weeks. In none of these cases were the gums affected, but in one there was quite a marked cachexia. There is no doubt in my mind that all these were cases of genuine scurvy of a mild type, and if allowed to go on would have developed the other usual symptoms.

In older children, scurvy is occasionally seen with causes and symptoms more like the adult type of the disease. The symptoms referred to

the lower extremities are not so marked. There are swelling and sponginess of the gums with frequent hæmorrhages; the teeth may loosen and fall out; there may even be some sloughing of the gums; the breath is intensely fetid; and hæmorrhages may take place from the kidneys, the bladder, or the stomach. There is a very marked general cachexia, extreme languor, and often syncopal attacks. These cases are usually due to a diet deficient in fresh vegetables, and are most frequent among the very poor.

Diagnosis.—The diagnosis of scorbutus is usually an easy one, as the great majority of cases are fairly typical. The symptoms to be relied upon for diagnosis are:

1. Hyperæsthesia, especially about the knees and legs, which is often very acute. It may be the first symptom noticed. The pain is increased by any motion or pressure, but otherwise does not seem to be present.

2. There is disability or disinclination to move the limbs—usually the legs—which may be so great as to lead to the suspicion of paralysis. This disability is usually due to pain, sometimes to epiphyseal separation. It is similar to the pseudo-paralysis of hereditary syphilis depending upon osteo-chondritis.

3. The mouth is the seat of hæmorrhagic gingivitis. The gums are swollen, bleed easily, and at times cover the teeth. There is ulceration about the teeth which have appeared, and partial discoloration of the mucous membrane over the teeth soon to appear.

4. There are swelling and ecchymoses about the large joints, especially about the knee and ankle. The ecchymoses may be seen in any part of the body.

5. There may be hæmorrhages from the mouth, nose, stomach, bowels, and occasionally from the kidneys. In rare instances hæmorrhage has occurred into the orbit, producing exophthalmus.

6. There are a general cachexia and marked anæmia with flabby muscles, and often the signs of rickets.

7. There is a history of bad feeding, usually of the continued use of some proprietary food.

8. The symptoms are immediately improved and in most instances rapidly cured, by antiscorbutic diet without other treatment. This is perhaps the most diagnostic of all the symptoms.

Scorbutus in infancy is usually mistaken for rheumatism or paralysis; less frequently for rickets, ostitis, and purpura. By close attention to the symptoms above mentioned it is almost impossible to make a mistake in diagnosis.

Prognosis.—This is invariably good if the disease is recognised early. Scarcely any other cases improve with such marvellous rapidity as do these when the proper dietetic changes are made. Complete recovery can usually be predicted in two or three weeks. Death is not an uncommon

termination in cases which have been unrecognised. Of Barlow's thirty-one cases seven were fatal. I have seen but one fatal case.

Treatment.—This is remarkably simple: to discontinue all proprietary foods and condensed milk, and give an abundance of fresh cow's milk, beef juice, orange juice or other fresh fruit, and, in cases that are over a year old, potato. In addition, iron and cod-liver oil may be required later, but the essential thing is the change in diet.

The tenderness requires that the child shall be kept as quiet as possible, and its cachexia that it be protected against cold and exposure.

RICKETS (RACHITIS).

Rickets is a chronic disease of nutrition. While the only important anatomical changes are found in the bones, it is not to be regarded as a bone disease; but as a very complex pathological process which affects the bones, muscles, ligaments, mucous membranes, and nearly all the organs of the body, particularly those of the nervous system. It occurs especially between the ages of six months and two years. It is not common in the country, but is exceedingly frequent in most large cities. While not a fatal disease *per se*, rickets adds very greatly to the danger from all acute diseases in infancy, and even to some degree also to those of later life. Under proper conditions of diet and hygiene it tends to spontaneous recovery.

Etiology.—The essential cause of rickets is dietetic, although hygienic influences play a very important rôle in its production. While it seems to be demonstrated that diet alone may produce rickets, nevertheless this condition is much more easily produced when there are also unfavourable hygienic surroundings. Rickets is not common in nursing children unless lactation be unduly prolonged,* as, for example, where nursing is continued for fifteen to eighteen months without other food. Artificially-fed children are much more prone to the disease, especially those who are badly fed. The diet in these cases is usually very deficient in fat, and often at the same time in proteids, while it contains an excess of carbohydrates. It is somewhat difficult to separate the effects which these different conditions produce. It appears, however, that the most important factor is a great deficiency in fat. Rickets is exceedingly common in children reared upon the proprietary foods, nearly all of which are very low in fat and contain an excess of carbohydrates. It is also common in children who are reared upon sweetened condensed milk, and for precisely the same reason. When both fat and proteids are low, rickets is more liable to result than when only the fat is deficient.

* An exception to this statement must be made in the case of Italian children. In this class as observed in New York it is very common to see marked rickets in those getting nothing but the breast.

Hygienic surroundings are next in importance to diet. Although, as previously stated, rickets is essentially a disease of cities, being principally seen in children living in crowded tenements where the effects of improper food are most strikingly shown, yet even here the disease is rare in those who get a plentiful supply of good breast milk.

Animal experiments.—Bland-Sutton experimented, in the Zoölogical Gardens, London, upon lion whelps. Those which were weaned early and fed solely upon raw meat invariably became extremely rachitic. Two young cubs, fed upon rice, biscuits, and raw meat, died from rickets. Two young monkeys, upon an exclusively vegetable diet, became rachitic. To the young lions who had developed rickets, milk, cod-liver oil, and pounded bones were given in addition to the meat, and in three months, although the hygienic condition of the animals remained unchanged, all signs of rickets had disappeared. Guerin produced typical rickets in puppies which were kept upon a meat diet for four or five months, while others of the same litter, which were suckled, remained in good health. Other animal experiments by various observers with different articles of food have given results that were not uniform. It seems, however, to be pretty positively established, that withholding milk from young animals and putting them upon a diet of meat, vegetables, or starches is sufficient to produce rickets, and that the earlier this is done the more certain is the result. This may occur apart from any change in the hygienic surroundings. These animal experiments strengthen the opinion above given, that the essential cause of rickets is improper food, and that the element most uniformly lacking is fat.

Distribution of rickets.—According to Palm, the disease is almost unknown in the extreme north—Greenland, Iceland, Norway, and Denmark. It is also very rare in China, Japan, Greece, Turkey, and the southern portions of Italy and Spain. Its greatest frequency is in the temperate zone. The general immunity of children in southern climates appears to be due to the out-of-door life, and the almost universal custom of maternal nursing. In the cities of America no race is exempt from the disease. In New York the greatest susceptibility is among the Negroes and the Italians. Extreme cases of rickets are almost invariably in one of these nationalities. It is exceptional to see in a dispensary or hospital a child of either of these races who does not show, to a greater or less degree, the signs of rickets. These two southern races seem to bear very badly the climate and the confined life of the northern cities. So far as my observations are concerned, there is no peculiarity in the food of these people which explains the prevalence of rickets among them, and this must be attributed to a race peculiarity. In the country, the immunity from rickets is due partly to the more prevalent custom of maternal nursing, and partly to the better surroundings; the increased resistance of the children rendering them much less susceptible to the influences of bad

feeding than those of the cities. In New York among dispensary and hospital patients, rickets is exceedingly common, and is seen in all nationalities, although chiefly in the foreign elements of the population.

Heredity.—There is no evidence that rickets is a hereditary disease. Any cachexia in the parents, such as syphilis, tuberculosis, or alcoholism, may, however, by diminishing the child's resistance, be a predisposing cause of rickets. The later children in a family are more likely to be affected than the earlier ones, especially when the intervals between the pregnancies has been short, or where anything else has caused a deterioration in the general health of the mother.

Previous disease.—Rickets not infrequently develops in syphilitic children; the connection, however, seems to be no closer than to any other cachexia. The relation of rickets to other diseases, particularly with those of the digestive tract, is very much less intimate than one would expect. Acute diseases of the stomach and intestines are very frequently followed by marasmus, but only exceptionally by marked rickets. There is no sufficient ground for believing that rickets exerts any protective influence against tuberculosis, as has been asserted. In fact the thoracic deformity of rickets may be a predisposing cause to tuberculosis.

Rickets affects both sexes with equal frequency. The symptoms usually manifest themselves between the sixth and fifteenth months. Congenital and late rickets will be considered separately.

Rickets is therefore a complex disease of nutrition, whose exact pathology has not yet been definitely settled. It is more difficult to believe that the general nutritive disturbances are the result of the bone changes, than to regard both as having a common origin. Kassowitz regards the bone changes as inflammatory, excited by the presence of some irritant. The irritant has been believed by many to be lactic acid, originating in the digestive tract; but the evidence in support of this theory is not conclusive. It is very doubtful whether the process is as simple as the formation of lactic acid in the intestine and its circulation in the blood. It is, however, clear that it is something which interferes with the assimilation of the lime salts. At the present time, the disposition is to regard rickets as a disease of nutrition, which may be produced in animals by certain dietetic changes. In infants, it seems to be settled that it may be produced by similar changes in diet, aided very greatly, however, by unhygienic surroundings. The effect of these abnormal conditions is shown upon the whole organism, but the only constant and regular anatomical changes are in the bones. These osseous lesions resemble those of chronic inflammation. Precisely how the dietetic and other causes produce the bone changes is still a matter of speculation. The constancy of bone changes in rickets give it a place as an essential disease, and not merely a form of malnutrition.

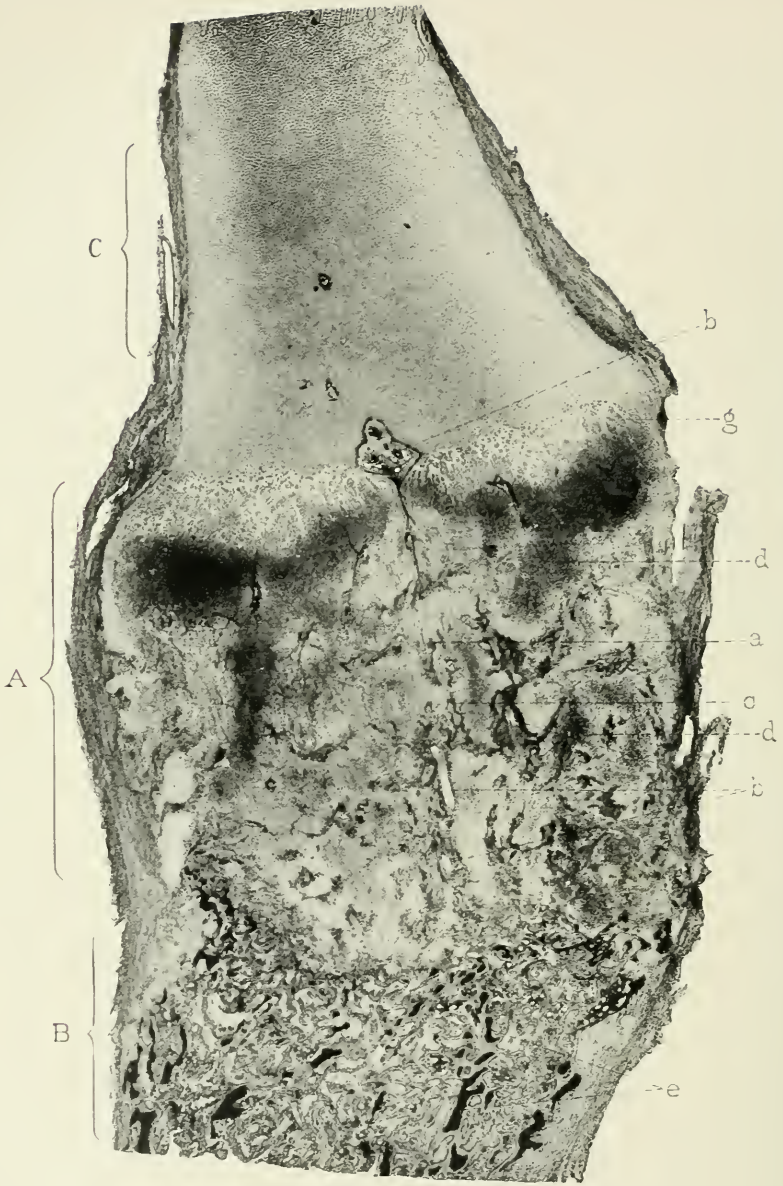
Lesions.—The only constant and characteristic lesions of rickets are found in the bones. It is still a matter of dispute whether these bony changes are to be considered as inflammatory, or simply as the result of disordered nutrition. Perverted nutrition and chronic inflammation are closely allied, and it really makes but little difference which view is taken. Occurring at a time when the growth of bone is so rapid, the effects of rickets are very striking and very serious.

In order to appreciate how bones are affected by rickets, it must be remembered that the long bones grow in length by the production of bone in the cartilage between the epiphysis and the shaft; that the shaft grows in thickness by the production of bone beneath the inner layer of the periosteum; and that the medullary canal is continually increasing in size by the absorption of the inner layers of the bone. In rickets there is an exaggerated production of cartilage at the epiphysis, and excessive cell-growth beneath the periosteum, while the process of ossification in these tissues goes forward slowly and imperfectly, or is entirely arrested. At the same time the absorption of the medullary layers may be even more rapid than normal. In health the growth of bone in length is much more rapid than its increase in diameter, owing to the greater activity of the changes taking place at the epiphysis; so, in rickets, it is at the extremities of the long bones that the most marked changes are seen.

One of the most striking features of rachitic bones is their unnatural flexibility. This is due to deficient ossification in the superficial layers of the shaft of the long bones, and also at their extremities. Normally, bone contains about one third organic and two thirds inorganic matter. In marked rickets the proportions are reversed, the bones often containing twice as much organic as inorganic matter. Changes are seen in all the long bones, but all are not affected to the same degree. Sometimes those most affected will be the bones of the leg, sometimes those of the forearm, and sometimes the ribs. The extent varies with the severity of the process.

There are characteristic changes in form. The most constant is enlargement of the epiphyses of all the long bones. This is most strikingly seen in the lower extremities of the radius and tibia. The enlargement may be so marked that the width of the epiphysis is increased by one half its diameter. All the sharp angles, borders, and prominences of the bones are rounded off. The curvatures of rachitic bones are more fully described under the symptoms. They may be due to a variety of causes. Some are simply an exaggeration of the normal curves, much increased by the swelling of the epiphyses; others are due to muscular action, to atmospheric pressure, to some unnatural posture, such as the cross-legged position, to the weight of the limbs, or to the weight of the body. The principal change in the form of the flat bones consists in the production of large bosses or prominences due to thickening of the bone, usually about the centre of ossification. These bosses are soft and spongy. Frac-

PLATE IV.



Bone in Rickets.

Longitudinal section of a rib at the junction of the costal cartilage, in a severe case of rickets (slightly magnified). C = costal cartilage, B = bone, A = proliferating cartilage-zone, which is much widened. Between the hypertrophied cartilage cell-columns (*a*) making up this proliferating zone, are seen medullary spaces (*b*) containing blood-vessels. In this zone lie masses of bone (*c*) not calcified. The calcification zone is almost wanting, only scattered islands (*d*) of calcified cartilage-cells being seen.

Beyond this proliferating zone (A) is a layer of bony tissue (B) made up of small bands of which only a few have a nucleus containing lime (*e*). These nuclei appear black. The bony bands differ both in form and arrangement from those of normal ossification. Between the bony masses are medullary spaces which appear light in the illustration. At (*g*) the beginning of cartilage proliferation is seen. Above this zone the cartilage is normal. (From Karg and Schmorl.)

tures are not uncommon. The bones most frequently broken are the radius and ulna; next, the clavicle or the ribs. The fractures are usually of the green-stick variety. There is a bending of the outer and a fracture of the inner layers of the shaft of a long bone. This results in more or less impaction, and is usually followed by the production of considerable callus. The epiphyseal changes result in arrested growth in length, rachitic bones being usually much shorter than normal. Increased vascularity is seen in the bosses upon the flat bones, at the extremities of the long bones and upon stripping the periosteum from the shaft.

In a longitudinal section of one of the long bones, the principal change seen at the extremity is that the cartilaginous layer which unites the epiphysis and the shaft is very much enlarged, both in width and thickness, the latter being sometimes four or five times the normal. This cartilaginous area is of a bluish colour, rather softer than normal cartilage. On one side it blends with the cartilage of the epiphysis, on the other it presents an irregular dentated border, and in it the calcified areas are irregular and scattered. The epiphyseal centres of ossification are enlarged, softer, and more vascular than normal, thus increasing the size of the extremity of the bone. In the shaft, the outer layers of bone are thickened and soft, like decalcified bone, the deeper parts being firmer, while the deepest layers may be completely ossified. The medullary canal is much more vascular than normal, its contents resembling granulation tissue. Toward the extremities the trabecular spaces are much increased in size, so that the bone appears unnaturally porous. On vertical section of one of the flat bones—e. g., one of the bosses upon the skull—there is found a great increase in the size of the trabecular spaces. The bosses are made up of large spongy masses, so soft as to be easily indented with the finger, and on pressure there oozes blood and serum in a considerable quantity.

Microscopical changes.—At the junction of bone and cartilage at the extremity of one of the long bones, there are readily traced in normal bone (Fig. 32) several distinct zones. Next to the hyaline cartilage (*a*) there is a proliferating zone (*b*), made up of cartilage cells and matrix, the cells having no orderly arrangement. Next to this is a columnar zone (*c*, *d*), in which the cartilage cells are arranged in regular rows or columns. Adjoining this is the zone of calcification (*e*); and, finally, there is the zone of ossification (*f*, *g*), where true bone is formed.

In rickets (Plate IV and Fig. 33), the principal changes are seen in the proliferating and columnar zones. The proliferating zone (Fig. 33, *b*) is increased chiefly by the multiplication of new cells; it is also more vascular than normal. The columnar zone (*c*) is affected in a similar way and to a much greater degree. It is less regular in its formation, and, instead of containing but few vessels, it shows large vascular channels, sometimes surrounded by medullary spaces (*e*). The ossification zone, instead of being narrow and sharply outlined, is broad and very irregular.

Calcified areas (*f*) may be seen in the midst of regions which are cartilaginous, while masses of cartilage (*h*) occupy areas which should be completely calcified. In some places there appears to be a transformation of cartilage into bone-tissue of an inferior sort by a direct or metaplastic process. In the shaft there is seen more or less thickening, and an increased vascularity of the periosteum. Beneath the inner layer there is

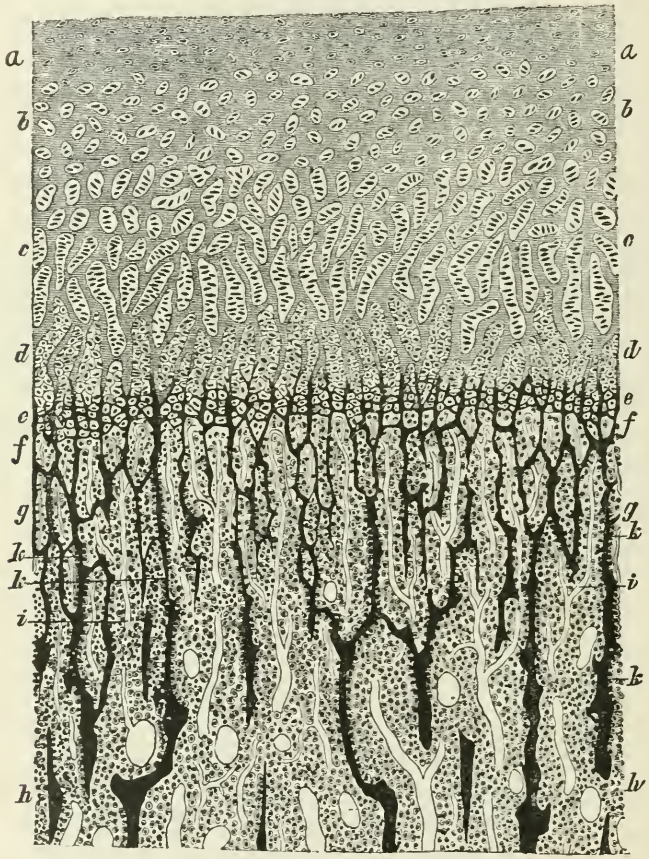


FIG. 32.—Section through ossification zone of normal bone (Ziegler). *a*, hyaline cartilage; *b*, zone of beginning cartilage proliferation; *c*, columns of cartilage cells; *d*, columns of hypertrophic cartilage; *e*, zone of temporary calcification; *f*, zone of primary medullary spaces; *g*, zone of primary bone formation; *h*, fully developed spongy bone; *i*, blood-vessels; *k*, layer of osteoblasts.

excessive cell-proliferation, while calcification of this new tissue is imperfect or absent, and instead of hard, compact bone, we find irregular, spongy masses. In the spongy bone there is considerable thickening, with an erosion of bony trabeculæ, which results in the formation of large medullary spaces filled with blood-vessels and connective tissue rich in cells.

Termination of the rachitic process.—After a variable time, usually from three to fifteen months, the active proliferative process going on in the cartilage and beneath the periosteum ceases, and is gradually replaced

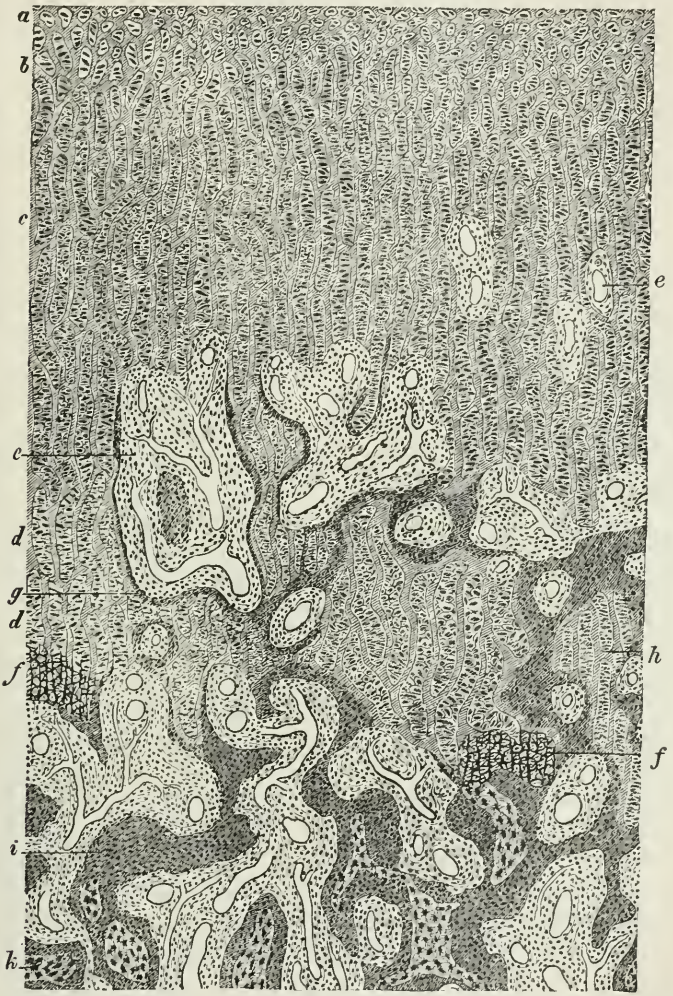


Fig. 33.—Rachitic bone (Ziegler). Longitudinal section through ossification zone of the upper diaphysis of the femur of a moderately rachitic child one year old (highly magnified). *a*, unchanged hyaline cartilage; *b*, beginning cartilage proliferation; *c*, columns of proliferated cartilage cells; *d*, columns of proliferated hypertrophic cells; *e*, medullary spaces containing blood-vessels lying within the cartilage; *f*, calcified cartilage; *g*, bony tissue; *h*, remains of cartilage within the bony tissue; *i*, point of uncalcified bony tissue; *k*, calcified bony tissue.

by ossification. The bone becomes less vascular, and a rapid formation of bone takes place in the normal way. In addition, there is in some places a direct transformation of cartilage into bone. Condensation and

contraction take place in the spongy masses of bone. As the result of this, the affected bone may become even harder than normal; often it is ivory-like. Its structure, however, is never quite like that of healthy bone.

In the long bones the epiphyseal swellings slowly diminish, and may quite disappear; the slighter curvatures may be entirely overcome, and the greater ones much lessened. The beading of the ribs becomes almost imperceptible; the bosses upon the skull shrink very markedly, and may leave scarcely a trace of their existence. In most cases the active process in rickets has come to an end by the time the child is two and a half years old, often at two years.

Visceral lesions.—These are not infrequent, but are not essential to rickets. In the lungs they are due to deformities of the chest wall and to complications. Beneath the deep lateral furrows which are so common, there is found a part of the lung in a state of more or less complete collapse. This is accompanied by emphysema of the portion just anterior to it. Acute and chronic bronchitis and broncho-pneumonia are exceedingly frequent. A low grade of chronic catarrhal inflammation in the stomach and intestines is common, and is often associated with dilatation of these organs. The spleen is enlarged in most cases during the period of active symptoms. This is usually moderate in degree, although marked enlargement is not at all rare. The swelling of the spleen is due to simple hyperplasia, and not to amyloid degeneration. Enlargement of the liver is less frequent, and may occur with or without that of the spleen. There are no constant changes in the structure of these organs. The lymph nodes (lymphatic glands) are frequently enlarged. Rachitic patients are more prone to these swellings than are other children. They are due to simple hyperplasia, and have no close connection with rickets. Cerebral changes are rare, and those described are rather of accidental occurrence than dependent upon the rachitic process. As stated under Symptoms, enlargement of the head is usually due to thickening of the cranial bones. Although hydrocephalus is occasionally seen, it is extremely doubtful whether it is more frequent than in patients not rachitic. Hypertrophy of the brain has been described in connection with rickets, but as yet this does not seem to be established by sufficient pathological evidence. The muscles are flabby from imperfect nutrition, and sometimes atrophied from disuse, but no essential anatomical changes have been demonstrated in them.

Symptoms.—A well-marked case of rickets makes a striking picture (Plate V), and one not easily mistaken. There are seen the large head, beaded ribs, narrow chest, prominent abdomen, symmetrical swellings of the epiphyses of the wrists and ankles, and curvatures of the extremities. The beginning of symptoms is nearly always insidious, and the patient does not usually come under observation until they have existed for several weeks, often several months.

PLATE V.

TYPICAL RICKETS.

Showing the large head, narrow chest, prominent abdomen, marked enlargement of the epiphyses at the wrists and ankles. There are also curvatures of the forearms and legs which are not so well shown.

The patient a child two and a half years old.

Early Symptoms.—The most constant early symptoms are sweating of the head, extreme restlessness at night, constipation, beading of the ribs, and cranio-tabes. The head-sweating is rarely absent, and may continue for several months. It is especially profuse during sleep, the perspiration standing out in large drops upon the forehead, often being sufficient to wet the pillow. This is one of the causes of the nasal and bronchial catarrhs so common in rachitic infants. There is marked restlessness during sleep: the children tossing about the crib, kicking off the clothes, and never having the quiet, natural slumber of healthy infants. This may be due to many causes, but when persistent and associated with marked perspiration of the head, rickets should be suspected. Constipation is frequently seen as an early symptom, although it is more marked in the later stages of the disease.

The beading of the ribs is almost invariably the first appreciable change in the bones, and it is well-nigh constant. This forms the so-called "rachitic rosary," consisting of nodules at the line of junction of the costal cartilages and the ribs. It may be slight, or there may be a row of knobs as large as small marbles. In many cases with marked thoracic deformity, little or no beading of the ribs is seen externally, although at autopsy it is found to be very marked upon the internal surface of the chest (Plate VI). Beading of the ribs was noted in all but two of one hundred and forty-four successive cases of rickets, at the time of the first examination. In infants under six months there may be found soft spots in the cranium, usually over the occipital or posterior portions of the parietal bones. These are from one fourth to one inch in diameter, and there are usually several of them present. By pressure with the finger they give a sort of parchment-crackling sensation. They are known as cranio-tabes. In my own experience this has not been a frequent symptom. Cranio-tabes is more frequently seen when syphilis is associated with rickets, and it is seen also in syphilitic cases which are not rachitic. The rachitic cachexia is not usually present until the symptoms have existed for several months, and in many cases it is not seen at all.

Deformities.—The deformities of rickets are almost invariably symmetrical in character, and usually numerous. In extreme cases almost every bone in the body is affected.

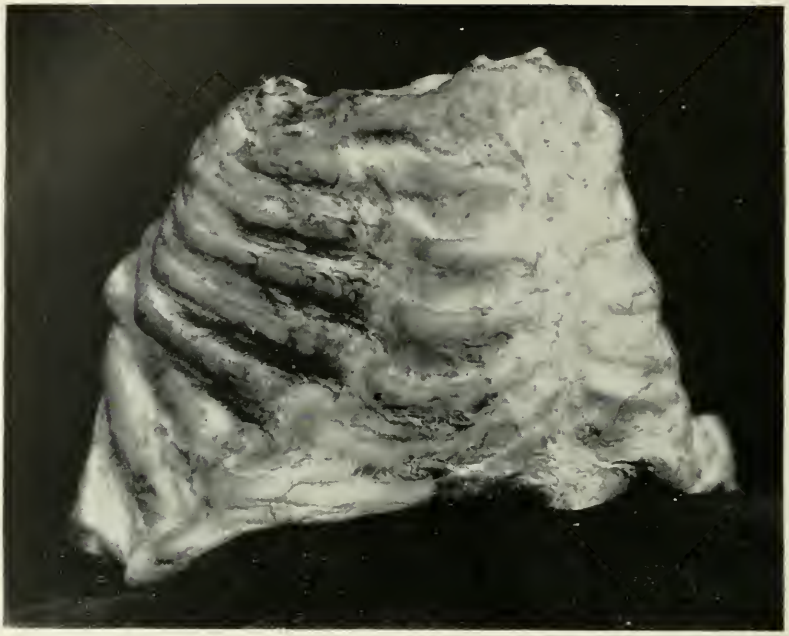
Head.—This usually appears to be too large, and although it may not be greater in circumference than that of a healthy child of the same age, it is out of proportion to the rest of the body. In marked cases the increase in circumference may be nearly two inches. The enlargement is in most cases due to thickening of the cranial bones. In one case with marked deformity, I found the skull over the parietal bones half an inch in thickness (Fig. 34). This thickening diminishes with recovery, but in most cases the head remains throughout life larger than it should be. The shape of the rachitic head is somewhat square (Fig. 35), owing

to the formation of large bosses over the parietal and frontal eminences. It is flattened at the occiput from pressure, and flattened also at the vertex. In extreme cases, the prominences upon the frontal and parietal bones may be so great as to produce quite a marked furrow along the line of the sagittal and frontal sutures, and one at right angles to this along the coronal suture (Fig. 36). This condition gives unusual prominence to the forehead. Marked deformity of the head has been observed in thirty-three per cent of my cases. The sutures may remain open for an

Fig. 34.—Rachitic skull from colored child two years old, horizontal section, inner surface; showing thickening of the bones, especially the frontal, and open fontanel.

unnatural time, occasionally until the end of the first year. The fontanel is late in closing, being frequently found open at two and a half, and sometimes even at three years. Often at eighteen or twenty months the fontanel is two inches in diameter. The veins of the scalp are often prominent, and the hair is frequently worn from the occiput, owing to restlessness during sleep. Occasionally rickets and hydrocephalus are associated, but this is the least frequent of all causes of enlargement of the head.

PLATE VI.



Deformity of the Chest in Severe Rickets.

In the upper picture, giving the external view, is shown a deep oblique furrow at the junction of the ribs and costal cartilages, these meeting at an acute angle.

In the lower picture the ribs have been separated from the spine and spread open, showing the same deformity as it appears from within, looking forwards.

From a coloured child ten months old.

Chest.—Beading of the ribs has already been mentioned. This is the most characteristic feature, but in the majority of cases there are, in addition, lateral depressions over the lower third of the chest, at the line of junction of the cartilages with the ribs, with eversion of the lower borders of the ribs. In severe cases these depressions or furrows are so great as to cause serious deformity (Plate VI). Usually there is a great diminution in the transverse and an increase in the antero-posterior diameter of the chest. Fig. 37 shows the outline of the chest of a rachitic child of two years, compared with that of a healthy child of the same age. Another frequent deformity is the "rachitic girdle," which consists in a transverse depression about two inches broad, extending from one side of the chest to the other, just above its lower border. A less frequent one is a deep circular depression over the ensiform cartilage. This is sometimes nearly an inch and a half in depth. Marked thoracic deformity was seen in twenty per cent of my cases, but in only a small proportion was the chest normal.

Fig. 35.—Rachitic head; Italian child two years old; square, prominent forehead and flat vertex.

The factors in the production of the thoracic deformity are atmospheric pressure and soft chest walls, these sinking in at the point where they have least resistance, viz., at the junction of the costal cartilages and the ribs. When there is any obstruction to the entrance of air, as in bronchitis, hypertrophied tonsils, or adenoid growths of the pharynx, the thoracic deformities are exaggerated. Irregular chest deformities depend upon the coexistence of pathological conditions in the lungs. Pigeon-breast is occasionally seen, but it is doubtful if this depends upon rickets alone.

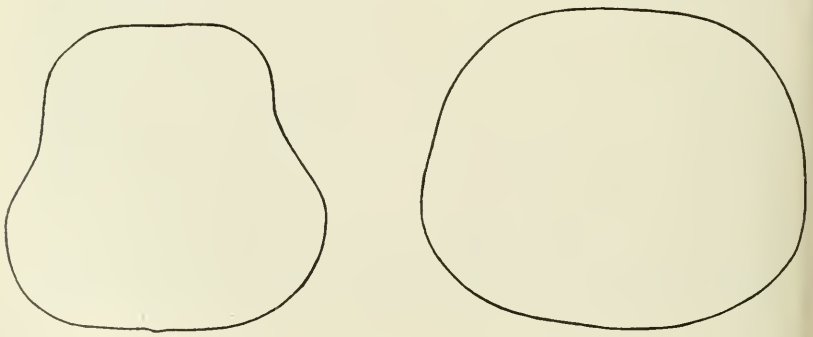
Spine.—In very many of the milder cases this is normal. The most characteristic deformity consists in a posterior curve (kyphosis), which is a general one, usually extending from the mid-dorsal to the sacral region. This existed in forty-six per cent of my cases. In the early part of the disease it disappears entirely on suspending the child, or making extension upon the extremities; but in cases of long standing it may not

disappear entirely by these tests. Very much less frequently there is seen a rotary curvature. This, in my experience, has been more frequently to the left side than to the right—the opposite of the common form of lat-

Fig. 36.—Rachitic skull from child one year old, showing frontal and parietal bosses and wide fontanel.

eral curvature seen in young girls. Marked lateral curvature in children under three years is usually rachitic.

The clavicle is affected only in severe cases. The usual deformity consists in an exaggeration of the anterior curve at the inner third of the



A B

Fig. 37.—A, horizontal section of a rachitic chest, child two years old, showing lateral furrows; B, section of chest of healthy child of the same age.

bone, which is somewhat shortened and its extremities enlarged. It is not infrequently the seat of green-stick fracture.

Deformities of the pelvis belong to obstetrics rather than to pædiatrics. The most common rachitic change is a diminution of the antero-posterior diameter and a narrowing of the subpubic arch. Irregular deformities, sometimes described as "crumpling of the pelvis," are not infrequent.

Extremities.—Deformities of the upper extremities are usually symmetrical. The humerus is affected only in severe cases. It has a forward and outward curve, although rarely a very marked one. Both the epiphyses are enlarged, although the upper one can not often be made out unless the child is very thin. The radius and ulna are frequently affected. They present a convexity upon their extensor surface (Plate V), which in some cases is very marked, particularly in children who have been creeping about. Green-stick fractures here are quite frequent. Rachitic changes at the epiphyses are more common than in the shaft, enlargement of the epiphyses at the wrist being one of the most constant bony deformities of rickets (Plate V). It was present in ninety-five per cent of my cases. Less frequently similar swellings are seen at the elbow. Enlargement of the ends of the metacarpal bones or the phalanges I have seen in but two or three extreme cases.

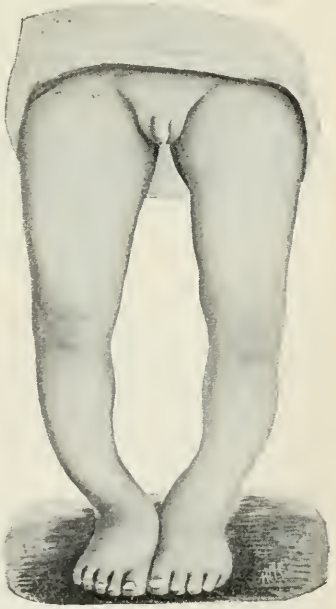


Fig. 38.—Typical bow-legs of severe form.

The lower extremities are rather more frequently affected than the upper, but in a similar way. The femur is involved only in severe cases; it commonly presents a general forward and outward curve, which is mainly due to the weight of the legs as the child sits. Occasionally there is also an outward rotation of the femur, where children have been allowed to sit much in a cross-legged posture. When such children begin to walk, the toes are turned very far outward. The principal deformities of the lower extremity are bow-leg (Fig. 38) and knock-knee (Fig. 39). Knock-knee is more common in females, and is believed to be due to an overgrowth of the inner condyle of the femur. Enlargement of both condyles can be demonstrated in most of the marked cases of rickets. The cases of slight bow-leg may be due simply to swelling of the epiphyses, the shaft of the bone being quite normal. This point I have verified by post-mortem observations. Such are probably most of the deformities which disappear spontaneously. The most severe cases of bow-leg are

often associated with some degree of antero-posterior curvature, and the latter may be the principal deformity. An exaggerated case of this kind is shown in Fig. 40. Enlargement of the epiphyses at the ankle is usually present when it is seen at the wrists, and nearly to the same degree. Enlargement of the upper epiphyses of the tibia and the fibula is seen only in severe cases. The cause of the deformities of the leg is not, primarily at least, walking too early, since they are common in children who have never walked; slight deformities, however, may be aggravated by early walking. A change which has not been sufficiently emphasized is the arrested growth of the long bones; this is one of the most characteristic features of rickets. A rachitic child of three years often measures in height six or eight inches less than a healthy child of the same age, the difference being almost entirely in the lower extremities.

Fig. 39.—Knock-knee.

All the *ligaments*, but particularly those about the large joints, are lax and frequently elongated. This may lead to the deformity known as weak ankles, or to an over-extension at the knee (*genu recurvatum*); also to unnatural mobility at the hips, shoulders, elbows, and wrists. The condition of the ligaments plays an important part in the production of spinal deformities.

Muscles.—The muscular symptoms of rickets are almost as constant and as characteristic as those of the bones. The muscles are small, very flabby, and poorly developed; hence rachitic children are unable to sit erect, or to stand or walk at the proper age. Of one hundred and fifty-one cases in which the date of walking alone was investigated, only twenty-seven, or eighteen per cent, walked before the fifteenth month; forty-seven per cent were not walking at the eighteenth month; twenty per cent not at two years; and ten per cent not at two and a half years. Late

walking is one of the most common symptoms for which advice is sought by parents with rachitic children. The muscular power in the extremities is sometimes so feeble as to suggest paralysis. I have seen a number of cases in which the symptoms so resembled paralysis, that even expert diagnosticians were unable to differentiate rickets from poliomyelitis except by the electrical reactions, those in rickets being usually normal or exaggerated. In other cases the symptoms may suggest cerebral palsy of the flaccid type. The muscular symptoms may be marked when the bony changes are slight, and conversely. As no lesions of the muscles have been demonstrated, the symptoms are probably due to imperfect nutrition. Two other symptoms depend chiefly upon the condition of the muscles, viz., pot-belly and constipation.

Pot-belly is quite an early symptom, and in most cases a very marked one (Plate V). It was noted in sixty per cent of my cases. The enlargement of the abdomen is uniform. It is everywhere tympanitic, and it may be as tense as a drumhead. It is due to a loss of tone in the abdominal muscles, and in the muscular walls of the stomach and intestine. It is aggravated by chronic indigestion and consequent intestinal putrefaction. The enlargement is thus mainly from tympanites. There may be a marked degree of dilatation both of the stomach and the colon. To a very small degree only, does the large abdomen depend upon swelling of the liver or spleen.

Fig. 40.—Extreme rachitic deformities of the legs.

The constipation of rickets, as already hinted, depends upon the loss of tone in the muscular walls of the intestines. It may alternate with diarrhœa. It rarely happens that a rachitic child has habitually normal evacuations from the bowels. Hard, dry, constipated stools frequently set up a condition of chronic catarrh of the colon in which large masses of mucus are discharged.

During the most active part of the disease—viz., from the third to the ninth month—*tenderness* may sometimes be elicited by pressure upon the epiphyses. This, however, is not a constant symptom, and a very unreliable one for diagnosis. In my own experience it has been marked in but a very small proportion of the cases. Acute tenderness should always suggest scurvy rather than rickets.

Fever.—According to some observers there is a febrile movement which belongs to the active stage of rickets, but I have never been able to satisfy myself of the truth of this observation.

Dentition.—As a rule, dentition is late and apt to be difficult—i. e., it is associated with attacks of indigestion or other disturbances which may be serious. Individual cases, however, present great variations in regard to this symptom. A study of the progress of dentition in one hundred and fifty rachitic children gave the following results: in fifty per cent the first teeth were cut on or before the eighth month, and in thirteen per cent on or before the fifth month; however, twenty per cent of the cases had no teeth at twelve months, and in eight per cent none had appeared at fifteen months. Even though the first teeth come at the usual time, the progress of dentition is often arrested by the development of rickets, and no advance made for five or six months. The difference in the cases appears to depend very much upon the age of the child when rickets begins. Those who give no evidence of it until nine or ten months old often have a nearly normal dentition, while the cases developing early show a marked retardation of this process. The order in which the teeth appear may be very irregular, but there is no rule in this respect. The character of the teeth in rickets, in the great majority of cases, is good. This was true in eighty-four per cent of one hundred and twenty-six cases examined with reference to this point. This is in striking contrast to hereditary syphilis, where the tendency to early decay is so constantly seen.

General appearance.—Rachitic patients are almost always anæmic. The blood is low in hæmoglobin, often down to thirty or forty per cent. In some few cases there is in addition quite marked leucocytosis. The number of red globules is not often nor uniformly affected. The majority of rachitic patients are fat and flabby. The tissues are soft and have but little resistance. Rarely, they may be thin, like patients suffering from marasmus.

Rachitic patients are very prone to suffer from hypertrophied tonsils, adenoid growths of the pharynx, and enlargements of the lymph nodes of the neck. In all forms of acute illness the feeble resistance of these patients is very evident. This is especially true of acute disease of the lungs.

The *mucous membranes* are very vulnerable in all rachitic patients. From the slightest indiscretion in diet an attack of acute indigestion or

diarrhœa is brought on, and from a very insignificant exposure, catarrhal inflammation of the upper or lower air passages is excited. In rachitic patients all such attacks are prone to run a protracted course. Inflammation of the trachea and larger bronchi is liable to extend to the smaller bronchi and the lungs.

The downward displacement of the *liver* and *spleen* from contraction of the chest should not be mistaken for enlargement of these organs. Moderate enlargement of the spleen is very common during the stage of most active symptoms—i. e., sixth to twelfth month. Great enlargement of either liver or spleen is infrequent, and when present it is doubtful whether it depends upon the rachitic process. It is rather to be connected with the condition of the blood which is developed during the disease.

Urine.—There are no recent studies of the urine of rachitic patients which are reliable.

Nervous symptoms are among the most frequent manifestations of rickets. Restlessness at night has already been mentioned as a prominent early symptom. Pain and tenderness are rare. A disposition to muscular spasm is seen in many cases. There may be laryngismus stridulus, tetany, or general convulsions. The first two are rare except in rachitic patients. All of these probably depend upon defective nutrition of the nervous centres. While in all infants, owing to the irritability of the nervous centres, convulsions are easily excited from relatively slight causes, in those who are rachitic this susceptibility is greatly intensified. In them, slight causes are sufficient to bring on either local or general convulsions. As a predisposing cause of convulsions in infancy, rickets takes the first place. The younger the child and the more active the rachitic process, the more frequently do convulsions occur. They belong especially to the first year, being most frequent between the third and ninth months. The exciting cause of convulsions in these cases is usually to be found in the stomach or intestine.

Course and termination.—Rickets is essentially a chronic disease, and its course is measured by months. The active symptoms in most cases continue from three to fifteen months, although they occasionally last a much longer time. The duration of the symptoms probably depends chiefly upon the duration of the exciting cause. That active symptoms cease when a child reaches the age of eighteen months or two years, is no doubt due chiefly to the fact that at this age the diet is more general, and is more likely to furnish what the child needs, and that more fresh air is likely to be secured than at an earlier age.

The earliest symptoms of improvement are a diminution in the nervous symptoms, especially in the restlessness at night; increased muscular power, as shown by disposition to stand or walk; diminution in the head-sweats; disappearance of the cranio-tabes; and improvement in the anæmia. The changes in the deformities are very slow, and from month

to month almost imperceptible. When improvement once begins, however, it usually goes steadily forward, relapses being exceedingly rare.

Congenital rickets.—Infants may present at birth the characteristic deformities of rickets, and there may be found even the minute bone changes of the disease. Such cases are reported to be common in Vienna and other large cities of Europe, where mothers during pregnancy have lived under unfavourable surroundings. In America, however, congenital rickets is a very rare disease. Single cases have been reported by Jacobi, J. Lewis Smith, and lately by Townsend. Cases of cretinism have sometimes been included under this term.

Late rickets.—Rare instances have been reported of bony deformities in all respects like those of rickets, developing in children from six to twelve years old. A number of such have been observed in England. I have not seen this disease, nor has a case been seen during the past twenty years at the Hospital for Ruptured and Crippled, New York, where more deformities come under observation than anywhere else in this country.

Acute rickets.—Although from time to time cases have been reported under this heading, from a study of the histories it is clear that the great majority, if not all of them, were cases of infantile scurvy. It is doubtful whether, strictly speaking, there is such a thing as acute rickets.

Diagnosis.—The diagnosis of rickets is not usually difficult, and after carefully examining a case one can not often be in doubt. It is the mild cases and the early stages of the disease that are most liable to be overlooked. The most important early symptoms for diagnosis are sweating of the head, cranio-tabes, great restlessness at night, delayed dentition, and enlarged fontanel. All these, taken separately, may mean something else, but collectively they can mean nothing but rickets. In the later stages some of the characteristic deformities are usually present; the most constant are beading of the ribs, enlargement of the epiphyses of the wrists and ankles, and bow-legs.

Special symptoms, when unusually prominent, may give rise to difficulty in diagnosis. The enlargement of the head may be mistaken for hydrocephalus. The delayed dentition and large fontanel of the cretin may be passed over as rachitic. Muscular weakness may be so great, especially when affecting the legs, as to make it easy to confuse a rachitic pseudo-paralysis for actual paralysis due to a cerebral or spinal lesion. When walking is much delayed, rickets may be passed over as simple backwardness. In nearly all of the last-mentioned group of cases the diagnosis may be cleared up by a careful search for the bony changes, and by the fact that in rickets there is only a general weakness of all the muscles, and not actual paralysis of any limb or group of muscles. The greatest difficulty is usually found where the muscular symptoms are marked and the bony changes slight, as is not infrequently the case. Here

the question is, whether rickets is sufficient to explain all the symptoms, or whether in addition some other condition is present. The electrical reactions will decide the question of poliomyelitis, while the presence of cerebral symptoms, exaggerated knee-jerks, and rigidity of the legs, will usually mark a cerebral birth-palsy. The bony enlargements of syphilis are not likely to be confounded with rickets, if it is remembered that the early lesions of syphilis are more like boggy infiltrations over the bones than actual swelling of the bone itself, and that when the bone is affected it is not at the extremity, but at the junction of the epiphysis and the shaft; the bone changes of late syphilis affect the shaft rather than the extremities of the long bones; where the bone is enlarged near the joint it is usually upon one side only. In syphilis there may be necrosis, while in rickets breaking down of bone is never seen. From scurvy, rickets is differentiated by the absence of marked hyperæsthesia, ecchymoses, and other hæmorrhages, the changes in the gums, and most of all by the fact that anti-scorbutic diet produces no immediate change in the symptoms. The diagnosis of rachitic curvature of the spine from vertebral caries will be considered in connection with the latter disease.

Prognosis.—Rickets *per se* is never a fatal disease. It is, however, a large factor in the mortality of the first two years, as the cachexia which it produces predisposes strongly to every form of acute disease. It is an important etiological factor in certain serious nervous conditions, especially convulsions. According to Gowers, ten per cent of the cases of epilepsy are in children who have suffered from rickets. Rickets adds very greatly to the danger of all acute diseases of infancy, particularly those of the respiratory tract. This depends partly upon the feeble muscular power and partly upon the thoracic deformities. The encroachment upon the capacity of the lungs by a marked thoracic deformity, may in itself be enough to keep a child in a delicate condition and retard its growth. At the same time such a condition is a constant invitation to acute attacks of bronchitis or pneumonia. The effect of rickets upon the future health of the child, depends chiefly upon the presence and extent of the thoracic deformity. When this is absent, as a rule no serious after-effects are visible, and although children may remain somewhat dwarfed on account of their short legs, in other respects they may be as well as if they had never been the subjects of rickets.

Prophylaxis.—As rickets is primarily due to improper food or feeding, and secondarily to bad surroundings, it may be prevented by the observance of proper rules of feeding as laid down elsewhere, and by removing children from their faulty surroundings. Especial care should be given to the later children of a family where the earlier ones have shown even the mildest symptoms of rickets, as the predisposition is sure to increase with each child.

Treatment.—In considering the treatment of rickets, the natural course of the disease is to be kept in mind, viz., that active symptoms frequently continue only until the tenth or twelfth, rarely longer than the eighteenth month, and that after this time the patient suffers more from the results of the disease than from the disease itself. The most important period for treatment, therefore, and the one in which it is most effective, is from the sixth to the fifteenth month. The earlier the treatment is begun the better will be its results. Constitutional treatment after the fifteenth or eighteenth month, has very little effect upon the disease, for by this time most of the harm has been done. The course of the disease when untreated is toward spontaneous recovery, from the changes in diet and life which are usually made when children have reached the latter half of the second year. Most of the cases seen in private practice are of a mild type and recover without special treatment, often no diagnosis being made until later in life, when the bony deformities or stunted growth indicate the previous existence of rickets. The first step in treatment is to remove the cause, and is therefore to be directed to the diet and hygiene of the patient. The results will depend upon how completely these causes can be removed.

Diet.—Carbohydrates, including sugars, proprietary infant-foods, and all farinaceous substances, should be reduced to the minimum, and in some cases prohibited. So far as possible the diet should consist of nitrogenous food and fats, especially milk, cream, eggs, red meat and fresh fruit. These articles are to be given according to the rules laid down in the chapters on Infant Feeding. In addition, cod-liver oil—which in these cases may be considered quite as much a food as a medicine—should be administered as soon as the stomach will tolerate it.

Hygiene.—This is the most difficult part of the treatment. In large cities it is almost impossible to secure for rachitic patients the surroundings they require. Whenever possible, such children should be sent to the country; but where this is out of the question, much may be accomplished by frequent excursions upon the water or into the country, by keeping children as much as possible in the parks and open squares of the city, and securing plenty of fresh air in sleeping rooms. Mothers are often very much afraid of fresh air, on account of the tendency of these children to take cold. If cold sponge-baths are given every morning, much can be done to lessen this susceptibility. Sunshine, though difficult to obtain in large cities, is a most efficient therapeutic agent. The establishment of suburban hospitals and homes for these cases would do more than anything else to lessen the mortality from rickets.

In a disease which tends so uniformly to recovery when causal conditions are removed, it is difficult to estimate the real value of medicinal treatment. No one thinks of relying upon drugs alone in the treatment of rickets, and where they are used in conjunction with other means it

is illogical to attribute all the improvement to the drugs employed. Those most used are cod-liver oil, phosphorus, and various preparations of lime. Regarding the value of cod-liver oil, there can be no question. While it can not be ranked as a specific in rickets, it should be given in every case unless contra-indicated by the condition of the stomach, except possibly during very hot summer weather. Phosphorus has been popularized in the treatment of rickets by Kassowitz, who regards it as a specific for the disease. I have been unable to satisfy myself, after five years' experience with its use, that in the great majority of the cases it had any decided influence upon the course of the disease. The best results from phosphorus are obtained in the early cases, where there are cranio-tabes and marked nervous symptoms. But even here I have not seen the striking benefit reported by others. In the later stages of rickets, it has been difficult to see any special result from its use. Phosphorus may be administered either in the form of the officinal oil of phosphorus diluted with olive oil, or as Thompson's solution. The dose is gr. $\frac{1}{200}$ three times a day, given after meals; it should be continued for several months. In such doses I have never seen it cause unpleasant symptoms.

The absence of lime in rachitic bones has led to the use of various preparations of lime as remedies. Those most employed are the phosphate, the lactophosphate, and the hypophosphite. While these may be beneficial as tonics, they are not in any sense to be classed as specifics. It is probable that when lime is given in excess of the amount furnished by ordinary breast-milk or cow's milk, this excess passes through the bowels unabsorbed. Arsenic and iron are valuable in the treatment of rickets, the special indication for their use being the presence of marked anæmia. Profuse sweating may be relieved by small doses of atropine—i. e., gr. $\frac{1}{800}$, three or four times a day, to a child of six months.

Treatment of the rachitic deformities.—The deformities of the chest are less amenable to treatment than most of the others. After the third year something can be done by gymnastics to develop the chest muscles and to increase the pulmonary expansion. The employment of the pneumatic cabinet, in which it is sought to overcome these deformities by the use of rarefied air, has never been given the trial which it deserves. From the very meagre reports published, this appears to be of considerable value.

The deformity of the spine (kyphosis) may usually be overcome by postural treatment. The patient should lie upon a hard bed; no pillow should be allowed under the head, but in severe cases one should be placed beneath the back, so that the head and buttocks are slightly lower than the lumbar spine. While sitting, the shoulders should be kept back and the trunk supported. For a few minutes each day the child should be placed upon the face, and the deformity overcome by raising the buttocks while pressure is made upon the spine. In severe cases, an apparatus

for giving spinal support, either by a steel brace or a plaster-of-Paris jacket, may be worn a few hours each day when the child is sitting up. Other means should be employed, especially friction and massage, to develop the spinal muscles.

In very many cases slight deformities of the extremities are outgrown when the general treatment can be properly carried out. Where these exist, the physician should take the curve of the limbs by seating the

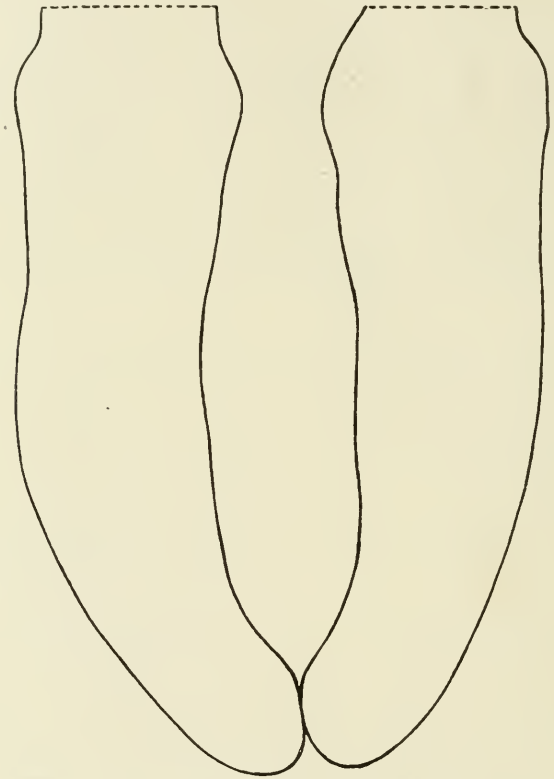


Fig. 41.—Tracing, showing the curve in a case of bow-legs.

child upon a flat surface and tracing their outline with a pencil held perpendicularly (see Fig. 41). A fresh tracing should be taken once a month. If the deformity is not very great and no increase takes place, it is safe to continue with general treatment only. If the deformity is marked or if it increases in spite of the constitutional treatment, braces should be applied. Something may be done toward straightening the bones by intelligent manipulation. Walking should be discouraged until the bones are quite firm. Friction of the extremities, and even the use of electricity, will do very much to increase muscular development. The habit of sitting

cross-legged—a very common one of rachitic children—should be prevented, and in fact any other habitual posture, on account of the danger of increasing certain deformities. But little is to be expected from the use of apparatus for the correction of rachitic deformities after the child is two and a half years old; since at this time, and often even at two years, the bones are so firm that no amount of pressure from a steel brace will have any effect.

Without going fully into the question of the surgical treatment of rachitic deformities, for which the reader is referred to text-books on general and orthopædic surgery, I will only state that osteotomy seems to me to offer decided advantages over the other means of treating severe deformities. A vast amount of time and patience is wasted in the vain attempt to overcome very marked deformities by apparatus. The best results in osteotomy are obtained when the operation is delayed until the fourth or fifth year, by which time the bones are sufficiently firm and solid. Operations in the second year are generally unsatisfactory, and those in the third year often so, because of the bending of the bones which takes place subsequently. The deformities which require operation are bow-leg and knock-knee, less frequently the curvatures of the femur or of the bones of the forearm.

SECTION III.

DISEASES OF THE DIGESTIVE SYSTEM.

CHAPTER I.

DISEASES OF THE LIPS, TONGUE, AND MOUTH.

MALFORMATIONS.

Harelip.—This is one of the most frequent congenital deformities. It is caused by an incomplete fusion of the central process with one or both of the lateral processes from which the upper half of the face is developed. This deformity may be single or double; the fissure is never in the median line, but usually just beneath the centre of the nostril. There may be simply a slight indentation in the lip, or the fissure may extend to the nostril. Both single and double harelip—more frequently the latter—may be complicated by fissure of the palate. Double harelip is usually accompanied by a fissure between the intermaxillary and the superior maxillary bone of each side.

Cleft Palate.—This is second in frequency to harelip. It may involve the soft palate only, or the fissure may extend into the hard palate, producing a wide gap in the roof of the mouth. The most frequent form is that in which only the soft palate is affected.

For the surgical treatment of both these deformities the reader is referred to text-books upon surgery. As to the time of operation, in cases of harelip it is wisest to defer interference until the child is well started in its growth—that is, the second or third month—and in cleft palate until the third or fourth year. The medical treatment of these cases consists in the care of the mouth and in the nutrition of the patient. The mouth in all cases must be kept scrupulously clean, but the greatest care is necessary not to injure the epithelium. A camel's-hair brush and plain lukewarm water, or a weak alkaline solution, are to be recommended. Both these deformities are exceedingly likely to be complicated by thrush. This is a serious menace to the success of any operation, and even to the life of the patient. The nutrition is always a matter of much difficulty, and a very large number of these cases die of inanition or marasmus. In cases of harelip, if the fissure is so great as to interfere with nursing, the child may be fed with a spoon or a medicine dropper until the operation

can be done. In cleft palate there may be attached to the rubber nipple of the nursing bottle a flap of thin sheet rubber in such a way that it closes the fissure in the mouth when once the nipple is in place. This flap should be shaped like a leaf, one extremity being sewed to the neck of the rubber nipple and the other end left free. In many cases, both before and immediately after operation, gavage (page 62) may be resorted to with the greatest benefit and with very little inconvenience.

Congenital Hypertrophy of the Tongue.—This is usually due to disease of the lymphatics, and is to be regarded as a lymphangioma. In a few cases hypertrophy of the muscular fibres has been present. The tongue may reach an enormous size, so that it is impossible for it to be contained within the cavity of the mouth, and it may thus interfere with nursing, deglutition, and even with respiration. The treatment is surgical. Cases like the above are to be distinguished from those of enlargement of the tongue seen in sporadic cretinism. In this disease the tongue is considerably enlarged and may protrude slightly from the mouth, but it is rarely, if ever, large enough to cause other symptoms. It diminishes notably under treatment with the thyroid extract.

Bifid Tongue.—These cases are extremely rare. Brothers has reported to the New York Pathological Society a case of cleft tongue in a child of one month. There was, in addition, a fissure of the soft palate.

Tongue-Tie.—This deformity is due to such a shortening of the frenum that it is impossible to protrude the tongue to a normal extent. It differs considerably in degree in different cases. In some, the tongue can not be advanced beyond the gums. Tongue-tie may interfere with articulation, and even with sucking. The treatment consists in liberating the tongue by dividing the frenum with scissors and completing the operation with the finger nail. This should be done in every case unless the child is a bleeder. In many cases the mother may think the tongue tied when the frenum is of normal length.

Bifid Uvula.—This is not very uncommon. It usually occurs in connection with cleft palate, but is occasionally seen when there is no other deformity present. It may be complete or partial, and it does not of itself require treatment.

DISEASES OF THE LIPS.

Herpes.—Herpes labialis is an exceedingly common affection in children, occurring in acute febrile diseases, particularly pneumonia, and sometimes alone. It is the familiar "fever sore" or "cold sore" of domestic medicine. The appearance is similar to herpes in other parts of the body. There is first a group of vesicles, then rupture and the formation of crusts. It is often quite difficult to cure on account of the disposition of children to pick the lip with the fingers. Although it heals without treatment, recovery is facilitated by the use of some antiseptic lotion,

such as dilute boric acid, followed by a dusting powder of zinc oxide and boric acid. This treatment is generally more successful than the use of ointments. Young children should wear mittens at night, to prevent picking at the crusts.

Eczema of the Lip.—This is an exceedingly common condition, and a very troublesome one. The vermilion border is dry and rough, and prone to deep cracks or fissures. These are usually seen at the angles of the mouth or in the median line. When severe they are exceedingly painful, bleed freely, and are the cause of very great discomfort, especially in the cold season. The lips should be covered at night by simple ointment, and this should be used as much as possible during the day. Where deep fissures form, they should be touched with burnt alum, or with the solid stick of nitrate of silver. Syphilitic fissures are considered with the symptoms of that disease.

Perléche (French, *perlécher* = *to lick*).—This name was first given by Lemaistre, in 1886, to a form of ulceration occurring usually at the angle of the mouth. It begins in most cases as a small fissure, which, by constant licking and irritation, to which there is usually added infection, may produce an intractable ulcer of considerable size. It often resembles the mucous patch of hereditary syphilis. The ulcer is of a grayish colour, is quite painful, and is associated with considerable swelling of the lip. It lasts from two to four weeks. The treatment is the same as in simple fissure—viz., the use of burnt alum or nitrate of silver, and covering the part with bismuth or oxide of zinc.

DISEASES OF THE TONGUE.

Epithelial Desquamation.—This is a disease of the lingual epithelium, which is characterized by the appearance upon the dorsum or margin of the tongue, of circular, elliptical, or crescentic red patches, with gray margins which are slightly elevated. It is sometimes improperly called psoriasis of the tongue. It is quite a common condition.

The beginning of the disease is not often seen. It is stated first to appear as a white or gray patch, like thickening of the epithelium. These patches enlarge quite rapidly, and are followed by detachment of the epithelium and the formation of bright red areas, which are the parts denuded of epithelium. As usually seen, there exists upon the tongue from two to half a dozen of these red patches surrounded by a gray border, which is about one twelfth of an inch wide, and slightly elevated. The outline of the patch is nearly always crescentic (see Fig. 42). From day to day the configuration of the patches changes; the gray lines advance across the tongue from side to side, or from base to tip, disappearing as they reach the border or the extremity. They are followed by the red patches, and as the old ones fade away new ones form and run the same course. The white border seems to be made up entirely of epithelium.

The red patches are of a bright colour nearest the border, gradually shading off into the normal colour of the tongue. Only the epithelium is involved, the deeper structures being unaffected. The duration of the disease is indefinite; it usually lasts for months, and often for years. Guinon reports several cases in which a cure took place during an intercurrent attack of measles or scarlet fever.

The cause is unknown. The condition occurs rather more frequently in females than in males, and Gubler has reported an instance of several members of the same family being affected. Most of the cases are seen in infancy and early childhood. The condition has been thought to depend upon nearly every disease of this period. Parrot believed that it was always syphilitic, but this view has been effectually disproved by subsequent observation. The disease is not accompanied by pain, salivation, or by other symptoms of stomatitis, and it is of little practical importance. Its symptoms are so characteristic that it can hardly be mistaken for any other condition. Treatment is unnecessary.

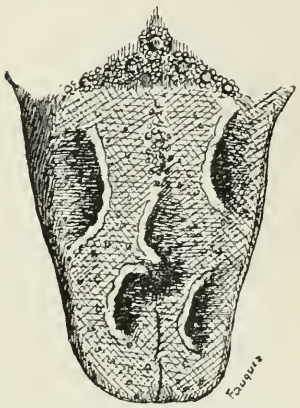


Fig. 42.—Epithelial desquamation of the tongue. (Guinon.)

Two other forms of epithelial desquamation have been observed, both much more rare than that described. In one of these the red denuded portion occupies the margin of the tongue, while the centre is gray or white; the irregular wavy outline which separates the two suggests strongly an outline map, and the condition is sometimes called the "geographical tongue." In another variety nearly the whole organ may be uniformly red, from loss of the epithelium, there being no borders or patches. Both these varieties are of much shorter duration than the more common form, usually lasting only a few weeks.*

Glossitis.—Inflammation of the tongue is not very common in children. It is usually of traumatic origin. The injury may be due to biting the tongue in a fall or in an epileptic seizure. Glossitis is sometimes excited by the irritation of a sharp tooth, causing a wound which may be the avenue of infection; or it may result from taking into the mouth irritant or caustic poisons. In a small number of cases no cause can be found. The symptoms are marked swelling of the tongue, so that it may protrude from the mouth; and it may even be so great as to cause severe dyspnœa. There are also profuse salivation, difficulty in swallowing

* For a fuller description and literature of the subject, see Guinon, Revue Mensuelle des Maladies de l'Enfance, 1887, p. 585; and Gautier, Revue Médicale de la Suisse, Romande, October and November, 1881.

and in articulation, and often considerable local pain. There may be a rise of temperature to 102° or 103° F. The treatment consists in the use of fluid food, which in severe cases may be introduced through the nose by means of a catheter. Ice may be used externally, or, better still, pieces of ice should be kept in the mouth continually. If there is obstruction to respiration, and in all severe cases, scarification should be done on the dorsum along the side of the raphé.

Tongue-swallowing.—This term is used to describe a rare condition seen in infants, in which the tongue is turned backward into the pharynx, so as to obstruct respiration. It may be drawn quite into the œsophagus. Several marked cases have been collected by Hennig.* One of these will suffice as an illustration. A well-nourished infant of three months, in the course of a severe paroxysm of pertussis, was seized with convulsions, followed by asphyxia, and died in a few minutes. After death the tongue was found to be doubled upon itself, its tip being tightly wedged into the œsophagus. While most frequently occurring with pertussis, tongue-swallowing has been seen in other diseases. I have never met with cases of such severity, although in several instances I have seen marked dyspnœa produced in young infants by the folding backward of the tongue. Tongue-swallowing should not be forgotten as one of the explanations of sudden asphyxia in a young infant. The conditions necessary to its production are a somewhat relaxed organ or a long frenum. In none of the fatal cases reported, however, had the frenum been divided. In some weak infants, falling back of the tongue, so that its base partly covers the epiglottis, produces asphyxia, precisely as it occurs in adult life under full anæsthesia. The recognition of the condition is a very easy one, and its treatment is to relieve the obstruction by drawing the tongue forward by the finger or forceps.

Ulcer of the Frenum.—The friction against the sharp edges of the lower central incisors frequently causes an ulcer of the frenum in infants. I have never seen it in older children. It usually occurs in pertussis, but is seen in other cases. In some it appears to be produced by friction of the teeth during nursing from the breast or bottle. It is more often seen in children who are delicate or cachectic than in those who are healthy and well nourished. The ulcer may be confined to the frenum, or it may extend quite deeply into the tongue. It is usually about one fourth of an inch in diameter, and of a yellowish-gray colour. When not readily cured by touching with alum or nitrate of silver, the child may be fed by gavage for several days, or the teeth may be covered by a bit of absorbent cotton.

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* Jahrbuch für Kinderheilkunde, xi, 299.