PEDIATRICS

THE

HYGIENIC AND MEDICAL TREATMENT

OF

CHILDREN

BY

THOMAS MORGAN ROTCH, M.D.

PROFESSOR OF THE DISEASES OF CHILDREN, HARVARD UNIVERSITY

ILLUSTRATED

PHILADELPHIA

J. B. LIPPINCOTT COMPANY

1896

DIVISION V.

PREMATURE INFANTS.

LECTURE XII.

I SHALL next speak of that class of infants which is designated as premature, because they are born prior to the usual two hundred and eighty days which represent the normal duration of intra-uterine life. I describe this class of cases directly after what I have just told you about infant feeding not only because it is essentially the proper management of the food which preserves the lives of these infants, but because I consider that the best way to feed premature infants is by means of food carefully prepared at milk-laboratories. This method of feeding premature infants is far superior to even breast-feeding, and, in my opinion, the use of milk-laboratories in these cases will result in a decided reduction in their mortality.

Very few cases are reported, and none of them appear to be absolutely authentic, where an infant has survived which was born much before the twenty-seventh or twenty-eighth week of intra-uterine life. The premature infant in its intra-uterine development is unprepared to meet the conditions of extra-uterine life, and often dies within a few days, and usually within a few hours.

A sufficient number of careful investigations regarding the characteristic appearances and the development of the fœtus during the last four months of intra-uterine life has not yet been made and recorded to enable us to state definitely what age the infant represents when it is born. The few facts which we possess concerning this subject must, however, be made use of, and, though not absolutely correct, are sufficiently so to be of great value to us in our management of these cases. One reason for the difficulty which arises in every case in determining the age of the fœtus is that the conditions which influence its growth during intra-uterine life are very varied. The health of the mother and her hygienic surroundings, together with the influence of heredity on the size of her offspring, present good reasons for decided variations in the growth of the fœtus in different cases at the same period of intra-uterine life.

If the infant is living when it is born, we should at once carry out the

rules for preserving its life which have proved to be best in the case of any infant born prematurely. These rules should be insisted on even if the infant has been born at a much earlier stage of development than is, according to our present ideas, compatible with its viability. This is necessary, because so many errors in our calculation as to when the impregnation took place are liable to arise, and also because a fœtus may have arrived at a period of intra-uterine development which is perfectly compatible with life, and yet from its small weight and general characteristics have the appearance of one whose development is incompatible. Whatever advances we may make in the future in preserving the lives of premature infants born at an earlier date than is supposed to be compatible with life,—namely, from the twenty-fourth to the twenty-eighth week,—it would hardly be practical at this time to discuss the treatment of infants born before the twenty-fourth week.

TWENTY-FOUR WEEKS.—A fœtus born at about the twenty-fourth week of intra-uterine life usually breathes feebly, and dies in the course of a few hours, apparently from an inability to accommodate itself to conditions for which it is not prepared. At this stage of development it may still have fine hair (lanugo) over the whole of its body, but it is often the case that this hair, commonly found from the sixteenth to the twentieth week, has disappeared. At this age it still has very little deposition of fat in the subcutaneous cellular tissue, and it has a decidedly emaciated appearance. In other respects, except its size, it does not differ very much in its appearance from the fœtus of some weeks' later development. Its eyelids have separated, though it is so feeble that, as a rule, it cannot open and shut them.

The estimation of the length of the fœtus is difficult to make, and, on the whole, unsatisfactory and inexact. These measurements, in all probability, differ very much when made by different investigators, owing, as Minot has pointed out, to the many changes in the curvature of the longitudinal axis of the human embryo, which make it impracticable to employ any one system of measurement in obtaining comparable results for all ages. Hecker's figures, however, are probably as reliable as any we know of. According to this author, at about the twenty-fourth week the fœtus measures 28 to 34 cm. (11¼ to 13½ inches). Its weight, according to Lusk, is about 690 grammes (23 ounces).

TWENTY-EIGHT WEEKS.—By the time the fœtus has reached the twenty-eighth to the twenty-ninth week of intra-uterine existence its condition, so far as its development is concerned, is such that there is no necessary contra-indication to its living if it happens to be born at this time. It has been stated that an infant born prematurely at the twenty-eighth week is more likely to live than one which is born at the thirty-second week of intra-uterine life, and that this has been proved by statistics. If true, the reason for this, I believe, is because much greater care is taken of the former than of the latter. It is reasonable to believe that an earlier stage

of intra-uterine development is less likely to insure continuance of life after premature birth than a later stage, provided the same precautions are taken in each case.

Hecker's and Lusk's figures, in a general way, state that when the fœtus is born at about the twenty-eighth to the twenty-ninth week it measures from 35 to 38 cm. (about 13¾ to 15 inches) and weighs about 1170 grammes (39 ounces). The skin is still wrinkled, is of a dull red color, is covered with vernix caseosa, and there is very little deposition of subcutaneous fat. The infant can move its limbs slightly, cries feebly, and often dies in a few hours or days. Yet it is this class of prematurely born infants whose lives I expect to see preserved in the future, when all the precautions which I am about to describe against external and dangerous influences have been taken and improved apparatus has been employed.

THIRTY-TWO WEEKS.—Again, using Hecker's and Lusk's figures for the thirty-second, thirty-sixth, and thirty-eighth weeks, at about the thirty-second week of intra-uterine life the fœtus measures from 39 to 41 cm. (about 15½ to 16½ inches) and weighs about 1560 grammes (52 ounces). The hair of the head by this time has increased in thickness, and the lanugo, which in many cases is pronounced from the twenty-eighth to the thirty-second week, has either begun to disappear or has entirely disappeared from the face. The nails, which between the twenty-eighth and thirty-second weeks are often not well developed, now present a normal appearance, though they frequently do not quite reach the tips of the fingers. At this age, also, in boys, it is often possible to feel the testicle in the scrotum. There is usually, also, at this age, in a healthy fœtus, considerable deposition of subcutaneous fat, and the senile aspect of the earlier periods of intra-uterine life is much lessened.

THIRTY-SIX WEEKS.—At about the thirty-sixth week the length of the fœtus is from 42 to 44 cm. (about 16¾ to 17½ inches) and its weight is about 1920 grammes (64 ounces). The lanugo has usually at this period disappeared, and the infant, although less energetic than at full term, is decidedly stronger than in the previous periods which I have mentioned. It sleeps a great deal, and is still in a condition to die easily unless carefully looked after.

THIRTY-EIGHT WEEKS.—At about the thirty-eighth week of intra-uterine life the infant measures about 45 to 47 cm. (about 17¾ to 18¾ inches) and weighs about 2310 grammes (77 ounces).

WEIGHT.—It is important to remember that the weight of premature infants of the same age varies at birth, just as we have seen that it does in the case of infants born at term.

In treating these cases, observance of their weight is of the greatest importance, and until we have obtained a regular progressive daily increase in their weight we are never sure that they are thriving sufficiently to live. The daily gain which the premature infant should make has not yet been determined, but it is much less than is expected when an infant is born at

full term, and may be stated to be about 10 to 20 grammes ($\frac{1}{3}$ to $\frac{2}{3}$ ounce). Any decided loss in weight, such as 30 to 40 grammes (1 to $1\frac{1}{3}$ ounces), beyond what would occur from natural causes, should make us look upon the infant as being in a critical condition and impress upon us the importance of taking active measures to prevent further loss. This loss in weight must, as it is relatively so small, be carefully adjusted to the loss which naturally occurs from the fæcal discharges. Thus, the total amount of loss in weight from the fæcal discharges may amount in these premature infants to from 30 to 60 grammes (1 to 2 ounces) for each fæcal discharge, and this may entail a considerable loss of the infant's weight in the twenty-four hours beyond that occasioned by defective nutrition.

I have here to show you an infant (Case 102) prematurely born at about the twenty-eighth week of intra-uterine life.

CASE 102.

Infant premature at seventh month. Birth-weight, 1740 grammes; present weight, 1540 grammes; present age, 10 days.

Its weight at birth was 1740 grammes (about $3\frac{8}{9}$ pounds). It is now ten days old and has lost about 240 grammes (about $\frac{1}{2}$ pound). You see that it is in a very somnolent condition, that it has very little hair on its head, and very little subcutaneous fat. You will also notice the senile expression of its face, that there is no appearance of lanugo, and that the nails are well formed. The small size of the infant will be still more appreciated if you compare it with the hand of the nurse, which, for comparison, is placed beside it.

There have been so few observations recorded of the development of the various parts of the fœtus in the later months of intra-uterine life that I am not prepared to describe systematically the development of the premature infant as I have already done that of the infant at term (Lecture III., page 54). There are, however, some facts which I have observed and others which have been recorded.

HEAD, THORAX, AND ABDOMEN.—Looking at this infant (Case 102) critically, we notice that all those anatomical conditions which I have emphasized in my description of the infant at term as being especially prominent are still more marked in the premature infant. Thus, you will notice how large the head is in comparison with the thorax, and how very large, in proportion, is the abdomen. The abdomen is in almost every case much distended in premature infants, owing to the large proportionate size of the liver. This distention of the abdomen lasts for many weeks, and

even months, and its gradual return to the normal size and appearance is one of the signs that the infant is doing well and is gradually acquiring the normal anatomical development of the infant born at term.

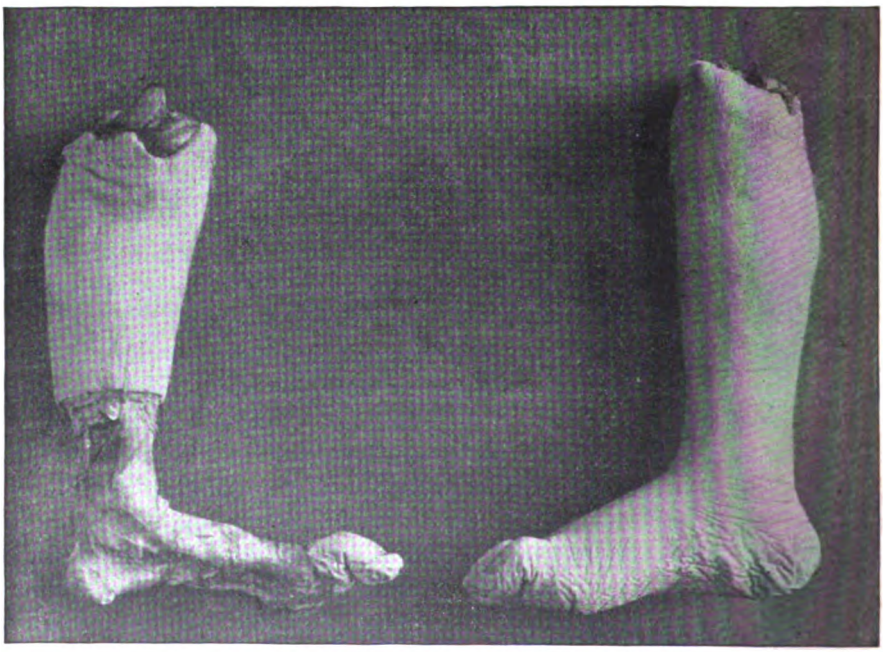
Fig. 71.

Tracings of fœtal feet (natural size), seven months old.

SKIN.—The various changes in the color of the skin, which I have already described as represented by erythema neonatorum and icterus neonatorum, I have noticed to occur in the premature infant as they do in the infant at term.

SWEAT-GLANDS.—I have told you that the function of the sweat-glands is, as a rule, not developed at birth, and that we do not expect the infant in the early weeks of life to perspire. I have also told you that there is a great variation as to the time of the development of the function of the sweat-glands. In an

Fig. 72.



Legs and feet (natural size) of infant premature at seven months. Left foot dissected and showing internal arch. Partially dissected metatarso-phalangeal joint of great toe in shadow. Inferior edge of scaphoid shows as a shaded line.

infant premature at seven and one-half months I have noticed free perspiration take place after it had been born one week.

FEET.—I have already told you how few observations have been made on the development of the various parts of the fœtus in the later months of intra-uterine life, and I think all facts determined at this period of existence should be recorded. I therefore consider Dane's observations on the instep of a seven months' fœtus (Case 103) born alive to be of value in connection with what I have already said about the feet of infants born at term (Lecture II., p. 50). These tracings (Fig. 71) represent this premature infant's feet, and you see how admirably the presence of the instep is shown.

The infant died a few hours after birth, and I have here to show you (Fig. 72) its feet and lower legs. The skin of the right leg is badly wrinkled by the alcohol in which it was preserved. It looks strikingly like the foot as it appears in adults, and its arch stands out plainly, unmasked by any pads of fat. The left foot has been dissected down to the ligaments. The arch made by the os calcis, cuboid, and fifth metatarsal bones represents the lower edge of the cut. On the inner border of the foot the metatarso-phalangeal joint of the great toe is seen partially dissected. Behind this the enlargement at the tarso-metatarsal joint forms a considerable bulging. Behind and above the latter the inferior edge of the scaphoid shows as a shaded line.

From these specimens and from the tracings we see that the foot at seven months closely approaches in external appearances the well-developed foot of the adult, and that when the infant was supported with its feet on smoked paper it left an excellent impression. The dissection also shows a remarkably well constructed bony framework.

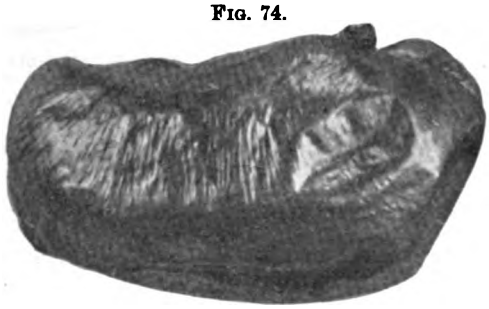
GASTRIC CAPACITY.—As the question of the proper amount of food to be given to a premature infant is of the utmost importance, it is well to know about what the average gastric capacity of the fœtus is during the later months of intra-uterine life. No series of complete and reliable observations on this point have been made, that I know of, and the rules by which we are guided must for the present be very general ones. The less the weight of the infant, the less, in many cases, is the gastric capacity. I have here to show you some fœtal stomachs.

The first stomach (Fig. 73) is that of a fœtus about four and one-half months old, and is interesting merely as showing the relatively advanced development of the lesser and

FIG. 73.

Fœtal stomach (natural size), four and one-half months old.

FIG. 74.



Fœtal stomach (natural size), seven and one-half months old. Weight of fœtus, 1920 grammes. Gastric capacity, 18 c.c.

greater curvatures at this age, as well as the rapid growth which takes place between the fourth and the seventh month.

The next stomach (Fig. 74, p. 293) was taken from an infant born prematurely at about the twenty-ninth to the thirtieth week. It is of a rather peculiar shape, corresponding to that which I have described to you in a previous lecture (Lecture IV., Fig. 29, p. 89). The weight of this fœtus was 1920 grammes (about 4 pounds). Its gastric capacity was 18 c.c. (about 4½ drachms).

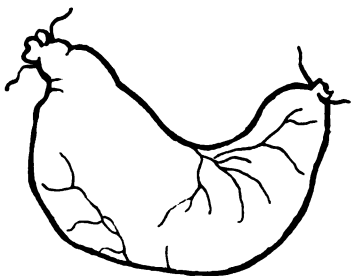
This next stomach (Fig. 75) was taken from a fœtus at about the thirty-second week, which died in forty-five minutes from the time of its birth. The gastric capacity was 22 c.c. (5½ drachms). The weight of this infant was 1230 grammes (2 pounds 9 ounces).

FIG. 75.

Fœtal stomach (natural size), eight months old. Weight of fœtus, 1230 grammes. Gastric capacity, 22 c.c.

The next stomach (Fig. 76) was taken from a fœtus born at about the thirty-second week of intra-uterine life, and weighing 1440 grammes (about 3 pounds). Its gastric capacity was 8 c.c. (about 2 drachms).

FIG. 76.



Fœtal stomach (natural size), eight months old. Weight of fœtus, 1440 grammes. Gastric capacity, 8 c.c.

INTESTINAL CONTENTS.—The meconium in premature infants presents the same appearance as is seen in infants at term. When the food is properly regulated, the fæcal discharges assume the consistency and color which are seen in those of infants who have been born at term. This color in its usual varieties is well represented in this plate (Plate III., 6, 7, 8, 9, facing p. 112).

AMYLOLYTIC FUNCTION.—The amylolytic function of the infant at term is so slightly developed that we may safely assume that it should not be depended upon for the digestion of starch in the premature infant under any circumstances.

SUGAR.—Although we must assume that the function of absorbing sugar is not developed to the same extent in the premature infant as in the infant at term, yet, in all probability, it is more highly developed than the other functions of digestion. Sugar is needed to keep up the animal heat of the premature infant, which is so very much more readily lessened than in the infant at term. Sugar, therefore, is an important element in the premature infant's food, but should be given at first in a much lower percentage than later, when the equilibrium of the gastro-enteric tract has been acquired.

FAT AND PROTEID DIGESTION.—The function of digesting fat and proteids is in a much more undeveloped condition in the premature infant than in the infant born at term, and should, therefore, not be depended upon to the same degree as can safely be done in arranging the food for the older infant. Much smaller percentages of these elements should be given to the premature infant than to the infant at term, both for purposes of digestion and of absorption, for, in all probability, the power of absorption of the gastro-enteric tract in premature infants is in a very undeveloped condition.

KIDNEY.—We should expect, from the lack of development of the kidney in premature infants, to find a considerable deposit of uric acid, such as I have described as appearing in the early days of life in infants at term (Lecture IV., page 111, Plate III., 1). This is, in fact, the case, and the appearance of uric acid on the napkins of premature infants is, therefore, not necessarily to be looked upon as denoting an abnormal condition. It should, however, be carefully watched, for where it becomes excessive it is an indication that the infant's food has not been properly adjusted to its digestive powers and that the infant may soon begin to fail.

CIRCULATION.—The heart in premature infants has not yet arrived at the complete stage of development needed to render it a reliable central force which can fulfil the demands that will be made on it in the external world to sustain the equilibrium of the circulation. Therefore as little work as is possible should be thrown upon the heart, and the infant should be kept quiet, and not be carried about, as is customary with infants born at term.

In a number of cases which I have carefully examined I have failed to detect a cardiac murmur, which leads me to think that the foramen ovale closes soon after birth in the same manner as it does in the infant at term.

ANIMAL HEAT.—The animal heat of the premature infant is much more easily reduced, and is even more important to its vitality, than it is in the infant at term. Following the rule that the smaller the size of the human being the greater proportionately is the entire surface, and, therefore, the greater the opportunity for lowering its temperature, an atmosphere which is suitable for the infant at term is too cold for the premature infant.

Premature infants should be thoroughly protected from changes of temperature of the atmosphere in which they live, and this temperature should be raised to a point which will correspond in some degree to that of intra-uterine life.

AIR.—Just as a necessity exists for the premature infant to live for some weeks in an atmosphere where the air approaches in its temperature the warmth which exists in intra-uterine life, so is it almost to the same degree important that the air which it breathes should be free from dust and micro-organisms. The lung is in a very undeveloped condition, and although it may be sufficiently developed to carry on the function required of it in extra-uterine life, yet all its tissues are exceedingly sensitive, as are those of the nose and naso-pharynx through which the air must be introduced to the lungs. The air of the ordinary room where infants live when they are born necessarily contains many impurities, both irritating and morbid. This irritation of the respiratory passages may of itself be sufficient to reduce the vitality of the infant beyond the limits of life.

TOUCH.—Premature infants have to be carefully handled, as they die easily from influences which would have little or no effect upon the infant born at term. In intra-uterine life they are floating in a fluid which practically prevents what in the external world corresponds to *handling*. While they are living in the amniotic fluid they are almost completely protected from the influence of touch, which necessarily affects them as soon as they are born. *Touch*, then, is an important element, to be as much as possible avoided when the premature infant is born, as it has a decided tendency to lower the vitality.

An instance of the care which is needed to preserve the lives of these infants came to my notice in the case of an infant (Case 104) premature at eight months which was in my service at the City Hospital.

During the first week or ten days of its life this infant was in charge of an unusually careful and experienced nurse, who appreciated the risk of handling it. It was gaining in weight and was doing well; but unfortunately another nurse was substituted who did not understand this class of infants so well. She allowed the patients in the ward to handle the infant, to talk to it, and to surround it with various similar deleterious influences. For a few days it lost in weight, and then it suddenly died. There is no doubt that it was unable to withstand the amount of handling which would have done no harm to an older infant.

LIGHT.—The premature infant should live in comparative darkness during the early weeks of its life. Light is not requisite for the development of the infant in the earlier stages of its existence, and too much light will impair its vitality. It is important to adapt the light to the stage of its development, and gradually to accustom it to more light as it grows older.

SOUND.—In the normal intra-uterine conditions the infant is very slightly exposed to sound, and all its functions are adapted to silence rather than to the many noises which unavoidably surround it in the external

world. We should therefore arrange that from the minute it is born it is protected from noise.

PULSE, TEMPERATURE, AND RESPIRATION.—I have not any very exact records of the average pulse, temperature, and respiration found in premature infants. These infants seem to present rather irregular types of temperature and pulse, as well as of respiration. They have to be so carefully handled that observations as to these physical signs must be made with great caution. The main point in regard to these three conditions of the premature infant is that they are all represented by irregularity. The *temperature* of the premature infant, when it has once begun to gain in weight and to thrive, is usually a little above the normal temperature of the infant at term. Before it has begun to gain in weight and when its vitality is much depressed, the temperature, as would naturally be expected, is rather below the normal standard; and we should watch this sign with the greatest solicitude, as a decided and continuous depression is often indicative of death.

The *pulse* is difficult to take in the premature infant, and, as a rule, is somewhat quicker than in the infant at term.

The *respirations*, irregular in the infant at term, are still more irregular in the premature infant, at times being rapid for a few seconds, and then becoming almost imperceptible for some minutes.

This infant which I have had brought here to show you (Case 105) was prematurely born at the thirty-second week, and illustrates the fact that a premature infant, if its weight is not extremely small and if its development is somewhat above the average expected for its age, can live and thrive without all the precautions being taken for its preservation which I have already spoken of. These cases, however, merely emphasize the fact that if we are guided by them in our treatment of premature infants in general, we shall make many fatal mistakes and far fewer lives will be saved.

This infant weighed at birth 2954 grammes (about 6½ pounds). This would indicate that its chances for living were good, the other conditions of its development being normal, as you will understand by referring to this table (Table 2, p. 49) of the relation of weight to vitality. You see that the weight of this infant is between 2500 and 3000 grammes, showing that the vitality has risen above what is designated as low; in fact, it is within 49 grammes (about 1¾ ounces) of the 3000 grammes which represent a fair vitality. The infant was kept in a room where the temperature was 23.8° C. (75° F.). The air which was around its bed, which was in a basket, was heated to about 29.4° C. (85° F.). The infant was wrapped in fresh absorbent cotton. During the first twenty-four hours one teaspoonful of food was given every hour. After that time it was fed every hour during the day, and every two hours during the night. On the third day the mother had a sufficient supply of breast-milk, which flowed easily. The infant was therefore fed with the breast-milk from a spoon for a week, was then put directly to the breast, and continued to nurse until the end of the third week, when, as its mother's milk failed, it again had to be placed upon a carefully regulated substitute food.

There is nothing else especially interesting to record either in its history or in its physical condition, except that it had a small umbilical hernia, which did not cause any discomfort, and which closed at the end of the third month.

With this attention to its warmth and food it throve as any infant at term would have done, and has since been well and strong.

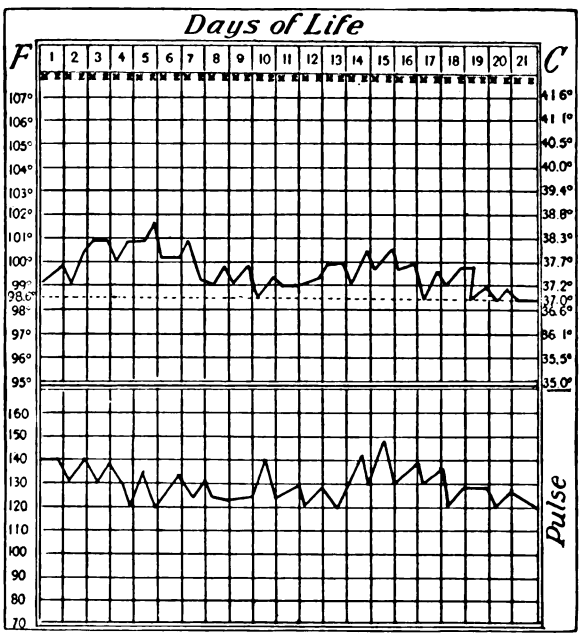
Here is a table (Table 81) which represents its weight for sixty-one days, and here is the record (Chart 5) of its temperature and pulse during the first three weeks of its life.

TABLE 81.

Weight for Sixty-One Days of Infant Premature at Thirty-Two Weeks.

Day of Life.	Grammes.	(Pounds.	Oz.)	Remarks.
Birth-weight . . .	2964	(6	8)	Cow's milk, with spoon.
Third	2724	(6	0)	Mother's milk, with spoon.
Sixth	2814	(6	3)	" " " "
Ninth	2964	(6	8)	Mother's milk direct from breast.
Thirteenth	3178	(7	0)	" " " " "
Sixteenth	3388	(7	7)	" " " " "
Twentieth	3598	(7	14)	Modified milk.
Twenty-third . . .	3812	(8	6)	" "
Twenty-seventh .	4116	(9	1)	" "
Thirtieth	4236	(9	5)	" "
Thirty-third . . .	4476	(9	13)	" "
Thirty-seventh . .	4600	(10	2)	" "
Forty-first	4840	(10	10)	" "
Forty-fourth . . .	4900	(10	12)	" "
Forty-eighth . . .	4994	(11	0)	" "
Fifty-first	5084	(11	3)	" "
Fifty-fifth	5234	(11	8)	" "
Fifty-eighth . . .	5324	(11	11)	" "
Sixty-first	5384	(11	13)	" "

CHART V.



All the possible causes which may reduce the premature infant's vitality must be thoroughly understood and obviated. You must also appreciate that a failure to recognize and obviate one of these causes may defeat the benefit which may arise from attending to all the others.

The premature infant should, so far as is possible, be restored to the

condition that it has been forced out of,—namely, a condition of darkness, silence, and warmth.

You see, therefore, that there are a great many points to be considered when you undertake to treat intelligently an infant prematurely born, and it is this treatment which I shall endeavor to explain to you.

AMOUNT OF FOOD AT EACH FEEDING.—I have already stated that the amount of food to be given at each feeding is very important. By referring to the weights and gastric capacities of the premature infants already described (Figs. 74, 75, 76, page 294), you will see how misleading is the weight of the infant if we take it as an exact index of the gastric capacity. We must, however, take the weight into account, as, from even the very imperfect data at our command, the weight of premature infants appears to bear a decided relation to their gastric capacity. We should at least be more inclined to increase rapidly the initial amount of food given in the case of an infant of large weight than in that of a small one. It is better to begin with too small rather than too large a quantity. By watching carefully for signs of hunger, a desire which the infant expresses by feeble but continuous cries, which stop when the food is given to it, we can gradually increase the amount until it seems to want it at regular intervals, is satisfied, and sleeps quietly during the intervals of feeding.

By referring to these fœtal stomachs (Figs. 73, 74, 75, 76), you will understand that it is safer to begin with 4 or 5 c.c. (about 1 drachm) and gradually to increase the amount up to a point where our very imperfect knowledge on this subject, derived partly from the weight of the infant, makes us believe that the stomach is full, than to begin at once with the larger amount. It is absolutely necessary that we should avoid undue distention of the stomach, as this may prove fatal.

INTERVALS OF FEEDING.—The premature infant's stomach is small, and is, in all probability, emptied quickly, and, as food is necessary for keeping up the animal heat required for the maintenance of its life, the intervals of feeding should be much shorter than those required for the infant at term. In the early days, and in fact weeks, of life, I have found that it is better to feed the premature infant regularly every hour. Four or five weeks after birth, if it is gaining in weight and is digesting well, these intervals can be so lengthened that by the time it arrives at term we can usually make the feeding intervals one and a quarter to one and a half hours, and a few weeks later two hours.

COMPOSITION OF FOOD.—The careful adjustment of the premature infant's food to its digestive organs is of even greater importance than in the case of the infant at term. There is no doubt that if we consider the hypersensitive condition and the undeveloped state of the digestive organs prior to birth, the most exact adjustment of the food to these digestive organs is absolutely necessary. This adjustment is best accomplished by means of carefully prepared prescriptions at the Milk-Laboratory. Through this instrument of precision three important advantages are gained:

(1) we insure a clean food free from micro-organisms; (2) we can obtain low and properly balanced percentages of the constituents of the milk; (3) we have, at any time, the power of exactly varying, to within a fraction of one-half of one per cent., the percentages of the three most important elements of the milk,—namely, the fat, the sugar, and the proteids. In addition to these latter two advantages possessed by the substitute over the maternal method of feeding are others of almost equal importance. One advantage is the absence of variation in the substitute food arising from emotional causes, and another is that the infant need not be taken from the incubator to be fed.

This prescription (Prescription 30) is the one which I should begin with in feeding an infant premature from the twenty-eighth to the thirty-sixth week:

PRESCRIPTION 30.

℞ Fat 1.00
Sugar 3.00
Proteids 0.50
24 meals, each 4 c.c. (1 drachm).
Heat to 75° C. (167° F.).
Reaction faintly alkaline.

If the infant is over twenty-nine weeks, or if it is unusually large for its age, and especially if it is unsatisfied, it is well in a few days to change the prescription to this one (Prescription 31):

PRESCRIPTION 31.

℞ Fat 1.50
Sugar 4.00
Proteids 0.50
24 meals, each 8 c.c. (2 drachms).

If the infant is over thirty-two weeks, vary the prescription in a few days, under the same conditions as in Prescription 31, to—

PRESCRIPTION 32.

℞ Fat 1.50
Sugar 5.00
Proteids 0.75
24 meals, each 12 c.c. (3 drachms).

If the infant is over thirty-six weeks, the milk should, after forty-eight hours, be increased and strengthened to—

PRESCRIPTION 33.

℞ Fat 2.00
Sugar 5.50
Proteids 1.00
24 meals, each 16 c.c. (4 drachms).

The infant, however, under all circumstances, must be watched critically, and any or all of the percentages of the elements or amounts of the food increased or decreased according to the individual indications.

When the infant is born at the thirty-eighth or thirty-ninth week its development is usually so near that of the infant at term that the incubator will not be needed, and the food can be given in about the proportions which would be adapted to the early days of the infant at term (Prescription 3, page 181).

WEIGHING.—A knowledge of the weight of the infant is exceedingly important in the management of its feeding, and changes in the degree of its vitality take place so rapidly that the daily increase or decrease in its weight becomes the principal index by which we are guided in changing the food.

The handling, however, which is necessary to obtain the daily weight is often a serious obstacle to the maintenance of its vitality. We should, therefore, endeavor to obtain the weight without reducing the vitality. The means for doing this I shall describe later.

CLEANSING AND CLOTHING.—A premature infant should not be bathed beyond what is necessary for simple cleanliness.

It should not be dressed, but should be wrapped in absorbent cotton. The cotton soon cleanses it thoroughly, and, if changed twice daily, or oftener if necessary, supplies the place of both clothes and bath. As a rule, no oil or ointment should be applied to its skin.

INCUBATORS.—I have already told you, when speaking of milk-laboratories, that it is better not to spare expense in obtaining the very best means for preserving life which comes within our power. If you appreciate this great principle, which lies at the root of all successful methods of preserving the lives of premature infants, you will understand that even the smallest details which I have spoken of, and which I shall again mention more at length, are not to be considered trivial or beneath your earnest and careful attention. The premature infant's life is so difficult to preserve that we should make use of every device which our ingenuity can suggest. From the very moment it enters the world its viability is likely to be brought to an end, and every minute is of importance in our endeavors to combat this tendency. We should, therefore, be ready to protect it at once from the adverse influences which surround it. We should have decided views of how to treat this early period of life, and also have the means which we think should be best employed ready to be supplied at once.

In the treatment of premature infants only one of the principal methods of maintaining their viability usually receives much attention. It is commonly supposed that if the atmosphere which surrounds the infant is kept at a sufficiently high temperature all that is requisite has been done for its safety. This until very recently has been accomplished by placing the infant in a room where the temperature is as high as the nurse in charge

of it is able to endure. This procedure is necessarily a very uncomfortable one for the nurse, and at times renders it almost impossible for her to use her mind intelligently. It also requires a much more frequent change of nurses than would be the case if the atmosphere of the nursery were cooler. In addition to this means of preventing undue loss of heat, the infant is wrapped in cotton-wool and placed in a basket lined with hot-water bottles, or it is placed at once in an apparatus which is called an incubator. These incubators have been used for many years in different parts of the world, notably in Paris. They are of different forms, which I need not describe here, as there is nothing especially important to recommend about them when we compare them with the latest form of incubator, which I shall presently describe to you (Fig. 80, page 306). The purpose of them all is the same,—namely, to keep the infant warm. Some of them are made of tin, with double walls, so that hot water can be continually kept in them, and thus sufficient warmth be applied to the infant. Others are made of wood, and kept warm by means of hot-water bottles introduced into them from below. None of them combines in the best way the many requisites necessary to preserve the premature infant's life.

The name incubator has been applied to these various devices for keeping up the animal heat of the infant. It is a misnomer, for incubation means hatching, and, in the precise sense of the word, the premature infant is already hatched and has been incubated. What we accomplish by this apparatus is analogous to what is done to keep up the animal heat and preserve the lives of young chickens after they are hatched, and the name *brooder* would be more applicable to machines devised for preserving the lives of premature infants than the term *incubator*. The word incubator is, however, so generally used to represent an apparatus intended to preserve the premature infant's life until it has attained the age of two hundred and eighty days, that it will, in all probability, for the present be retained. The true meaning, however, of what I am endeavoring to explain to you is so much better expressed by the word *brooder*, meaning warming, and not hatching, that I shall use it in speaking of the latest apparatus which has been invented for the purpose of human brooding.

Before speaking of the treatment of premature infants where every detail can be carried out in the most approved manner, I shall mention a few cases which illustrate the different points to which I have just referred. For instance, where it is impossible to obtain an incubator at once for preserving the premature infant's animal heat, it must be treated in the way which I have already referred to, by placing it in a room where the temperature has been raised to 32.2° C. (90° F.).

I have here a picture (Case 106) representing an infant premature at the seventh month, and now fourteen weeks old.

It is in this basket, enveloped in cotton-wool, and covered with blankets. You see that the thermometer is kept in the basket beside it, and the nurse has continually to watch it.

It was under the care of Dr. Hunt, of West Newton, with whom I saw it in consultation. It was placed in the incubator when it was four weeks old. It was taken out of the incubator when it was twelve weeks old. At this time it had gained very little in

FIG. 77.

Infant premature at twenty-eighth week. Birth-weight, 1200 grammes. Present age, fourteen weeks. Treated in basket heated by hot-water bottles. Temperature of air in basket shown by thermometer introduced between side of the basket and the blanket. The infant was removed from the incubator when it was twelve weeks old.

weight, was emaciated, puny, and feeble. Its abdomen was much distended, and its skin wrinkled, dry, and yellowish in color.

Here is a picture (Fig. 78) of this infant taken when it was fourteen weeks old, which shows the senile expression of the face so characteristic of premature infants at birth, and later when they are not thriving.

FIG. 78.

Infant premature at twenty-eight weeks. Present age, fourteen weeks.

Here is another picture (Fig. 79) of this infant, with its day nurse and its night nurse, its basket, and the scales on which it was weighed daily.

This picture is instructive in making you appreciate how small this infant was, as is well shown by comparing the size of its head with that of the nurses' heads.

FIG. 79.

Infant premature at twenty-eight weeks. Present age, fourteen weeks.

The next infant (Case 107) which I shall speak of was one which was prematurely born at about the thirty-third week. It was treated in a basket warmed with heaters, and in a room where the temperature was kept from 29.44° C. (85° F.) to 32.22° C. (90° F.). It was carefully nursed by a night nurse and a day nurse.

It weighed 2490 grammes (about 5 pounds 3 ounces). It was under the care of Dr. Edward Reynolds, with whom I saw it in consultation. Its food was carefully regulated at the Milk-Laboratory, and the first prescription which was written for it, and which proved to be adapted to its digestion during the first week or ten days, was this one (Prescription 34):

PRESCRIPTION 34.

℞ Fat 1.00
Sugar 3.00
Proteids 1.00
Lime water 5.00

The mixture to be heated for twenty minutes at 68.38° C. (155° F.).

From my later experience with these cases, I should begin with the percentage of proteids 0.50, as I have already described in this prescription (Prescription 30, p. 300). In the early days of this infant's life oxygen had to be administered to it for two or three minutes every hour. It was fed every hour, and received six drops of brandy with each feeding. At my first examination, which was made when it was six hours old, a distinct cardiac murmur was heard at the base of the sternum, and there were a few fine moist râles throughout both lungs. The murmur and the râles disappeared in the course of a week, and the infant, after losing 135 grammes (about 4½ ounces) in the first three days, began to make small gains in weight, and when it was seven weeks old it weighed 2730 grammes (about 5 pounds 11 ounces), was plump, had a healthy color, and seemed very well. It began to perspire when it was seven weeks old.

This case received the very closest attention, and was treated with all the details for safety which were possible to be attained without the use of an incubator, but we must consider that its weight, 2490 grammes (about 5 pounds 3 ounces), and its age, thirty-

three weeks, were such as to make the preservation of its life a much more simple matter than that of the infant (Case 106) whose picture I have just shown you, and whose light weight pointed towards so undeveloped and premature a condition that any omission in regard to the closest detail of treatment would have been likely to prove fatal.

This infant had progressed so far in its general condition and development that at the age of eight weeks it was taken out of the cotton in which up to that time it had been wrapped and was dressed. At this time it was taking 56 c.c. (1¾ ounces) at each meal, and was fed once in two hours.

The next case (Case 108) is that of an infant which was four weeks premature, and which was, for a premature infant, tolerably vigorous at birth. It was under the care of Dr. Samuel Breck, with whom I saw it in consultation. It was not placed in an incubator. Unfortunately, its nurse had no idea of the importance of protecting it from external influences. It was fed on a carefully prepared food from the Milk-Laboratory, and began to gain in weight, and in every way showed no evidence of its vitality being interfered with; but the nurse was possessed with the idea that it needed plenty of cold fresh air. The window in the infant's room was left open one night when the weather was quite cool. The following day it did not take its food well, was somewhat cyanotic, and was found to have lost almost 240 grammes (½ pound). It was then placed, as it should have been in the beginning, in a warm room, treated with the utmost care, and not handled much. None of these measures, however, were sufficient to prevent a still further lessening of its vitality. It never rallied from the first blow which was struck at its vitality, and lost its life practically through the ignorance of the nurse who was in charge of it.

A post-mortem examination showed nothing abnormal, except that the mesenteric glands were somewhat enlarged.

The next case (Case 109) was that of an infant born at about the twenty-fifth week of intra-uterine life. Its weight was 1080 grammes (about 2¼ pounds). There are a number of interesting points to be recorded in this case.

It was not strong enough to suck, and had to be fed with a spoon. Its mother's milk, the analysis (Analysis 55) of which I have here to show you, at once caused such disturbance that modified milk from the Laboratory had to be substituted.

ANALYSIS 55.

Fat	1.29
Sugar	4.10
Proteids	6.83
Ash	0.26
Total solids	12.28
Water	87.72
	100.00

This is the prescription for the modified milk which it digested well:

PRESCRIPTION 35.

Modified Milk.

℞ Fat	1.00
Sugar	3.00
Proteids	0.75

The infant's temperature in the rectum was 36.7° C. (98° F.). It seemed to be doing fairly well, but did not gain in weight, and on the fifth day of its life was unable to swallow. It was then fed by gavage.

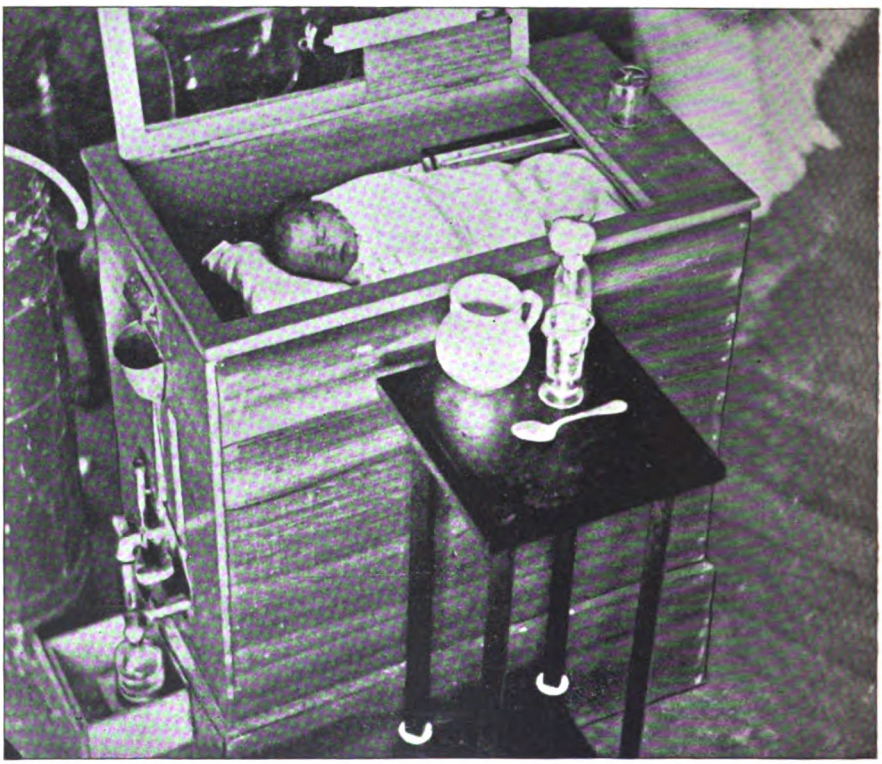
It was treated with great care so far as keeping it warm was concerned, but an incubator could not be obtained for it, and it died when it was seven days old.

It is interesting in this case to notice that the meconium came as is usual in the infant at term, and began to change its color on the third day, and that by the fifth day the fæcal movements were yellow and well digested.

These particulars were given to me by Dr. Woods, who was in charge of the case. Its death was evidently due to the lowering of its vitality consequent upon its age and lack of sufficient development to withstand the influences surrounding it in extra-uterine life.

I now wish you to examine this incubator (Fig. 80), which was devised by Dr. Worcester, of Waltham, Massachusetts. It is far superior in its mechanism and in its general utility to the other incubators which I have already referred to, except that of Tarnier, which it closely resembles. It is practically a wooden box, 76 cm. (2½ feet) long, 45.5 cm. (1½ feet) wide, and 76 cm. (2½ feet) high. This box, as you see, has a glass lid, which can be raised when necessary, but which is intended to be kept closed and to be used as a window through which to observe the infant. Two or

FIG. 80.



To left of incubator is the oxygen tank. To left of incubator on the floor is the lamp. At upper right end of incubator is an anemometer.

three holes at the end and at the bottom of the box allow the entrance of air. A hole at the top and end of the box, fitted with an anemometer, serves as an exit for the air. The continuous motion of the anemometer shows that the ventilation is being carried on properly. At the bottom of the box is a metallic boiler. A pipe from this boiler is brought through the end of the box, turns upward for a few inches, and then turns back and enters the box, where it connects again with the boiler. Outside of the end

TABL

Showing Details of Sixty-Four Days of Life in

Days of Life.	Intervals between Meals.	Amount at each Meal.		Percentages of Food.				Fæcal Discharges.			Weight.		
				Fat.	Sugar.	Proteids.	Lime Water.	No.	Character.	Wight.			
		C.c.	Dr'ms.							Oz.	Gr'ms.	Lbs.	Oz.
1	. . . . .	. .	. . . .	. .	3 per ct. sol. in aq. dis.	. . . . .	. . . .	. .	meconium.	. . . .	2040	4	4
2	1 hour.	4	1	1.00	3.00	1.00	5.00	2	brown, small.	. . . .	2040	4	4
3	1 hour.	4	1	1.00	3.00	1.00	5.00	2	"	. . . .	2040	4	4
4	1 hour.	4	1	1.00	3.00	1.00	5.00	2	"	. . . .	2040	4	4
5	1 hour.	4	1	1.00	3.00	1.00	5.00	2	only fairly digested.	. . . .	2040	4	4
6	1 hour.	4	1	1.00	3.00	1.00	5.00	2	"	. . . .	2040	4	4
7	1 hour.	4	1	1.00	3.00	1.00	5.00	2	"	. . . .	2040	4	4
8	1 hour.	4	1	1.00	3.00	1.00	5.00	2	"	. . . .	2055	4	4½
9	1 hour.	4	1	1.00	4.00	1.00	5.00	2	yellow.	. . . .	2040	4	4
10	1 hour.	4	1	1.00	4.00	1.00	5.00	2	well digested.	. . . .	2025	4	3½
11	1 hour.	8	2	1.00	4.00	1.00	5.00	2	"	. . . .	2025	4	3½
12	1 hour.	8	2	1.00	4.00	1.00	5.00	2	"	. . . .	2055	4	4½
13	1 hour.	8	2	1.00	4.00	1.00	5.00	2	"	. . . .	2070	4	5
14	1 hour.	8-10	2-2½	1.00	4.00	1.00	5.00	2	"	. . . .	2070	4	5
15	1 hour.	8-10	2-2½	1.00	4.00	1.00	5.00	2	"	. . . .	2070	4	5
16	1 hour.	12	3	1.50	5.00	1.00	5.00	2	"	. . . .	2160	4	8
17	1 hour.	12	3	1.50	5.00	1.00	5.00	2	"	. . . .	2160	4	8
18	1 hour.	12	3	1.50	5.00	1.00	5.00	2	"	. . . .	2160	4	8
19	1 hour.	12	3	1.50	5.00	1.00	5.00	2	"	. . . .	2190	4	7
20	1 hour.	12-14	3-3½	1.50	5.00	1.00	5.00	2	"	. . . .	2160	4	8
21	1 hour.	16	4	1.50	5.00	1.00	5.00	2	"	. . . .	2175	4	8½
22	1 hour.	16	4	1.50	5.00	1.00	5.00	2	"	. . . .	2220	4	10½
23	1 hour.	16-18	4-4½	1.50	5.00	1.00	5.00	2	"	. . . .	2235	4	10½
24	1 hour.	16-18	4-4½	1.50	5.00	1.00	5.00	2	"	. . . .	2250	4	11
25	1 hour.	18-20	4½-5	2.00	5.00	1.00	5.00	1	"	. . . .	2250	4	12
26	1 hour.	18-20	4½-5	2.00	5.00	1.00	5.00	2	"	. . . .	2250	4	12
27	1 hour.	18-20	4½-5	2.00	5.00	1.00	5.00	1	"	. . . .	2265	4	12½
28	1 hour.	18-20	4½-5	2.00	5.00	1.00	5.00	2	"	. . . .	2310	4	15
29	1 hour.	20	5	2.00	5.00	1.00	5.00	2	"	. . . .	2310	4	15
30	1 hour.	22	5½	2.00	5.00	1.00	5.00	3	slightly green.	. . . .	2280	4	13
31	1 hour.	22	5½	2.00	5.00	1.00	5.00	4	"	. . . .	2295	4	12½
32	1 hour.	22	5½	2.00	5.00	1.00	5.00	4	"	. . . .	2295	4	12½
33	1 hour.	24-26	6-6½	2.00	5.00	1.00	5.00	5	"	. . . .	2295	4	12½
34	1 hour.	28	7	2.00	6.00	1.00	10.00	8	"	. . . .	2295	4	12½
35	1¼ hrs.	32	8	2.00	6.00	1.00	10.00	5	yellow and well digested.	. . . .	2340	4	14
36	1¼ hrs.	32	8	2.00	6.00	1.00	5.00	5	"	. . . .	2400	5	0
37	1¼ hrs.	32	8	2.00	6.00	1.00	5.00	3	"	. . . .	2430	5	2
38	1¼ hrs.	48	12	2.00	6.00	1.00	5.00	3	"	. . . .	2490	5	4
39	1¼ hrs.	48	12	2.00	6.00	1.00	5.00	3	"	. . . .	2550	5	6
40	1¼ hrs.	48	12	2.00	6.00	1.00	5.00	5	"	3	2550	5	5
41	1½ hrs.	48	12	2.00	6.00	1.00	5.00	2	"	2½	2550	5	5
42	1½ hrs.	48	12	2.00	6.00	1.00	5.00	2	"	2½	2550	5	5
43	1½ hrs.	48	12	2.00	6.00	1.00	5.00	1	"	. . . .	2580	5	8
44	1½ hrs.	48	12	2.00	6.00	1.00	5.00	2	"	2½	2550	5	10
45	1½ hrs.	48	12	2.00	6.00	1.00	5.00	5	"	8	2550	5	10
46	1½ hrs.	48	12	2.00	6.00	1.00	5.00	6	"	9	2580	5	8
47	1½ hrs.	48	12	2.00	6.00	1.00	5.00	6	"	9	2580	5	8
48	1½ hrs.	48	12	2.00	6.00	1.00	5.00	4	"	. . . .	2520	5	11
49	1½ hrs.	48	12	2.00	6.00	1.00	5.00	4	"	. . . .	2520	5	13
50	1½ hrs.	56	14	2.00	6.00	1.00	5.00	6	"	6	2550	5	15
51	1½ hrs.	56	14	2.00	6.00	1.00	5.00	5	"	6	2550	5	15
52	1½ hrs.	64	16	2.00	6.00	1.00	5.00	6	"	5½	2520	5	9
53	1½ hrs.	64	16	2.00	6.00	1.00	5.00	5	"	. . . .	2520	5	9
54	1¾ hrs.	64	16	2.00	6.00	1.00	5.00	2	"	3	2550	5	3
55	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	1	"	3	2550	5	3
56	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	1	"	2	2520	5	5
57	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	3	"	5	2550	5	5
58	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	1	"	. . . .	2580	5	7
59	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	3	"	. . . .	2520	5	8
60	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	1	"	. . . .	2610	5	11
61	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	3	"	. . . .	2550	5	9
62	1¾ hrs.	64	16	3.00	7.00	1.00	5.00	5	"	. . . .	2610	5	12
63	1¾-2 hrs.	64	16	3.00	7.00	1.00	5.00	2	"	. . . .	2610	5	12
64	1¾-2 hrs.	64	16	3.00	7.00	1.00	5.00	2	"	. . . .	2670	5	13
65	1¾-2 hrs.	64	16	3.00	7.00	1.00	5.00	2	"	. . . .	2670	5	14
68	1¾-2 hrs.	64	16	4.00	7.00	1.00	5.00	2	"	. . . .	2700	6	15

At six months weighed 7080 grammes (14 pounds 12 ounces) and was taking 150 c.c. (5 ounc

...tor of Case 110. Premature at Thirty Weeks.

...ATURE ...TAX.	PULSE.	RESP.	TEMPERATURE OF INCUBATOR.		REMARKS.
°F.			°C.	°F.	
99.5	135	60	32.2	90	Nails formed. No lanugo. Heart normal. Lungs normal. Emaciated. Cry feeble.
. . . . .	. . .	. . .	32.2	90	Uric acid on napkin. Food heated to 75° C. (167° F.).
. . . . .	. . .	. . .	32.2	90	Somnolent.
. . . . .	. . .	. . .	32.2	90	No uric acid. Fed with dropper.
102.5	. . .	50-60	32.2	90	Temperature went up in evening. Perspired freely. Temperature of incubator lowered to 28.3° C. (85° F.). Hiccough relieved by brandy.
99.5	. . . . .	. . .	28.3	83	Respirations irregular: 10 quick and then imperceptible for 10 seconds. Cord fell. Somnolent.
. . . . .	. . . . .	. . .	26.6	80	Cry a little stronger. As still perspiring a little, temperature of incubator reduced to 26.6° C. (80° F.).
. . . . .	. . . . .	. . .	26.6	80	Slight ophthalmia neonatorum. Icterus neonatorum. Black cloth over lid of incubator.
. . . . .	. . . . .	. . .	26.6	80	Somnolent.
. . . . .	. . . . .	. . .	26.6	80	Less icterus.
99.5	130	60	26.6	80	Hiccough.
100.5	130	60	26.6	80	Hands and feet cold.
. . . . .	. . . . .	. . .	26.6	80	Hands and feet warmer. Oxygen in fresh-air-box for 10 minutes three times daily. Seems hungry.
. . . . .	. . . . .	. . .	28.8	84	Every other feeding takes 2½ drs. Oxygen as on 13th.
. . . . .	. . . . .	. . .	28.8	84	Oxygen as on 13th.
99.0	130	60	29.4	85	Oxygen 5 minutes twice daily. Feet cold when incubator below 29.4° C. (85° F.).
98.8	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	Less icterus.
. . . . .	. . . . .	. . .	29.4	85	Oxygen.
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	Very hungry. Oxygen.
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	Oxygen.
. . . . .	. . . . .	. . .	29.4	85	Occasional cyanosis.
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	Oxygen.
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	Brandy 5 drops every 2 hours.
98.5	. . . . .	. . .	28.3	83	Feet and hands not cold except when temperature of incubator as low as 26.6° C. (80° F.). Seems hungry.
. . . . .	. . . . .	. . .	28.3	83	Oxygen. Brandy 5 drops three times daily.
98.5	. . . . .	. . .	28.3	83	Brandy 5 drops three times daily. Oxygen. Began to feed with nipple.
. . . . .	. . . . .	. . .	26.6	80	Respirations deeper and more regular. Slight cyanosis. Oxygen.
98.8	140	40	29.4	85	
. . . . .	. . . . .	. . .	29.4	85	
. . . . .	. . . . .	. . .	26.6	80	Oxygen. Brandy 5 drops.
. . . . .	. . . . .	. . .	26.6	80	
101	. . . . .	. . .	26.6	80	Oxygen. Brandy 5 drops every other feeding.
. . . . .	. . . . .	. . .	26.6	80	
. . . . .	. . . . .	. . .	26.6	80	
99	138	48	25.5	78	Allowed to have a little light in incubator. Omit oxygen.
99	. . . . .	33	25.5	78	
99.5	. . . . .	. . .	25.8	75	Oxygen. Brandy. Somnolent.
101	. . . . .	. . .	25.8	75	No light.
99.5	. . . . .	. . .	25.8	75	Is brighter. Oxygen.
. . . . .	. . . . .	. . .	25.8	75	
. . . . .	. . . . .	. . .	25.8	75	Oxygen. Brandy.
. . . . .	. . . . .	. . .	25.8	75	Seems stronger. More light.
99	. . . . .	. . .	25.8	75	Oxygen.
. . . . .	. . . . .	. . .	25.8	75	Brandy.
99.5	. . . . .	. . .	25.8	75	Seems hungry.
99	. . . . .	. . .	25.8	75	Oxygen.
99	. . . . .	. . .	22.2	72	Omit oxygen.
99	. . . . .	. . .	22.2	72	Sleeps and takes food well. Seems stronger and brighter, and is tranquil. Does not cry.
. . . . .	. . . . .	. . .	22.2	72	
. . . . .	. . . . .	. . .	22.2	72	Very bright and tranquil.
. . . . .	. . . . .	. . .	21.1	70	
. . . . .	. . . . .	. . .	21.1	70	Taken out of incubator. Cried 9 hours. Vomited. Put back into incubator.
. . . . .	. . . . .	. . .	21.1	70	
. . . . .	. . . . .	. . .	21.1	70	Tranquil. Does not cry.
. . . . .	. . . . .	. . .	. . .	. . .	Taken out of incubator and washed in water at 35° C. (95° F.).
99	. . . . .	. . .	. . .	. . .	Sleeps well. Does not cry. Is growing stronger.
. . . . .	. . . . .	. . .	. . .	. . .	Thriving. Brandy omitted.

...ch heal. Looked bright, had a good color, and was well developed and vigorous.

of the box there is a pipe by means of which the boiler can be filled with water. A stop-cock allows the water to run off from the boiler when it is necessary to empty it, or to regulate the heat of the water by allowing the cold water to flow out and warm water to replace it. A lamp of any kind placed under the arm of the pipe which comes from the boiler keeps up and regulates the warmth of the water in the boiler. I would here call attention to the fact that when the source of heat is outside of the incubator there is a danger that the free flame may set fire to the nurse's dress.

Above the boiler is a shelf, on which the infant's bed is placed, sufficient space being left between the ends of the bed and the box for a free circulation of the contained air.

A thermometer is attached to the water apparatus of the boiler, and indicates the heat of the water.

A thermometer is attached to the lid of the box, and is intended to show the temperature of the air in the box.

I have here a picture (Fig. 80) of an infant (Case 110, page 306) in this incubator, prematurely born at about the thirtieth week of intra-uterine life.

The lid of the incubator is open, representing a time when the infant is to be fed. On the left of the incubator part of the oxygen tank is shown. On a table beside the incubator are the measuring glasses, a glass tube with a cotton stopper containing the infant's food, which was prepared at the Milk-Laboratory, a pitcher of warm water to keep the food warm, and the teaspoon with which the infant was fed. In the bed beside the infant you will see that there is another thermometer, which it was found necessary to use, as the thermometer attached to the lid was subject to such variations in temperature through the glass, according to the variations of the temperature in the room, that it did not indicate exactly the temperature of the air by which the infant was surrounded. In the treatment of this infant in the incubator much difficulty arose in keeping the ventilation perfect, and at times the air for hours had to be forced through the air-box by fanning the air through the holes of entrance.

This infant was taken care of in an unusually exact way, and with such intelligence on the part of the nurses and parents that the details of its life in the incubator become of extreme value in our study of the treatment of this class of cases. I shall therefore describe the details of its existence in the incubator from the time when it was born until it was sufficiently developed to be safely taken care of in the ordinary way.

The infant and its mother were under the care of Dr. George Haven and Dr. W. L. Richardson, with whom I saw it in consultation in the early hours of its life and by whom it was placed in my charge. At birth its nails were fairly developed. Its face was not especially wrinkled, but its body and limbs did not show much evidence of subcutaneous fat. The lanugo was not present. Its weight was 2040 grammes (about 4½ pounds). On comparing this weight with the weights given in this table (Table 2, page 49) of the relation of weight to vitality, you will see that it is representative of that of an infant at term of very low vitality. The heart and lungs were normal. No cardiac souffle was heard over the area of the foramen ovale. The cry was rather feeble. The infant was very somnolent.

I think you will be able to understand the details of this case most clearly if I arrange them for you in the form of a table (Table 82).

The table records the details of the infant's life in the incubator during a period of sixty-four days. The record will, I think, be of great use to

any one who has charge of a premature infant in an incubator, as it illustrates exactly what emergencies are likely to arise and how they can be met.

The infant, as is seen by referring to the column of remarks, came very near dying a number of times, and unquestionably would have died had it not been carefully managed, as, for example, by the administration of oxygen, by prompt changes in its food, by the regulation of the temperature of the incubator, and by the constant attention of a day nurse and a night nurse.

I have now in a general way told you the main facts which are known about premature infants, and the results of my experience with this class of cases. The last case (Case 110) which I have described as being treated in Dr. Worcester's incubator was the one from which I learned how very inadequate are our usual methods of treating premature infants. In the direction of this case I received so much information as to the mechanical management of the many difficulties which were continually presenting themselves in the daily care of the apparatus from Mr. J. P. Putnam, that it was at once impressed upon me that a domicile in which an infant might have to live for several months should be devised and regulated as to its ventilation and general practical usefulness even more carefully than the houses in which adults live. This meant that such apparatus needed the skilled attention of an expert in building and in ventilation. I therefore placed in Mr. Putnam's hands the construction of what I prefer to call a *brooder*. I am also indebted for many valuable suggestions as to the construction and use of the brooder to Mr. G. E. Gordon, who has had considerable experience in preserving the lives of premature calves.

Before inspecting the brooder more closely I should like you to examine this table (Table 83), in which I have condensed what I have already told you concerning the requirements needed to preserve the lives of premature infants.

TABLE 83.

Indications for conserving the Viability of Premature Infants.

I. There should be a receptacle which shall guard the infant from the deleterious influences of extra-uterine life.

II. There should be an apparatus that can be obtained quickly and transported rapidly, and which therefore should be kept at some central and convenient station.

III. The place where the brooder is kept should be free from the influence of any disease.

IV. The brooder should be so constructed as to make it possible for it to be absolutely cleansed and disinfected each time after it has been used, hence it should be made of metal.

V. The brooder should, as soon as the infant is placed in it, be under the observation of trained nurses night and day.

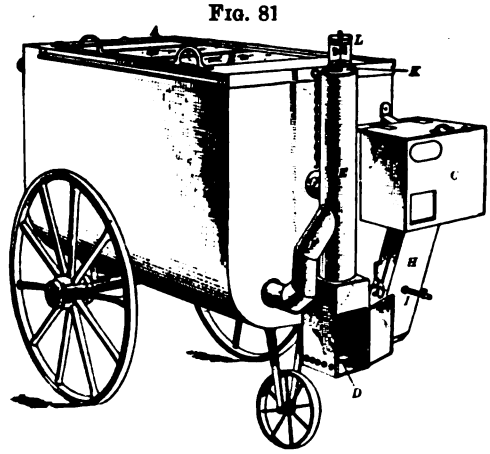
VI. The food for the infant should be regulated with the greatest precision, with the closest attention to minute details, and, if possible, at a milk-laboratory.

These are the principal rules which should be attended to where the physicians of any community wish to provide the best means for preserving the lives of the premature infants in that community. The expense of such

means, while too great for any one individual, is comparatively insignificant for a number. The brooder at present must necessarily be an expensive machine, but if provision should be made for it in combination with such scientific facilities for infant feeding as I have already recommended, I believe that any community would find it of infinite benefit. I am also sure that there would result saving of life for the people, and saving of time and expense for the physicians, combined with the greatest satisfaction to both people and physicians. Such a combination, in cities of a milk-laboratory or in the country of a Babcock milk-tester with a brooder kept in one central station, I hope to see established everywhere. One such station for districts which might be included in a radius of ten or even of twenty miles would be amply sufficient to accomplish very favorable results.

BROODER.—You will now, I hope, appreciate that it is often quite necessary to provide not merely a receptacle but an actual habitation for premature infants during a period of months. Such a habitation, which I prefer to call a *brooder* in order to represent it by the name which explains it rightly, I have here to show you (Fig. 81).

FIG. 81



Brooder for premature infants. *A*, scales for weighing infant; *B*, glass lid of incubator; *C*, fresh-air box, containing clock-work and fan; *D*, lamp for heating water-jacket; *E*, chimney; *F*, return flue from heating-flues; *G*, return fresh-air flue; *H*, entrance for fresh air; *I*, connection for oxygen tank; *J*, mixing-valve; *K*, ventilating exit; *L*, anemometer.

This apparatus has been made to fulfil the conditions of a house for the premature infant, and it practically meets the indications called for in this table (Table 83, p. 308). After being used, it can be completely disinfected and cleansed. It is kept at the Milk-Laboratory, whence it can be obtained at a moment's notice. For purposes of disinfection, and that it may not absorb micro-organisms or dirt of any kind, which in wooden receptacles invariably cause a decided odor, it is made entirely of metal.

The brooder is supported, as you see, on three wheels, preferably made of light steel, two behind and one guiding wheel in front. A handle is used to push it to different parts of the room, or, if necessary, to an adjoining room, so that the mother can see her infant if she is too sick to leave her bed. The top of the brooder is about 91 cm. (3 feet) from the floor, so that the nurse does not have to stoop unnecessarily, but at the same time can, when sitting down, see into it from above. It is 76 cm. (2½ feet) wide and 91 cm. (3 feet) long. The body is made of copper; the walls are double, and insulated on the outside, to prevent radiation. The water used

for heating circulates on all sides, and the infant is thus warmed by direct radiation. The top of the brooder is covered in the middle by a thick plate-glass lid, which can be raised sufficiently to allow the hands and arms of the nurse to be freely used in the brooder, and is by a simple contrivance kept from falling down while the infant is being fed or touched. A chain prevents the lid from falling backward. On the under side of the glass lid is a fine wire sliding screen, which comes directly over the infant's head and between it and the glass. This is simply a precaution against the possible breakage of the glass lid and consequent injury to the infant.

This plated box (*C*), which you see attached to the upper front end of the brooder contains some strong clock-work with a fan attachment. This oval opening in the clock-box admits the air to the brooder. Below the opening for the fresh air is a window, through which the fan and clock-work can be watched.

Just below the air-opening and above the clock-work is a fine open wire shelf, on which is spread a thin layer of cotton-wool. The air, which by means of the fan is drawn into the box, is sifted through the cotton and carried down the air-shaft (*H*) directly into the brooder. In this air-shaft (*H*) you see there is a small stop-cock (*I*). This is the point of attachment for the tube from the oxygen tank, to be used when oxygen is needed to be mixed with the entering air-supply.

In this air-shaft, also, is attached a valve, which is so regulated by a register handle that the air can be utilized either above or below the boiler, according as it is needed and as I shall explain later.

The bottom of the brooder constitutes an air-chamber, and in this is a boiler which, with its heating or combustion direct and return flues, warms the interior of the apparatus.

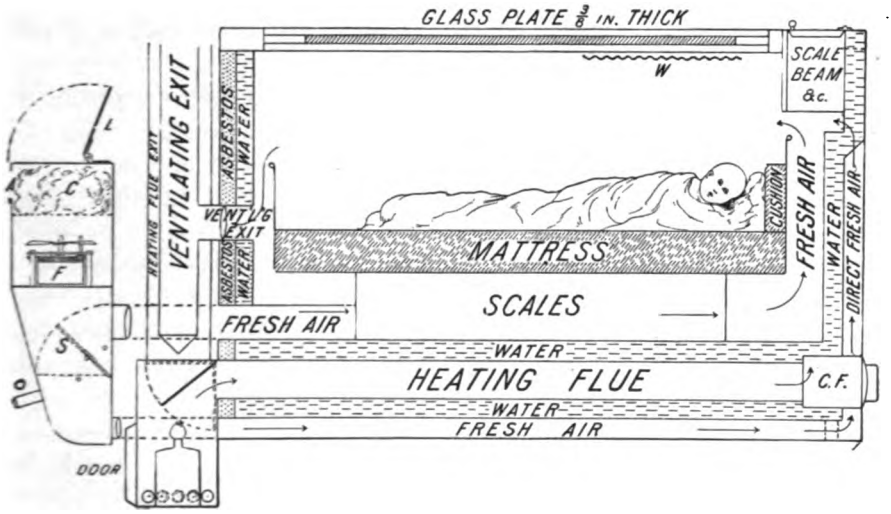
Above the boiler is placed the platform of a scale. The balance power of this scale is on the top of the back end of the brooder. The platform of the scales acts as the support for a metal pan 61 cm. (2 feet) long and 30.5 cm. (1 foot) wide, on which the infant is placed. This pan should be made of sheet iron, enamelled on both sides with white porcelain enamel, and should have handles at either end to facilitate its removal from the brooder. From the ends of this pan is hung by wires, which can be easily attached or detached, a light frame made of four steel rods crossed. On this frame is tied with tapes a piece of strong cotton cloth. This cloth is the infant's bed, on which it is placed wrapped in clean absorbent cotton. This cotton cloth is about 2.5 cm. (1 inch) above the bottom of the pan. The infant's head is turned to the back end of the brooder.

At the front end, opposite the foot of the infant's bed, is the exit (*G*) for the vitiated air. This exit passes through the end of the brooder and enters a ventilating pipe which has at its top an anemometer (*L*). The bottom of the shaft is outside the brooder, and has a closed cone-shaped end, which is enclosed in a metal box in such a way that a lamp (*D*) can be placed under it. The heat from this lamp answers two purposes. One is,

by keeping the ventilating shaft hot, to aid the ventilation, and the other is to heat the water in the boiler. A register-valve (*J*) attached to the pipe can shut off the heat if necessary from the boiler, and allow it to go directly up the double pipe (*E*, *K*), whereby its entire power will be used in promoting ventilation, or the valve may be set so as to direct the flame partially into the boiler, thus placing its temperature completely under control. In this way the heat from the lamp (which is enclosed in the box) is without danger entirely utilized for heating and ventilation.

I have now shown you the brooder and its general features. I shall still further explain to you its mechanism by means of this sectional diagram (Diagram 6).

DIAGRAM 6.



Section of brooder. *L*, lid of fresh-air box, open; *A*, entrance of fresh air; *C*, cotton, resting on wire shelf above clock-work; *F*, clock-work and fan; *S*, valve regulating hot and cold fresh air; *O*, pipe for oxygen attachment; *C. F.*, cleaning-flue; *Door*, door to lamp-box; *W*, wire frame to protect against breakage of lid.

The smoke-flue of the lamp, marked "Heating Flue," passes through the centre of the boiler, marked "Water" in the diagram, as far as to the cleaning-flue, marked *C. F.* Thence it returns and enters the upright pipe marked "Heating Flue Exit." The horizontal return-flue is not shown in the diagram, because it is behind the horizontal arm shown. The little gate-valve shown directly above the lamp regulates absolutely the amount of heat which is allowed to pass through the boiler, and the temperature of the warm water therein may be tested by a chemist's thermometer, inserted at any opening which may be provided for it as directed when the brooder is built.

The fresh-air flues are constructed, as shown, one above and one below the boiler. One flue comes in contact with the upper or hottest part of the boiler, and presents a very large surface of contact therewith by being flattened so as to cover completely the upper side of the boiler. The other flue touches the bottom of the boiler only in one line, or not at all, so that

the air passing through it is practically unaffected by the boiler heat. By this arrangement the temperature of the fresh air can be regulated at will by the attendant by simply raising or lowering the valve *S*.

In virtue of the large amount of heating surface of the heating flue in this apparatus, it is found that a very small flame suffices to keep up the desired temperature, and it results from this that no injurious products of combustion contaminate the air of the room. A very small alcohol lamp can be used, while with a less scientific arrangement this fuel might be found too expensive.

It is probable that an electric current will be found most suitable to supply the heat in place of the lamp, as well as to drive the fan, and this can be very easily accomplished with a small battery.

By packing the water-jacket with asbestos, external radiation is prevented.

The heating of the brooder varies as to time and degree according to the atmosphere of the room where it has been standing. If, however, the temperature of the room is 21.1° C. (70° F.), and the temperature of the water which is introduced into the boiler is about 40.5° C. (105° F.), it will be found that after the cool air in the brooder has been displaced the temperature of the air in the brooder will in about fifteen minutes rise to 35° C. (95° F.). The temperature will remain at this point for about half an hour. As soon as the temperature begins to fall the alcohol lamp should be lighted, and as soon as the temperature of the water in the boiler rises above 35° C. (95° F.) the lamp should be extinguished. By careful regulation of the lamp and regulating the fresh air by means of the register-valves, an intelligent nurse can keep the temperature of the brooder at whatever degree the physician orders. The thermometer should, in order to show accurately the temperature of the air which the infant is breathing, be beside it on its bed, as when attached to the lid it is influenced by changes of temperature in the room.

If any difficulty arises from the temperature not responding quickly enough to the register-valves and lamp, it is well to draw off a little hot water and replace it by some cold water if it is desired to lower the temperature, while to raise the temperature the withdrawn water is to be replaced by hot water.

NURSES.—The brooder is not intended to obviate the necessity of skilled nursing. On the contrary, a nurse should be in constant attendance night and day. She should have all the details of the infant's care and the mechanism of the brooder explained to her minutely, for an emergency may arise at any time, and always requires to be dealt with immediately.

The brooder supplies the means for exact treatment, but intelligent minds and trained gentle hands are indispensable. The nurse should frequently observe the infant through the glass lid, and should be certain that the anemometer is in constant motion.

APPARATUS CONNECTED WITH THE BROODER.—A stethoscope like this one (Fig. 85, p. 323) is the best adapted for examining the infant in the brooder. It can be bent in any direction, and the small calibre of its cup is best adapted to the infant's size.

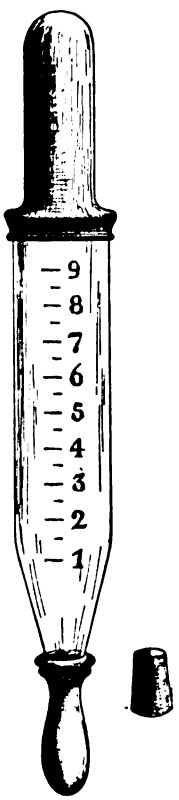
A piece of dark cloth should be kept over the glass lid, to preclude the light, while the sun should be allowed to shine freely into the room.

The method of feeding the infant in the brooder is important. It frequently happens that the premature infant is too weak not only to suck the breast, but also to be fed from the bottle. In such cases it is customary to use a spoon or a medicine-dropper. These, however, are very unsatisfactory instruments. The food is liable to be spilled, the spoon or dropper has to be frequently filled, and much time is taken to complete the feeding. The lid of the brooder, also, should not be kept open for a longer time than is unavoidable.

I have lately made use of a device suggested by Dr. Breck, who first brought it to my notice when I was seeing a premature infant with him in consultation where there was much difficulty in getting the infant to swallow, and where it would not suck.

It is simply this glass cylinder (Fig. 82), 12 cm. (4¾ inches) long and 2.4 cm. (1 inch) in diameter. The cylinder is graduated to 2 c.c. (½ drachm), and holds 36 c.c. (9 drachms). It is shaped at one end so as to have a small rubber nipple fitted to it. The large end is covered by a rubber cot. The rubber cot, which has no holes, acts as an air-reservoir, and by simply introducing the small perforated nipple into the mouth and gently pressing the rubber cot the food is slowly forced down the infant's throat, without choking it and without the infant having to suck or apparently to use any effort. To fill the tube the rubber nipple and cot are removed, a rubber stopper like this (Fig. 82) plugs the small end of the cylinder, and the required amount of food is poured in at the large end.

FIG. 82.



Feeder for premature infants (reduced one-half).

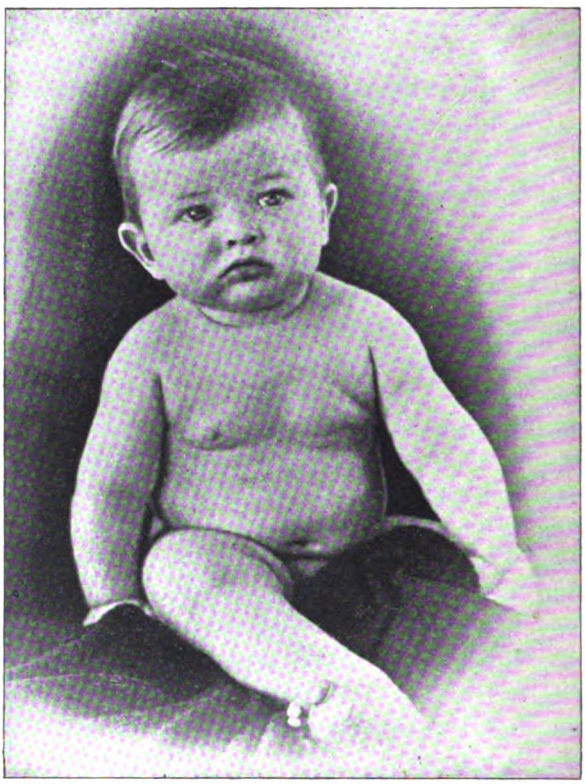
This method of feeding is especially desirable for a weak premature infant in a brooder, because it entails no loss of strength on the part of the infant, and can be easily managed by the right hand of the nurse while her left hand supports the infant's head. This method is far preferable to that of gavage, which is not so easily managed by the nurse and causes more exhaustion to the infant.

The question is often asked whether premature infants, even if their lives are saved, can be as well developed physically and mentally as are those born at term. In my experience, there seems to be no question that when once we have succeeded in making the

infant gain steadily in weight and assume the appearance of an infant at term its subsequent condition differs in no respect from that of infants born at term.

I have here to show you a picture of the infant (Case 110, p. 307) which was treated in Dr. Worcester's incubator.

FIG. 83.



Infant premature at thirty weeks. Birth-weight, 2040 grammes. Treated in incubator eight weeks. Present age, nine months. Present weight, 8400 grammes.

This picture was taken when the infant was nine months old, and it weighed at that time 8400 grammes (17½ pounds). As its birth-weight was 2040 grammes (about 4½ pounds), you see that it has quadrupled its weight. It was fed entirely on modified milk from the Laboratory during the first year, and is now a fine large boy, walking and talking at two years of age. It is perfectly healthy and well developed both physically and mentally.

His sister, who was premature at the twenty-eighth week, is now eight years old. She is well developed and strong, and is unusually bright and intelligent for her age. She is, in fact, decidedly in advance mentally of the other children of her age at her school.

I have here the record of an infant prematurely born at about the thirtieth week, and weighing 2850 grammes (about 5 pounds 15 ounces), which was the first premature infant that happened to be treated in this brooder (Fig. 83).

This infant (Case 111) was born at ten minutes past three on February 16. It was placed in the brooder at 9 P.M. of the same day, the temperature of the brooder being 34.4° C. (94° F.).

On the following day, February 17, the infant was given by the nurse 4 c.c. (1 drachm) of diluted cow's milk every hour for three feedings, which he vomited almost immediately after taking. The intervals of feeding were then increased to two hours, but the milk was not retained. The nurse then gave him 2 c.c. (½ drachm) every three hours during the night, which he retained for a number of feedings, but then vomited bile and mucus, together with the undigested food which had been given him.

February 18 the infant was found to have lost 420 grammes (14 ounces) in weight, to be very weak, and to be unable to retain the milk diluted with water. The meconium came away on this day, and there was a uric acid stain on the napkins. The infant was very restless. Its respirations were irregular, and its feet and hands were cold. The temperature of the brooder, which up to this time had been kept at 34.4° C. (94° F.), was lowered to 33.8° C. (93° F.), as the infant had begun to perspire. A substitute food was ordered from the Milk-Laboratory on this day, the prescription for which was as follows (Prescription 36):

PRESCRIPTION 36.

℞ Fat 1.00
Sugar 3.00
Proteids 0.50
To be heated for thirty minutes at 75° C. (167° F.).
Lime water 5.00
24 tubes, each containing 4 c.c. (1 drachm).

This food was given to the infant every hour.

On the following day, the 19th, the record was that the food had been retained, that the infant had seemed so hungry that the amount had to be increased to 10 c.c. (2½ drachms), and that it was found advisable to feed it every two hours rather than every hour. There was no vomiting. There were two movements of the bowels, which still showed evidences of undigested milk and some meconium. The infant's weight on this day was found to be the same as on the previous day, 2300 grammes (5 pounds 1 ounce).

On the following day, February 20, the infant was found to have gained 30 grammes (1 ounce). It was taking its food regularly every two hours, alternating with the mother's milk, which had come in considerable quantity. There were still evidences of uric acid in the urine. The temperature of the brooder was kept at 31.6° C. (89° F.).

On the following day, February 21, the weight was as on the previous day, 2230 grammes (5 pounds 2 ounces). The color of the fæcal discharges was yellowish brown. There was only one discharge in the twenty-four hours, obtained by the use of a suppository. The temperature of the brooder was kept at 30° C. (86° F.).

On the following day, February 22, it was found that the infant had lost 60 grammes (2 ounces). The substitute food was then given every two hours, alternating with the breast-milk. On that day there were three yellow well-digested movements. The temperature of the brooder was kept at 29.4° C. (85° F.). The infant seemed stronger, was very quiet, and slept except when it awoke to receive its food.

On the following day, February 23, there is no record of the infant's weight, but it was evidently in a very precarious condition and seemed exhausted. It did not take its nourishment readily. It had five small fæcal discharges in the twenty-four hours, which, however, were yellow and fairly digested.

On the following day, February 24, the breast-milk was omitted, and 4 c.c. (1 drachm) of modified milk were given every two hours, the percentage of the sugar being raised from 3 to 3.5. There were four small fæcal movements during the day; the first one was green, the last three were yellow and decidedly better digested. The temperature of the brooder was kept at 29.4° C. (85° F.). During the day the infant gained 60 grammes (2 ounces) in weight. It was so weak on these two days that it would have been dangerous to take it out of the brooder to weigh it, so that the continual record of the weight which

could be obtained by the scale-bed of the brooder was of the utmost value in regulating the changes in the food necessary to save the infant's life.

On the following day, February 25, the infant's weight was found to be 2260 grammes (5 pounds 3 ounces), an increase of 30 grammes (1 ounce). The percentages in the modified milk were then changed to the following (Prescription 37):

PRESCRIPTION 37.

℞	Fat	1.50
	Sugar	4.00
	Proteids	0.75

One drop of brandy was given with each feeding. There was one fæcal discharge, which was yellow and well digested. On this day 4 c.c. (1 drachm) of food were given to the infant every two hours until its feeding at 10.30 P.M. After this it seemed so hungry that at midnight 36 c.c. (9 drachms) were given, at 3 A.M. 40 c.c. (10 drachms) were given, and at 5.30 A.M. 30 grammes (1 ounce) were given. The weight was now found to be 2420 grammes (5 pounds 5 ounces), an increase of 60 grammes (2 ounces) in the twenty-four hours. The amount of food which the infant had taken in the previous twenty-four hours was found to have been 375 grammes (12½ ounces). The fæcal discharges were yellow and well digested. Brandy was continued to be given. The temperature of the brooder was kept at 29.4° C. (85° F.). At times a little breast-milk was given to the infant, in order to satisfy the mother, but it evidently did not agree with it.

On February 27 the weight was found to be 2450 grammes (5 pounds 6 ounces). The prescription for the modified milk was then changed as follows (Prescription 38):

PRESCRIPTION 38.

℞	Fat	2.00
	Sugar	5.00
	Proteids	0.75

30 grammes (1 ounce) of this were given to the infant every two hours during the day, and every two and one-half hours during the night. One yellow well-digested fæcal discharge was obtained by means of a suppository. The temperature of the brooder was then reduced to 27.7° C. (82° F.).

The following day, February 28, the weight was found to be 2480 grammes (5 pounds 7 ounces). The brandy was still continued, and there was one yellow well-digested fæcal discharge. The breast-milk had been entirely omitted, and 450 grammes (15 ounces) of modified milk had been taken in the twenty-four hours.

On the following day, March 1, it weighed 2510 grammes (5 pounds 8 ounces). The amount of modified milk given was 495 grammes (16½ ounces) in the twenty-four hours, and one drop of brandy was given with each feeding. There was great improvement in the infant's appearance, and it was much stronger.

On the following day, March 2, there had been no increase or loss in weight. The temperature of the brooder was kept at 27.2° C. (81° F.). 510 grammes (17 ounces) of the modified milk were taken in the twenty-four hours. There was one fæcal movement, well digested and yellow.

On the following day, March 3, the weight was found to have increased to 2600 grammes (5 pounds 11 ounces). The percentages of the modified milk were then changed to the following (Prescription 39):

PRESCRIPTION 39.

℞	Fat	2.50
	Sugar	5.00
	Proteids	1.00

There were two well-digested fæcal discharges on this day. The temperature of the incubator was reduced to 25° C. (77° F.). 615 grammes (20½ ounces) of the modified milk were given in the twenty-four hours.

The following day, March 4, the infant was found to have lost 60 grammes (2 ounces), and the temperature of the brooder was therefore raised to 26.6° C. (80° F.). 630 grammes (21 ounces) of modified milk were taken in the twenty-four hours, and there was no especial change in the infant's condition.

On the following day, March 5, 30 grammes (1 ounce) in weight were found to have been gained, and the infant was looking better and decidedly gaining in strength. It was evident that the proper temperature for this especial infant at this age and at this period of its development was 26.6° C. (80° F.).

After this time the infant continued to develop normally, and on being taken out of the brooder in April was thriving in every way.

It is now five months old, and weighs 7110 grammes (14 pounds and 13 ounces).