wash or gargle, or, better still, for the sake of continuous application to the parts through the avenue of the saliva and buccal mucus, given internally. A convenient practice is to prescribe a five-per-cent. aqueous solution of the salt, which is upon the verge of a saturated solution, and direct this to be used as a mouth wash or gargle every two hours, and at the same time a couple of teaspoonfuls to be taken internally. Such quantity will represent about 0.50 gm. (gr. viij.) of the salt—a moderate single internal dose. Among the varieties of buccal disorders amenable to potassium chlorate may be mentioned mercurial stomatitis; and some practitioners even combine the potassium salt with their mercurials in constitutional mercurialization, with the view of lessening the risk of salivation. In diphtheria, also, the chlorate is a good deal used, the good effects being probably the local ones only, and the risk to kidneys or heart from too free dosage being genuine and considerable. Of preparations, the United States Pharmacopœia makes official *Trochisci Potassii Chloratis*, Troches of Potassium Chlorate, the ingredients being the salt, sugar, and tragacanth, and a little of spirit of lemon for flavoring. Each troche contains 0.30 gm. (about gr. v.) of chlorate. In ordinary sore throats or sore mouths, for the treatment of which affections the preparation is especially intended, these lozenges, if allowed to dissolve naturally without chewing, may be taken continuously through the day.

Edward Curtis.

[1] Ringer and Murrell: Journal of Physiology, i., p. 88.
[2] Basham: Practitioner, vol. v., p. 259.
[3] Jacobi: Medical Record, vol. xv., p. 241.

POTASSIUM, TOXICOLOGY OF.—Independently of the corrosive action which characterizes the oxid, hydroxid, and carbonates of potassium, those compounds of potassium with acids, which have little or no toxic qualities, such as the chlorid, sulfate, or tartrate, exert a distinctly poisonous action. In this respect the potassium compounds differ notably from those of sodium.

Experiments on dogs demonstrate that the injection of from 1 to 2 gm. of potassium chlorid, nitrate, sulfate, etc., directly into the circulation, produces death very quickly from cessation of the heart's action. Smaller quantities produce a slowing of the pulse, more or less gastritis, dyspnœa, convulsions, and sometimes death.

Diluted doses seem to have a less serious effect than the same weight of the salt in a concentrated form.

All fatal cases of poisoning in the human subject by the potassium salts of non-toxic acids have been due to ignorance or accident.

Potassium Bromid—KBr.—Two cases have been reported in which death followed the administration of very large quantities of potassium bromid. Duncan (*British Med. Journal*, 1882, Part I., p. 616) relates a case of a child three years old, who died in less than half an hour after taking between 5 and 6 gm. of the drug. The other case was that of an adult female, to whom was administered by her physician 4.2 gm. every four hours for four days. The patient died five days after taking the last dose (Hamer, *Columbus Med. Journal*, vol. iii., p. 259).

Aside from bromism several non-fatal cases are on record, in some of which the patient exhibited a peculiar idiosyncrasy as regards the tolerance of this substance.

Potassium Chlorid—KCl.—The poisonous action of this compound upon animals has been to some extent investigated. When injected into the blood supply of a nerve, the latter loses its excitability. The salt is eliminated with the urine, but much more slowly than sodium chlorid. I find no fatal cases reported as a result of the poisonous action of this salt upon human beings.

Potassium Nitrate—KNO_3.—This substance is commonly known by the name of nitre or saltpetre. Its use as a preservative of meat and other articles, and among agriculturists in the treatment of diseases of domestic animals, makes it one of the common household drugs.

In poisoning by potassium nitrate it is quite certain that the acidulous constituent plays no small part in the toxic action. This conclusion follows from observations upon man and lower animals, when subjected to the action of sodium nitrate (see two cases of poisoning by sodium nitrate, Collischorm, *Deutsche med. Wochenschrift*, vol. xv., p. 844). Large doses (3–5 gm.) cause uneasiness in the stomach and intestines, followed by vomiting, diarrhœa, and generally a frequent desire to urinate. Fifteen to twenty grams produce an acute gastro-enteritis, the vomit tinged with blood, pronounced weakness, cold sweats, and cramps, especially in the calves of the legs.

Woodman and Tidy ("Forensic Medicine and Toxicology") report six fatal cases in which the dose varied from 15 to 45 gm., and the duration from two to sixty hours. Wormley ("Micro-Chemistry of Poisons," p. 69) mentions an instance of an aged man who died in half an hour after taking a quantity of potassium nitrate in mistake for sodium sulfate. Size of dose not given. Bailey (*Phila. Med. and Surg. Reporter*, June, 1872, p. 75) records a recovery after taking 125 gm.

Lesser (*Vierteljahr. f. ger. Med.*, 1898, 3. F., xvi., 93) reports the case of a woman aged forty-six, who died twelve hours after taking about 70 gm.

Most of the cases of poisoning by potassium nitrate have been due to mistaking the substance for magnesium or sodium sulfate or sodium chlorid. In several instances overdoses produced serious results.

The symptoms consist of a severe burning pain in the abdominal region, nausea, vomiting, purging, vomit and stools containing blood, coldness of the extremities, facial tremors, weak and irregular pulse, and collapse. Difficult respiration was observed in some cases.

No chemical antidote is known. The treatment should be to remove the poison from the stomach, give mucilaginous drinks, and treat the symptoms.

Post-mortem Appearances.—The stomach is usually highly inflamed, with dark-colored patches, and the mucous membrane partially detached. Similar appearances have been observed in the duodenum and intestines. Sometimes the indications of asphyxia are present; the lungs are congested, and the right heart is filled with thick, very dark blood.

Potassium Sulfate—K_2SO_4.—This substance was formerly employed to produce abortion, several fatal results having occurred from such use. Bayard reports a case (*Ann. d'Hygiène*, April, 1842) in which 33 gm. of potassium sulfate were administered as a laxative after delivery. Death followed in two hours. A case is recorded in the *Medical Times and Gazette*, 1856, p. 420, in which 8 gm., administered to produce abortion, caused death.

The symptoms noted were pain in the stomach, nausea, vomiting, purging, and cramps in the limbs. A post-mortem examination showed the stomach to contain a reddish liquid, and the mucous membrane to be of a purple color.

Potassium bitartrate—$KHC_4H_4O_6$.—Although this substance, commonly called cream of tartar, may be found in every household, I find recorded but two fatal cases of poisoning by its use. In Tyson's case (*Lancet*, vol. i., 1837–38, p. 162) death followed in four days the taking of 125 gm. Roger reports a case (Friedreich's *Blätter f. ger. Med.*, xxviii., 1887, p. 196) in which 200 gm. caused death in twelve hours.

The prominent symptoms were severe abdominal pain, persistent vomiting and diarrhœa, thirst, feeble pulse, and paralysis of the legs. A post-mortem examination showed the interior surface of the stomach covered with red streaks and patches, and the intestines somewhat inflamed.

Analysis.—Since potassium compounds are normally present in the body fluids and tissues, the analyst cannot report them as having been introduced into the system, unless he can prove them present in abnormal quantity, or in unusual combination. Cream of tartar, on account of its sparing solubility, may be found in the stomach in the solid form.

Louis Warner Riggs.

POTT'S DISEASE. See *Spine, Diseases of.*

POWDER SPRINGS.—Cobb County, Georgia. Post-Office.—Powder Springs.

Access.—Take Western and Atlantic Railroad to Marietta, and from thence private conveyance to the springs, ten miles distant.

These springs were discovered about fifty years ago, but for want of improvements their reputation has been confined to the surrounding country. There are four springs, one of which has been approximately analyzed as follows:

One United States gallon contains: Iron sulphate, gr. 2; calcium sulphate, gr. 1; iron oxide, gr. 1.50. Total solids, 4.50 grains. The contained gases are: Carbonic acid, 1 cubic inch; hydrogen sulphide, 1.5 cubic inches.

The other springs contain about the same ingredients. The flow of water is about two and a half gallons per minute. The waters are evidently chalybeate, and we are informed that they have been found highly useful in depressed and debilitated states of the system where a fairly potent ferruginous tonic is indicated.

James K. Crook.

POWHATAN LITHIA AND ALUM SPRINGS.—Powhatan County, Virginia. Post-Office.—Tobaccoville.

Access.—From Richmond viâ Farmville and Powhatan Railroad to Tobaccoville station, forty-eight miles west, thence three-quarters of a mile by private conveyance to springs.

These springs are two in number, one known as the Lithia, the other as the Alum Spring. They yield about five hundred gallons of water per day. A qualitative analysis of the lithia water by Dr. W. H. Taylor, State chemist at Richmond, showed the presence of lime, magnesia, soda, lithia, potash, iron, silica, sulphuric acid, carbonic acid, and chlorine. The alum water was analyzed at the Smithsonian Institution and found to contain about the same ingredients, except that the lithia was replaced by alum. The water is sold to some extent, but the property has never been much developed and no hotel accommodations have been provided.

James K. Crook.

POWNAL SPRING.—Cumberland County, Maine.—Post-Office.—West Pownal. Hotel.

Location.—Eighteen miles from Portland and ten miles from Poland Spring.

Access.—Viâ Grand Trunk Railroad to West Hanover Station, or Maine Central Railroad to Pownal Spring Station.

The surroundings of the spring are very pleasing to the eye. The White Mountains, in the distant northwestern horizon, form an impressive background, while to the southward a wide panorama is unfolded to the view of the beholder, even Portland harbor being easily seen by the aid of a small glass. The location of the spring is upon land higher than any other in the immediate vicinity, thus giving no opportunity for surface pollution. The water comes apparently from the solid rock, and is clear and sparkling. The average temperature of the water as it emerges is 42° F. This is subject to a variation of only one degree in either direction during the entire year. The following analysis was made by State Assayer Franklin C. Robinson, professor of chemistry at Bowdoin College in 1893:

Reaction neutral. One United States gallon contains: Silica, gr. 0.41; iron carbonate, gr. 0.04; calcium carbonate, gr. 0.33; magnesium carbonate, gr. 0.02; sodium carbonate, gr. 0.09; sodium sulphate, gr. 0.08; sodium chloride, gr. 0.16; potassium carbonate, gr. 0.02. Total solids, 1.15 grains.

Organic and volatile matter, 0.01 grain. The water is bottled and sold. It is recommended for the table, and is said to be useful in dyspeptic and urinary complaints, but the remarkable attenuation of the water would appear to require the ingestion of large quantities in order to secure appreciable therapeutic effects.

James K. Crook.

PREMATURE INFANTS.—By premature infants we mean those babies which are born before the two hundred and eighty days, considered the normal length of intra-uterine gestation, have elapsed, and after the period of viability of the child. This period, however, is only arbitrary, and varies within relatively wide limits. In this respect much depends upon the nourishment of the fœtus prior to birth, the health of the mother during pregnancy, the conditions demanding or leading up to the interruption of pregnancy, the character and duration of labor, the difficulty attending its birth, as well as the care of the infant after its advent into the world. Consequently, in a syphilitic, tuberculous, or albuminous mother, in a case of placenta prævia or of accidental hemorrhage or eclampsia, in a dry, protracted labor, after a breech, forceps, or version delivery—in all these conditions, on account of the immature development of the vital organs, the chance of survival of the baby is very much reduced.

There are cases on record in which it is claimed that the child in utero reached only the twenty-fourth week and yet lived. Perhaps, in the future, advances in our knowledge of their care will enable such infants, born before the date supposed to be compatible with life, to survive. It is more likely, however, that such cases are reported with mistaken calculations.

There are no characteristic appearances, no exact development upon which we can definitely state the age of the infant when it is born. The weight, the length, and development all vary for a given length of gestation and statistics given are only approximate, but yet of sufficient value to guide us somewhat in the management of such infants. It is therefore generally the rule that if the infant is born alive, we must endeavor, without regard to size and characteristics, by the best care and latest knowledge, to preserve its existence.

The general characteristics in the clinical picture of a premature child are as follows: The head is very large in proportion to the body, the abdomen is prominent, the movements are very weak, the body is limp, and the child has a senile, emaciated, and wizened-up appearance.

At the *twenty-fourth week* of intra-uterine life a fœtus, when born, usually breathes feebly. Some cannot cry, although others will give a faint mewl. The infant is covered by lanugo. Its eyelids have separated, though it is so feeble that it cannot often open and shut them. There is very little subcutaneous adipose tissue. It measures about 28–34 cm. (11¼–13¾ in.) in length and weighs 676 gm. (℥ xxiii.). The testicles are only at the inguinal rings. This fœtus may live from a few hours to fifteen days, but would in all probability die from insufficient assimilation after a weak digestion of food, from rapid loss of heat or from imperfect respiration. At the *twenty-eighth* week the fœtus measures in length from 35 to 38 cm. (13.75 to 15 in.) and weighs 1,170 gm. (41¼ oz.). The soles of the feet and palms of the hands are not covered by lanugo. The pupillary membrane, which had hitherto obscured the pupil, has now disappeared. The skin is still wrinkled, covered by vernix caseosa. The child still has an emaciated appearance. Such an infant with good care can live, but most of them die. There persists, however, in the minds of some of the old practitioners and among the laity, the idea that a child born at the seventh month is more apt to survive than one born at the eighth month. Of course this is nonsense, for the development and functions of the vital organs are by far less advanced at the earlier than at the later date, and it stands to reason that the elder fœtus will be stronger thereafter. Professor Parvin, in his "Science and Art of Obstetrics," tells how this superstition has descended through more than two thousand years from Hippocrates. The Greek explained it in this manner, that the fœtus is placed with its head at the fundus in the uterus until the seventh month when the increasing weight of the head causes it to descend to the lower zone. As soon as this occurs, the fœtus attempts to escape, and if it is strong it succeeds; but if the attempt fails, it tries again

at the eighth month, and if the infant now succeeds in escaping from the uterus, being exhausted by its previous effort, it is more apt to succumb.

At the *thirty-second* week the fœtus measures 39–41 cm. (15½–16 in.) in length, and weighs 1,571 gm. (3½ lbs.). The hair on the scalp is longer and more abundant; the down on the face is disappearing. One of the testicles, usually the left, has descended into the scrotum. The nails are firmer, but do not quite reach the finger tips. There is ossification beginning in the lower epiphysis of the femur. The child has lost some of its senile appearance and emaciation due to the increased deposition of subcutaneous fat. At this period, with proper care, the child ought to live. At the *thirty-sixth* week the infant measures 42–44 cm. (16½–17¾ in.) in length, and weighs 1,942 gm. (4¼ lbs.). There is a decided increase in subcutaneous fat. The nails are not yet perfectly developed. The lanugo has disappeared and the bones of the head are still soft and very compressible. The infant is much stronger, but is still in a condition to die easily unless well cared for.

A detailed description of a premature child is as follows: The *head* is excessively developed and consequently its contents (the brain) are excessively developed in comparison with the diminutive characteristics of the rest of the body. Yet the head is very soft and compressible, for the bones themselves are very poorly ossified, thin, and parchment-like, crackling under pressure, and the sutures and the fontanels are wide open. Consequently the symmetry of the head is easily destroyed, considerably so in the moulding of delivery, not only by the bony pelvis, but also even by a rigid cervix or perineum, yet more so in prolonged positions of the head after birth. The moulding is usually temporary and the bones ordinarily quickly resume their proper relations. However, if the child continuously lies on one side of its head, even though the pillow is very soft, from its mere weight a marked deformity develops. This can be avoided by letting the child lie on alternate days first on one side and then on the other.

Abdomen.—The abdomen is almost always relatively distended, due in a great measure to the large size of the liver and the accumulation of gas in the intestines whose peristaltic movements are very weak. This distention may last for many weeks, and the gradual return of the abdomen to a normal size is a good sign in the gradual development of the infant to the status of a child born at term.

Skin.—The skin is of a dull, brownish-red, more markedly so at first than at a later period; when the child cries this color changes to a brighter and healthier red. Aside from this, the color is apt to vary considerably at different times, for premature infants are prone to erythematous rashes, and are almost regularly icteric after the second or third day. If the child is doing poorly the skin is pale, transparent, dry, scaly, and waxy white, sometimes œdematous. It is soft and delicate, so thin in some spots, especially over the forehead and skull, that the superficial veins shine through. In other places it is very wrinkled, due to lack of adipose tissue; a condition which gives to the body and extremities an emaciated appearance and to the face a senile expression. There is present a varying amount of lanugo, depending on the degree of prematurity. The nails are soft and short, they do not reach the ends of the digits; this is more noticeable on the toes. The sweat glands are supposed to be undeveloped, but certainly many premature babies perspire profusely if the temperature of the incubators is too high. On the other hand, the sebaceous glands are moderately active, yet more so before birth than afterward.

The *extremities* are thin and emaciated, with apparently atrophied muscles. According to Dane the instep is as well developed as is that of an adult.

The *movements* are few and slow, but at times spasmodic.

The *respirations* are shallow, irregular, and superficial, and often suspended for a time. The little one sucks slowly and weakly, and swallows with difficulty, and the mere effort is followed by more or less exhaustion.

The *tissues* of the infant are not yet sufficiently developed to meet the demands of extra-uterine life; this is especially true of the *gastro-enteric tract.* The capacity of the stomach is small, varying with the weight and size of the child. The walls are weak and thin, and an organ holding at first two or three drachms will easily dilate until it has a capacity of an ounce or even an ounce and a half, much to the infant's loss. Even absorption is slow and inefficient, and the digestive juices are lacking in ferments. The amylolytic function is practically suspended, and should not be depended upon at all for the digestion of starches. Sugar, on the other hand, is a foodstuff most easily taken care of by simple absorption. It is needed to keep up the animal heat, which is so easily lowered in the premature child, and consequently is of great importance. At first it should be given in lower percentages till the gastro-enteric tract is accustomed to the new work which it is required to perform. The function of digesting fats and albuminoids is far inferior to that of a full-term child; and all formulæ should consequently at the beginning be very low in such ingredients; even breast milk must be well diluted in the more premature children for a number of days after birth.

The *intestines* of a premature child contain meconium, and after a few days, if the digestion is good, the fæces assume the normal golden-yellow color. These infants, however, are prone to constipation on account of weak peristalsis, and often the stools contain curds, and too easily become frequent, green, acid, and slimy.

The *heart* is relatively large, but its action is weak. The foramen ovale often remains patulous for a longer period than if the infant were born at term. Inasmuch as the air cells of the lungs are by no means all in use for oxygenation, and inasmuch as the blood soon becomes impoverished from insufficent nutrition, large demands for increased work are made upon this vital organ. Consequently the infant should be kept quiet and no useless extra work should be put on the circulation, which is in such a precarious condition, not only on account of the many changes which occur with the first respirations in different structures of the body, but also for the reasons mentioned above. The pulse is more rapid than that of a normal infant, but it is not permissible to base a prognosis upon this fact.

The *blood* at birth contains an excessive amount of hæmoglobin, but it is loosely held in the red corpuscle, and the infant readily loses it and becomes anæmic. Destruction of hæmoglobin is going on rapidly and its manufacture progresses but slowly and for many days does not make up the loss. The blood itself, especially in those cases which are doing poorly, soon becomes thin, watery, and deficient in all its solid and vital ingredients. The child consequently often becomes waxy-white and œdematous.

The *animal heat* of the infant is easily affected. Deprived of its source of combustion and insulation (the subcutaneous fat), variations occur quickly and readily. Thrust at birth suddenly into an atmosphere twenty-eight degrees lower than that to which it had been accustomed hitherto, no wonder the temperature falls simply from radiation. The metabolism is too slow to manufacture enough heat to maintain a constant temperature, and the strain upon an uneducated heat centre is not borne. Again, another reason why the temperature is subnormal is that the premature infant with all its vital organs undeveloped is called upon to furnish more heat than the child at term, for we all know that the smaller the animal the greater is the surface exposed for radiation. Consequently the temperature is lowered both by an insufficient heat-production and by an excessive loss of heat, which the heat centre is powerless to control and therefore to set in equilibrium. So spasmodically does this centre act that the temperature of the child will for trivial causes run very high. This is especially the case during the first few days of life, and it is often very difficult, even in a well-regulated incubator, to keep this

temperature normal. Besides, slight gastro-intestinal troubles, as vomiting, constipation, or diarrhœa, will cause sudden rises which do not occur so readily in the full-term baby.

The *lungs* are also in a very undeveloped state, and although they are sufficiently developed to carry on their functions in extra-uterine life, the tissues of the respiratory tract are very sensitive and easily become inflamed. Especially is this true of the nose, nasopharynx, and mouth, for here infection readily occurs from inhalations of dirt and dust. Besides, even though the baby has cried very well at birth, the respiratory efforts do not at once aërate more than the anterior lobules of the lungs. Some of the children remain blue, breathing and crying weakly, and die in a few days. Others gradually make a greater use of their lungs, but from slight causes they acquire a secondary atelectasis in addition to the fœtal condition posteriorly. The irregularities of the respiration are very marked. Adriance explains this condition on the basis of his studies of the embryology and pathology of the lung. Before the fourth month of fœtal life there are no alveoli, and the bronchioles are far apart in the mesenchyma. In the development the tubes ramify rapidly. From this we see that, if a child is born prematurely, the bronchi predominate and the few alveoli are enclosed in connective tissue. The blood-vessels of the lungs are composed of a rich, unsupported capillary network, whose elastic walls are readily stretched and so encroach upon the air vesicles. The feeble respiratory movements permit of collapse of the air vesicles and engorgement of the vessels—conditions which result in hypostasis and atelectasis, posteriorly and inferiorly. Besides, the bony framework is poorly adapted for aëration. Being cartilaginous and very elastic, even with a strong muscular effort at respiration, the lower part of the chest is drawn in, especially over the sternum, and only a very little air really enters the alveoli. Cyanotic attacks consequently are very frequent and often fatal. The respiratory centre, like that of heat control, is spasmodic and weak in action. These respirations are often delayed, feeble, and even Cheyne-Stokes in character, and this undeveloped centre is often responsible for the cyanosis which ensues. Every autopsy on premature children who have died within a week or so after death shows atelectasis, and the weak pulmonary organs are responsible for most of these deaths.

The *liver* is very large and fills over one-half the space in the abdominal cavity. Bile is secreted in great quantities, and it is probably to over-production by the liver cells and to engorgements of the ducts that we must attribute the regular and early occurrence of icterus neonatorum.

The *kidneys* also perform their functions irregularly. For a day or two no urine is voided. Uric acid is secreted in abundance, for the napkins of the child are often stained with the characteristic pink color, and the pyramids almost always on autopsy are found to be plugged with uric-acid infarctions.

Prognosis.—The weight of a premature child varies, for the same duration of intra-uterine life, for many reasons; consequently we must base our prognosis less upon the weight at birth than upon the general condition of the child. Yet it goes without saying that, other things being equal, the more premature the child the less is the probability of its survival. The daily progressive gain, on the other hand, furnishes by far the best indication that matters are progressing satisfactorily; yet one has to wait a long time before this is manifest. Premature children, even though weighing less at birth, have a greater initial loss, and a loss which extends over a longer period, than the full-term child. It is not uncommon for a child weighing three and three-quarters pounds or thereabouts to lose from ten to fourteen ounces and to continue to lose for from ten to seventeen days. This is due to the immaturity of the digestive tract, and to the fact that the babies are invariably intensely jaundiced. On account of the latter condition they lie in a stupor, are with difficulty aroused, and take their nourishment very poorly; then besides, they gain more slowly. If the infant has, at the end of three or four weeks, regained the weight which it had at birth, it will have done very well. If, on the other hand, the loss is progressive, sooner or later there will be a fatal outcome. The prognosis then depends on the general condition at birth, on the degree of prematurity, and most of all on the subsequent care. Extremes of temperature must be guarded against. Attacks of cyanosis are not necessarily fatal, but they render the chance of survival very doubtful. If the child lives for four or five days, and the attacks are decreasing in number, the outlook is more hopeful.

Treatment.—There are four distinct objects which must be kept in view in the care and management of premature children.

1. The maintenance of a proper temperature.
2. The prevention of exhaustion.
3. The administration of the proper amount and kind of nourishment.
4. The avoidance of infection.

Premature children can be divided into three classes: (1) Those treated as babies at term. (2) Those wrapped in cotton. (3) Those placed in the incubator.

The weight, length, appearance of the baby, and even the assumed period of gestation, calculated from the mother's last menstruation, are simply relative in estimating the exact duration of fœtal life. It is by far a better procedure to consider the general condition of the infant, together with the above, before we put it into one class or the other. The majority of the babies would do better if they were to be placed in the last class from the beginning. Without a couveuse the best plan is to put a baby in cotton and surround it by hot bottles. Some babies will thrive in this way, but most of the very premature will not.

There are many kinds of incubators in use, notably those of Denuce, of Bordeaux, who in 1857 produced the first one which gave satisfactory results. In 1880 Tarnier constructed one which was afterward improved by Auvard. Credé also invented one which was successfully used. The brooder of Dr. Rotch, of Boston, is a very intricate and elaborate affair, in which the baby can be weighed without removal. The best one is probably that of M. Lion, of Nice, first used in 1891. It is composed of a parallelopiped of metal, standing on iron supports. It can be disinfected without deterioration by means of a steam stove under pressure or by cleansing with a solution of carbolic acid or with formalin gas (Fig. 3879). Ventilation is obtained by means of a tube, of about three inches in diameter, which enters the compartment low down on the left side. The exit is through a chimney in which is a fan, indicating by its rotation the strength of the current of air. The air on entrance is filtered by a gauze and cotton diaphragm. The front is fitted with glass doors, through which the infant can be seen, while at the side is a glass window by means of which the nurse can attend to the infant's wants without removing it. The baby is placed in the middle on a soft pillow, the warm, fresh air circulating about it. The air is kept moist by a large pan of water placed in the bottom. A thermometer is hung close to the door, and a hygrometer is fastened to the posterior wall of the chamber. The heating is effected by means of a siphon through which hot water circulates, and which communicates with a reservoir at the side. The temperature is automatically regulated by a metallic thermostat, which lifts or lowers a cap over a flame. This apparatus is very expensive, and therefore adapted for use only in hospitals or in wealthy families. Besides the Lion incubator, there is available a cheap modification of the Tarnier or Auvard couveuse, which any carpenter can make at a small expense. The main point in its construction is that there should be plenty of inlets and outlets for free ventilation. The disadvantages of this apparatus are, first, the lack of filtration of the air, and, second, there is no thermostatic regulation of the temperature. To ob-

viate the latter difficulty, therefore, careful attention will be necessary. A temperature as near constant as possible is to be obtained by varying the size of the flame and its distance from the tube connecting with the main tank of water (Fig. 3879).

In order to secure the maximum amount of fresh air the incubator—whatever kind is used—should be placed in the hall or in a large cool room. The direct rays of the sun ought never to strike it, because their heat would quickly unbalance a constant temperature. Before putting a baby into the chamber the apparatus should be

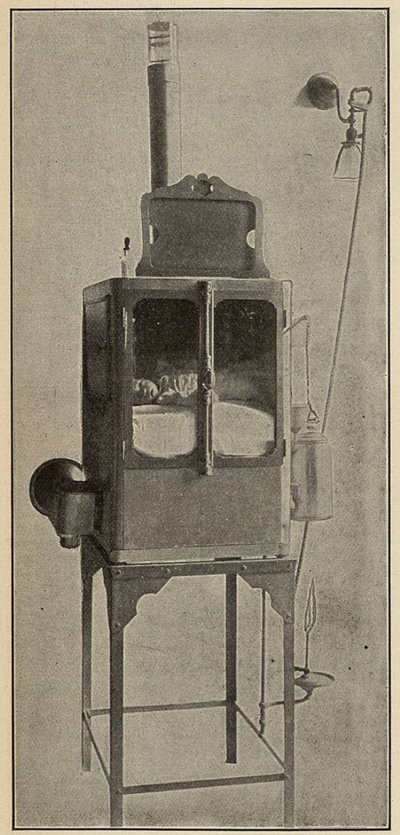

FIG. 3879.—Incubator of M. Lion, of Nice, France. (From the *Archives of Pediatrics.*)

thoroughly disinfected, as these infants are very susceptible to infection. The baby should lie on a very soft pillow.

The temperature should vary with the infant. It should be one which will keep the baby's temperature normal without exciting perspiration. I have found that a temperature of from 86° to 92° F. is about right. A variation of a degree or two makes but little difference. If a premature baby is expected, an incubator, the air of which is at a proper temperature, should be in readiness, at the time of its birth. The baby itself is first made to cry lustily (not with harsh methods of resuscitation, but mainly by the employment of hot baths and light titillation, and perhaps by easy swinging), and then the cord is quickly tied off and suitable dressings are applied. After the child has been weighed and anointed with albolene, but not bathed, it is dressed. A mistake is made in enveloping these infants in cotton. So wrapped up they will be too warm and will perspire too freely. The best clothing is a small light shirt and a napkin from the waist down, pinned over the feet and legs (Fig. 3881). When the baby is placed in the incubator it should not be removed, except to be weighed or nursed. The latter is not permitted until it is thriving. The weight is taken every five, seven, or ten days, and about once a week the infant is lightly sponged.

The napkins should be changed three or four times a day, only often enough for cleanliness, and in such a manner as to disturb the baby as little as possible. Before feeding, however, especially when the baby is stupid or sleepy, a light tap on the hand will make it take the bottle with much less coaxing and more rapidly.

The infant should be kept in the incubator until it has reached the development of full term, or longer if it is not improving. Some of the babies, nevertheless, will do well in cotton after having been given a good start in the couveuse. If possible, the temperature of the incubator should be gradually lowered almost to that of the nursery, before the baby is permanently subjected to the variation in the temperature of the air of an ordinary room.

In the administration of nourishment the amount and quality should depend on the age and digestive powers of the infant. Ordinarily, six hours after birth, the child should be given a warm sugar solution (five to six per cent. lactose in distilled water), about one-half to one drachm every hour. After from twenty-four to thirty-six hours an equal part of breast milk should be added. This is obtained by massage and expression, by the breast pump, or by spontaneous expression while a baby is nursing the other breast. If the best results are to be obtained, this milk should not be taken from the mother, but from a wet-nurse at least seven or eight days post partum—*i.e.*, at a time when the quality of her milk is about established, or at any rate when it is comparatively free from colostrum.

The amount of fluid nourishment administered is to be gradually increased, a drachm at a time, so that by the end of a week the child will be taking from six drachms to an ounce every hour. If the stools are normal, the breast milk can be gradually increased and the sugar solution gradually diminished; or, by the addition of a little lime water, the infant can often be put on pure breast milk at the end of two weeks. On this plan there should be little or no vomiting, and the stools should be normal, or nearly so, from the beginning.

The method of feeding can in almost all cases be carried on by means of sucking through a small nipple, especially if a little coaxing is resorted to. In some cases a medicine dropper or a feeder, such as is recommended by Rotch, can be tried if the baby refuses to suck. In others who are extremely weak and who will not swallow, gavage is necessary. In the experience of most men these cases do not do well; one likes, therefore, to get back to the bottle as soon as possible. The infants are apt to regurgitate, the milk fills the nares or nasopharynx, and when the baby takes its next inspiration some of the fluid is drawn into the larynx and even into the bronchi. This may cause an immediate asphyxia, an atelectatic area in the lung, a bronchitis, or a bronchopneumonia, which will soon end in death.

As soon as the baby is strong enough and is perceptibly gaining, it can be tried at the mother's breast. At first, two or three times a day is sufficient. If the child

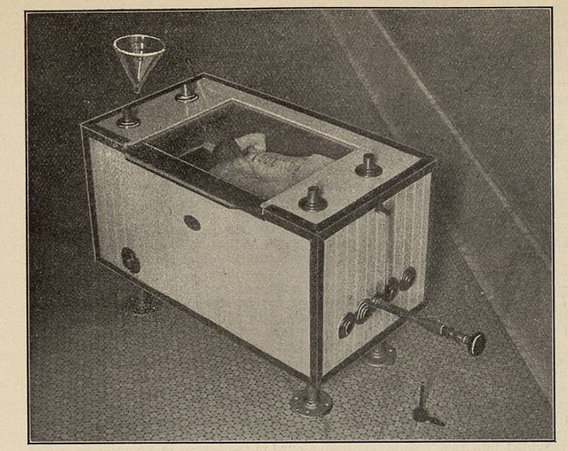

FIG. 3880.—Cheap Incubator in Use at the Sloane Maternity Hospital. (From the *Archives of Pediatrics.*)

does well, the number of nursings is gradually increased to every two hours. At the same time it is generally necessary to give the child the breast between these stated periods, and also to supplement the nursing by the bottle.

Dr. Rotch says that the best method of feeding premature infants is to give them the food which is carefully prepared at the milk laboratories; this food being, as he believes, far superior to mother's milk. In the experience of others, although weak modifications of cow's milk—as fat one per cent., sugar six per cent., and albuminoids 0.33 per cent., or even lower percentages—have been used, the results have not proved satisfactory, except in a very few cases. Mother's milk is the ideal food, and when it is possible to obtain it, every premature child should have it. Yet the variation in the composition of this breast milk in the first few days must be thoroughly understood if good results are to be obtained, for it often acts as a rank poison to the child. The colostrum is already well known as a highly albuminous laxative secretion, and in many cases it purges the new-born infant to an extreme. For a more complete and positive chemical analysis of human milk we are indebted to John S. Adriance. He has demonstrated the peculiarities in its composition during certain periods of lactation. His results are as follows: During the first few days the irregularities are most marked. The colostrum in the breast of a woman delivered at term shows a wide variation in amount of fat; the sugar is low at first, but increases rapidly, and by the end of the first two weeks makes a marked increase; the proteids, on the other hand, fail rapidly during the first few days from a maximum amount on the second day, but less rapidly thereafter. This colostrum then is rich in proteids, due to the sudden assumption of the mammary function and to the transudation of serum from blood-vessels into the breast secretion.

Even to a greater degree are these characteristics shown in the colostrum after a premature labor, and the high percentage of proteids exists for a much longer time. Consequently, the premature child should not at first nurse its mother, but a wet-nurse secured at least temporarily.

In the mean time the mother's breasts should be pumped and massaged or nursed by a baby at term, so that they will not dry up. After a time the mother's milk can be given diluted with a sugar solution, and this should be kept up until the mother's milk becomes normal, the change from wet-nurse to mother being made gradually. In this way gastro-enteric symptoms may be avoided.

In some babies the color is poor from the beginning, and at any time they are especially liable to attacks of cyanosis. For these conditions a little slapping to cause a good cry or the administration of oxygen will dissipate the blueness. Often the administration of a few drops of brandy in hot water every two or three hours will prevent further trouble. One must be very sure, however, that nothing has been aspirated into the larynx.

A great danger in the care of these babies is their susceptibility to infections. The incubator itself is a great germ carrier and should be regularly disinfected. The weakness of the lungs and gastro-enteric tract makes the infants especially vulnerable. Unless the air is filtered, dirt is carried in continuously; consequently the streptococcus, staphylococcus, and pneumococcus are always present,

FIG. 3881.—Clothing for Incubator Baby. (From the *Archives of Pediatrics.*)

seeking an avenue of entrance. Through the skin in eczematous spots or in areas of irritation, at the navel, through the eyes, nose, mouth, larynx, lungs, stomach, and rectum, the bacteria can gain admission. To prevent infection, then, the most careful cleansing is necessary, both of the incubator and of the baby itself. Undoubtedly many of the later deaths can be traced to this source.

Finally, in the carrying out of the above essentials in the proper management of the premature infant, the most patient and painstaking attention on the part of the nurse is necessary, and upon her conscientiousness depends the chance of its survival.

Results.—The statistics furnished here are taken from 2,314 births which occurred at the Sloane Maternity Hospital in the two years from October 22d, 1897, to October 22d, 1899, before which time there had been no incubator in use.

Four hundred and ten of these babies were premature, but of these 74 were still-births, which included macerated fœtus and the still-born babies of cases of placenta prævia, accidental hemorrhage, eclampsia, and the like. There remained, therefore, 336 which were suitable for treatment.

Among these cases was a set of triplets and there were 18 pairs of twins; 85 were treated as infants at term, and of these 4 died—a mortality of 4¾ per cent.; 145 were put in cotton, and of these 12 died—a mortality of 8 per cent. Some of this class should have been placed in the incubator, but for lack of room it was impossible to do this; 106 were incubator babies. These are divided into two classes: I. Those that died within four days of birth; II. Those that lived longer than four days.

I. Twenty-nine of the incubator babies died within four days. All of these but 3 were more or less asphyxiated at birth; 9 were breech cases, and of these 5 were difficult extractions; 3 were delivered after an accouchement forcé in placenta prævia. The rest were vertex presentations; but, of these, 2 were forceps deliveries; 6 were under seven months of uterine gestation; 22 had reached a period of between seven and eight months, and 1 a period of eight and a quarter months.

The causes of the premature labor were as follows: an endometritis in 14, syphilis in 2, albuminuria in 1, placenta prævia in 3, accidental hemorrhage in 1, persistent vomiting in 1, twin in 1, violence in 1, and in 4 the labor was induced. The largest baby weighed 5$\frac{3}{16}$ lbs.; the smallest, 2$\frac{7}{16}$ lbs. Only 5 infants lived over twenty-four hours; 24 were in such poor condition at birth that they survived only a few hours. In 16 of these cases autopsies were held, and in all of these there was marked atelectasis; in 7 hemorrhages of some degree, either into the brain or into the serous membranes; in 2 the foramen ovale was still patent.

II. Seventy-seven incubator infants survived the first four days; 51 were children of primiparæ, 27 of whom were out of wedlock; 3 infants were under seven months of gestation; 8 were over eight months, and the rest between seven and eight months along; 9 were breech presentations; 1 a transverse and the rest vertices; 2 were of triplets associated with albuminuria; 18 were in twin deliveries, associated with albuminuria or hydramnios. The causes of the premature labor were: endometritis in 27; syphilis in 4; phthisis in 2; albuminuria in 7; accidental hemorrhage in 1; placenta prævia in 1; in 2 the labor was induced for albuminuria and eclampsia; 1 was a Cæsarean section; another an ectopic gestation; the cause, in the remainder, was unknown. Seven were delivered by forceps, 2 by version, 1 by accouchement forcé, 1 by Cæsarean section, and the ectopic gestation by a laparotomy; 12 were slightly asphyxiated at birth, 9 moderately so, and 5 deeply asphyxiated; 2 after one and a half hours' work or resuscitation were put in the incubator, head downward, and their condition was so poor that they were expected soon to die, but they left the hospital gaining in weight; 5 weighed less than 3 lbs., 38 between 3 and 4 lbs., 33 between 4 and 5 lbs., 1 over 5 lbs.; the average weight was 3$\frac{13}{16}$ lbs. During their incubator life 28 had one or more attacks of atelectasis. All but 10 were more or less jaundiced. The initial loss of the infants was from 1 to 17½ oz.; the average was 7 oz. These figures are not quite correct, as the babies were weighed at different intervals, some on the fifth day, some on the seventh day, and others not till the fourteenth day.

The period of loss lasted for from five to twenty-two days, the average, eleven days; 10 lost steadily till death; 1 baby was in the incubator only three days, while another lived there eighty-two days. The average time was nineteen days. Some were removed early to make room for others who needed the place more urgently.

Only 3 of the 77 cases vomited. The stools were normal in 32.

One was discharged from the hospital as early as the eleventh day, and others also too soon, at their mothers' demand. One was eighty-nine days old, the average was twenty-four days.

In 16 diluted breast milk was supplemented, at times, with a mixture of cow's milk and water with Russian gelatin and lactose. In 10 a 1% proteid, 6% sugar, and 0.33% albuminoid modification of cow's milk was used. In all the rest diluted breast milk was relied upon. Twenty-seven never nursed at the breast; of these 12 died. A few nursed as early as the third or fourth day, two or three times a day; others not for three weeks, and one not till the sixty-eighth day. Of the 77, 13 died in the hospital, a mortality of nearly 17 per cent. The cause of death was atelectasis and bronchitis in 7, acute asphyxia from a curd in the larynx in 1, syphilitic pneumonia in 1, cerebral hemorrhage in 1, gastro-enteritis in 3, and a patent foramen ovale and ductus arteriosus in 1. The condition of 3 was poor at time of discharge, fair in 24, and very good in 37; 32 were above their birth weights and 57 were gaining in weight. To letters written about January 1st, 1900, no answer was obtained from 28. Thirteen were reported as having died; 1 of these lived fourteen months, 1 nine months, 1 four and a half months, 3 lived two months, 6 lived six weeks, 1 only a month. Five of these children died at the Nursery and Child's Hospital and 2 died at Bellevue Hospital. They were bottle-fed, and the probable cause of death was gastro-enteritis. Twenty-one were found to be *alive* and doing well. Some had nursed and the others were bottle-fed. The oldest baby was twenty-two months and almost all were good specimens of healthy children. One baby at seven months weighed 16 pounds. It weighed 4$\frac{1}{16}$ pounds at birth and nursed its mother after leaving the hospital. The ectopic and the Cæsarean babies were in fine condition.

STATISTICS.

Incubators.	Tarnier.	Charles.	Sloane Hospital.	At the Sloane Hospital, not counting those coming in but a few hours.
Saved at 6 months.	16 per cent.	10 per cent.	.....	.....
" 6½ "	36 "	20 "	22 per cent.	66 per cent.
" 7 "	49 "	40 "	41 "	71 "
" 7½ "	77 "	75 "	75 "	89 "
" 8 "	88 "	.....	70 "	91 "

From this table it appears that the statistics* at the Sloane Maternity Hospital are not so good as Tarnier's, unless those babies who were in very poor condition at birth and who died in a few hours, are omitted.

James D. Voorhees.

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* Tables containing more extensive data relating to these seventy-seven cases will be found in the Archives of Pediatrics for May 1st, 1900.

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PRESBYOPIA—Pr—from πρέσβυς, old, and ὤψ, eye; Fr., *presbytie*, from πρεσβίτης, an old-sighted person—is "the condition in which, as the result of the increase of years, the range of accommodation is diminished, and the vision of near objects interfered with" (Donders[1]). The range of accommodation diminishes year by year, from about 15 dioptries, at the earliest age (ten years) at which accurate observations have been made, to about 1 dioptrie, at the age of sixty-five or seventy; at forty it amounts to something less than 5 dioptries, and at forty-five to about 3.5 dioptries.[2]

Of the 15 dioptries of accommodation which the child of ten years is able to bring into exercise, from two-thirds to three-fourths (10 to 11 dioptries) may be lost without greatly incommoding an emmetrope in ordinary near vision. In emmetropia the distance (P_2) of the binocular near-point (p_2) is the reciprocal of the number of dioptries representing the binocular range of accommodation; hence, with a binocular range of accommodation of 5 dioptries, $P_2 = \frac{1}{5}$ metre (20 cm.), at which distance the smallest print in ordinary use is easily deciphered by eyes of average visual acuteness; when the binocular range of accommodation is reduced to 4 dioptries, $P_2 = \frac{1}{4}$ metre (25 cm.), at which distance ordinary newspaper print may still be read easily; with the loss of another dioptrie of accommodation (leaving but 3 dioptries available), $P_2 = \frac{1}{3}$ metre (33.3 cm.), and the reading of fine print becomes difficult, except under the conditions of good illumination and perfect acuteness of vision. These several values of P_2 correspond, in emmetropia, to ages ranging from about thirty-eight to about forty-seven years, and comparatively few emmetropes attain the latter age without seeking aid from convex glasses in reading or other fine work; the adoption of convex glasses by an emmetrope under forty is generally determined either by the exceptionally exacting nature of the work in which he habitually employs his eyes, or by the fact that his acuteness of vision is somewhat below the normal. When at the age of from fifty to fifty-five years the range of accommodation has become reduced to 2 dioptries, $P_2 = \frac{1}{2}$ metre (50 cm.), and the book must then be held at arm's length, at which distance only the larger sizes of print can be read; but, even with this range of accommodation, a public speaker may be able to read fluently from a plainly written manuscript lying before him upon a reading-desk or table.

The diminution of the range of accommodation with advancing years is a strictly physiological change, and is directly related to the progressive hardening of the crystalline lens, in consequence of which it becomes less and less capable of undergoing the change in curvature required for the adjustment of the eye for near vision. As this hardening of the crystalline occurs in all eyes alike, irrespective of their refractive condition as determined by the relation of the curvature of the refractive surfaces to the length of the axis of the eyeball, it would seem to be scientifically correct to define presbyopia as the loss of accommodative power incident to advancing years. Immemorial usage has, however, associated the name with the particular condition in which, as a result of increasing age, near vision becomes indistinct while distant vision remains either absolutely or relatively unimpaired. As thus defined, presbyopia is an incident in the life-history of all emmetropes and hypermetropes, and also of myopes whenever the myopia is of low grade—3 dioptries or less. In myopia of higher grades, 4 dioptries or more, the distance of the far-point remains within ¼ metre (25 cm.) of the eyes; so that, even with total loss of accommodation, it may still be possible to read fine print without the aid of glasses.

The striking contrast between the vision of myopes, who see only near objects distinctly, and that of presbyopes, who see distant objects clearly, while near objects appear confused, was very early recognized,[3] and, in the absence of any definite theory of accommodation, presbyopia was, for more than two thousand years, regarded as the opposite condition to myopia. Hypermetropia, the true opposite of myopia, remained confounded with presbyopia until after the middle of the nineteenth century, when the demonstration of a change in the form of the crystalline lens in accommodation by Cramer,[4] and, independently, by Helmholtz,[5] and the masterly analysis of the phenomena of accommodation in its relation to the several anomalies of refraction, by Donders,[6] dispelled the cloud of obscurity in which the whole subject had been so long enveloped, and through which only occasional glimpses of the truth had been previously enjoyed by a few exceptionally acute investigators.[7]

Premonitory signs of presbyopia may often be detected in emmetropes as early as the thirty-sixth year; exceptionally fine print, such as No. 1 of Jaeger's scale, being no longer read with the same perfect fluency as in youth, especially if the illumination is defective. Within the next five years newspaper print loses a little in sharpness of definition, and the finest needlework becomes difficult and perhaps deteriorates somewhat in quality. If the acuteness of vision (V—see *Optometry*) is normal, and the print not too fine, relief from the increasing strain in accommodation is obtained by holding the book or work a little farther from the eyes; but if vision is subnormal, or if the print is bad or very fine, a stronger illumination may be demanded, without increasing the reading distance. By the age of forty-five the disability has generally increased to she point that only fairly large print can be read with ease by ordinary artificial light, and a more powerful lamp is procured or the book is held nearer to the light; about this time the need of help from glasses commonly suggests itself.

A hypermetrope habitually wearing neutralizing (convex) glasses, or a myope wearing neutralizing (concave) glasses, experiences the disabilities of presbyopic vision at about the same age, and in about the same degree, as the emmetrope; thus, between the ages of forty and forty-five, the hypermetrope discovers that his convex glasses are no longer quite sufficient in reading, and similarly, the myope discovers that his concave glasses have become something of a hindrance in near vision, although in both cases the neutralizing (convex or concave) glasses continue to serve perfectly for distant vision. A change to stronger convex glasses by the hypermetrope, or to weaker concave glasses (or, perhaps, the temporary removal of his glasses) by the myope, is the remedy which now suggests itself, and which is, sooner or later, adopted. With a change of glasses reading again becomes easy, but with a corresponding falling off in the distinctness of distant vision. For this reason, an elderly emmetrope either removes his glasses or looks over them when not engaged in near work, and a presbyopic ametrope ordinarily requires two pairs of glasses, the one pair (neutralizing) for distance, the other pair (stronger convex or weaker concave) for reading and other near work; the inconvenience attending the use of two pairs of glasses may be obviated, in many cases, by wearing so-called bifocal glasses, in which both corrections are mounted in a single setting before each eye (see *Spectacles*).

A hypermetrope, not wearing convex glasses, experiences the disabilities of presbyopia at an earlier age than the emmetrope, after having, perhaps, passed through a more or less protracted stage of suffering from asthenopia (see *Asthenopia*). In myopia, on the other hand, if of low grade, the reading power with the unaided eyes is retained to a more advanced age than in