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THE APPRAISAL
OF THE
NEWBORN INFANT

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The Appraisal of the Newborn Infant

INTRODUCTION

The necessity for careful and adequate appraisal of the infant during the neonatal period has not been generally appreciated, nor have methods for making such an appraisal received sufficient attention. (The term "neonatal" is used to describe the period from birth through the first 30 days of life.) The neonatal period is one of great danger to the infant as well as one about which too little is known. That more attention should be given to the appraisal of the newborn infant and to his care is indicated by the high mortality rate among infants in the first month of life. It is well known that, although the mortality in the first year of life has been greatly reduced during the past 15 years, the mortality in the first month of life (neonatal mortality) has been reduced relatively little and the mortality on the first day of life has not been reduced at all. Contributions to knowledge of the problems concerning the neonatal period have been made through intensive study of individual infants as well as of groups of infants, but the information at hand with regard to these problems must be carefully evaluated and made readily available to all physicians. It is obvious, furthermore, that if appraisal is to be adequate new information must be collected, particularly in regard to well infants. The appraisal of the newborn infant will, of course, be made more exact by improvement in clinical methods of examination, by establishment of certain standards of growth and development, and by more intensive study of causes of neonatal deaths, supplemented by post-mortem and other laboratory examinations.

It is hoped that this bulletin will be useful to physicians in the examination of newborn infants and in the interpretation of the findings.

BASIS OF APPRAISAL

An appraisal of the newborn infant, to be adequate, should not be based on physical examination alone. It should involve also consideration of the socioeconomic background of the family; constitutional factors in the medical history of the family, especially the history of hereditary or transmissible diseases or defects; the prenatal history (the mother's pregnancy); and the natal and immediate postnatal history. Knowledge of the influence of these factors may tend to modify an examiner's appraisal.

The physical examination should be complete and should be supplemented by physical measurements, and, when indicated, by laboratory and roentgen-ray examinations. It should be repeated at least once during the first month, and more often if indicated by the history or by the development of some abnormal symptom. At the end of the first month of life another complete examination should be made.

SOCIOECONOMIC FACTORS

In the appraisal of the newborn infant socioeconomic factors play an important role which has not been sufficiently studied. That infant mortality is higher under poor socioeconomic conditions, such as low income, employment of mother, and congested housing, has been clearly demonstrated.[1]

HISTORY

FAMILY HISTORY

It is of great importance to inquire into and record the family history of the newborn infant, because, as has been noted, the influence of inherited traits (constitutional factors) and of transmissible diseases or defects must be considered in the total appraisal of the infant. There are certain hereditary or familial defects and diseases which are obvious at birth, such as harelip and cleft palate, and others that are not apparent until the period of later infancy or childhood, such as Friedreich's ataxia, progressive pseudohypertrophic muscular dystrophy, and amaurotic idiocy. Developmental defects such as Mongolism may be obvious at birth; others, such as certain cerebral defects which result in convulsions and spastic palsies, may not become obvious until later. Certain sex-limited defects, such as color-blindness and hemophilia, are not apparent at birth, and therefore a knowledge of the family history should be taken into consideration in the appraisal of the infant.

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[1] Causal Factors in Infant Mortality; a statistical study based on investigation in eight cities, by Robert Morse Woodbury. U. S. Children's Bureau Publication 142. Washington, 1925. 245 pp.

INFANT'S HISTORY

The history of the newborn infant consists of the prenatal history (mother's pregnancy), the birth history, and finally the immediate postnatal history, especially in regard to the onset of respiration.

Prenatal history.

The mother's health during pregnancy must be considered in relation to the maturity and weight of the infant and his adequacy for extrauterine existence.

The mother may have suffered during pregnancy from some disease which interrupted the pregnancy at some time before term or which may be transmissible to the infant. The most striking example of this is syphilis. That an infant infected by syphilis may be born prematurely or at term and with or without evidences of the disease is well known. Intrauterine transmission of almost any of the common communicable or infectious diseases, such as smallpox, chickenpox, and erysipelas, is possible. In fact, cases have been reported of infants born with typical scars of smallpox, as well as cases in which the acute lesions of the disease were present at birth. Erysipelas lesions in the infant may make their appearance within a few hours after birth if the mother is suffering from the disease. Tuberculosis, typhoid fever, and malaria have also been reported as transmissible to the fetus. On the other hand, the mother may confer on the fetus immunity to certain diseases, such as scarlet fever and measles. There are certain acute conditions in the mother, such as the toxemias of pregnancy, the effects of which on the fetus are not entirely clear. The infant is likely to be born prematurely, but studies have shown that if the infant is born alive at or near term no specific deleterious effects of the toxemia can be determined.

If the mother suffers from a deficiency disease the health of the infant may be affected. The outstanding example is thyroid disease in the mother resulting in cretinism in the infant. Women suffering with diabetes are likely to give birth to abnormally large infants.

There is some evidence that roentgen-ray therapy of the mother during pregnancy may result in injury to the central nervous system of the fetus (microcephaly).

In many instances the physical condition of the mother does not affect the infant, since normal infants may be born of diseased mothers. The history of the mother's pregnancy should, nevertheless, be considered in making the appraisal of the newborn infant.

The subject of immunity to disease in the neonatal period is an important one. The transmission of immune bodies and allergy from the mother to the infant has been rather extensively studied in recent years. It is well known that the antibodies of syphilis and tuberculosis may pass the barrier of the placenta and may be demonstrable in the infant's blood for weeks or even months after birth although the infant may be entirely free from infection. Likewise, immunity to scarlet fever, measles, poliomyelitis, and diphtheria in this period has been established.

Certain hormones that affect growth are probably transmitted to the fetus in the latter part of pregnancy. The therapeutic effect of such

hormones when given to prematurely born infants has been studied, but their value has not been accurately determined as yet.

Natal history.

When the course of the infant's birth is in any way abnormal, the effect on the infant may be apparent immediately or in the course of a few hours, or signs may appear at some period later in infancy and childhood which must be attributed to injury at birth. Of special significance are rapid or prolonged labor, dry labor, difficult delivery, instrumental delivery, and so forth.

Postnatal history.

The immediate postnatal history of the infant may be even more important than his natal history. Under ordinary conditions the respirations should start immediately and the infant's color should become good. If respirations are delayed artificial means to induce respiration must be used and the type and effectiveness of these methods must be considered in relation to immediate or remote effects on the organism. In this connection a history of any anesthetics and drugs given to the mother during labor must be known, particularly depressant drugs such as morphine and barbiturates. Appearance of cyanosis, pareses, paralyses, hemorrhages, twitchings, or convulsions in the immediate postnatal period, even if transitory, must be considered in making the appraisal of an infant that is apparently normal at the time of examination.

Fetal maturity.—After the birth of an infant the physician is at once confronted with the task of estimating its maturity. Since the exact date of conception is usually not known, calculations of the duration of pregnancy are ordinarily based on the date of the last menstrual period. The results of these calculations are often not accurate because menstruation may occur after conception takes place. It is usual to regard a fetus of less than 28 weeks' gestation as nonviable. When the time of gestation is estimated as between 28 and 38 weeks, the infant is called premature. When the time of gestation is estimated as between 38 and 40 weeks the infant is said to be mature. As a matter of fact it may be just as hard to draw a sharp line at the point where the "nonviable" fetus becomes a "viable" one as it is to set off sharply the "premature" from the "mature" infant.

A number of criteria are in use for the diagnosis of prematurity, none of which is entirely satisfactory from a scientific standpoint. Among them are (1) a birth weight of 2,500 grams (5 lb. 8 oz.) or less, (2) a crown-heel length of 47 centimeters (18.5 in.) or less, (3) relatively greater disproportion between head and chest circumference or head and shoulder girth than in the full-term infant, (4) an occipitofrontal diameter of the skull of less than 10 centimeters (3.9 in.), (5) a foot length of 7 centimeters (2.8 in.) or less, (6) roentgenographic evidence of absence of certain centers of ossification in the long bones.

Since two concepts are involved in any measurement of maturity—physical development and physiologic development—the exact period of gestation at which intrauterine life ends is a matter of legal or academic importance only. For clinical purposes, however, it is important that physicians recognize indications for special care and

that they have some basis for making a prognosis. The birth weight of the infant seems to be the best criterion from these points of view. In the first place weight is a measurement which is easily made and widely in use. Secondly, a background of statistics is available as to results of care in relation to birth weight. From clinical experience and mortality statistics it is clear that when the infant at birth weighs 2,500 grams (5 lb. 8 oz.) or less or measures 47 centimeters (18.5 in.) or less special care is needed. Moreover, statistics show that for infants weighing at birth 1,000 grams (2 lb. 3 oz.) or less survival is comparatively rare and that for infants above this weight at birth the chances of survival vary according to the birth weight. If the infant at birth weighs more than 1,500 grams (3 lb. 5 oz.) its chances of survival are four times as great as if it weighs 1,500 grams or less at birth. There are, however, some infants who according to weight or height or some other criterion should be capable of extrauterine existence and yet physiologically are incapable of such existence.

No rule should be laid down at present for determination of fitness for extrauterine existence, since the factors affecting viability are variable and not very well understood. "Immature" is a better term than "premature" to apply to infants who are physically or functionally unprepared for extrauterine existence.

The initial respiration.—Independent extrauterine life is not established until the infant breathes. Although the beating of the heart in the absence of respiration is evidence of life, it is merely evidence of persistence of intrauterine life. There is, moreover, evidence that the respiratory mechanism may function in utero, but the significance of this phenomenon is not clearly understood. Respiratory movements may occur when the head has been delivered and the body is still in the birth canal or immediately after separation from the body of the mother, or they may be delayed for varying periods, sometimes as long as an hour or more. Injury to an infant's central nervous system during birth or narcosis from anesthetics or such analgesic drugs as scopolamine, barbiturates, or morphine, administered to the mother during labor, may be a factor in delay of the onset of respiration.

Usually the infant at birth respires spontaneously and cries vigorously. When these physiologic processes do not occur at once it is necessary to take steps to induce respiration before the infant's heart stops beating. What is the best method to use is a debatable question. There is, however, agreement that, whatever method is used, the approach should be gentle and great care should be taken to keep the infant warm. Before any mechanical method is used the upper air passages should be cleared of mucus and other fluid by aspiration, through the use of a soft-rubber catheter attached to a negative pressure bulb. Following this, gentle rhythmic compression of the chest can be used, care being exercised not to squeeze the upper abdomen. Too violent compression in this region might raise intracranial pressure or rupture the liver. At the time that artificial respiration is being carried on inhalations of oxygen or of a mixture of 5 percent carbon dioxide and 95 percent oxygen may be given by various means, such as a mask or a nasal catheter.

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The infant should under no circumstances be spanked, swung, or plunged into cold water; but, as has been mentioned, care should be taken to keep him warm throughout the time when attempts are being made to make him breathe.

Considerable variation in the rate and volume of respirations may occur in the newborn infant in the early days of life without pathologic significance, so far as is known. Even during sleep the respiratory rate may vary widely (16 to 93 per minute). The rate and volume are greater when the infant is awake than when he is asleep. There is a tendency, moreover, for the volume of inspired air to increase from day to day. On the other hand, marked change in the respiratory rate—slowing or accelerating—particularly if combined with increase or decrease in volume, should be regarded as evidence of some abnormal condition such as intracranial injury or acidosis.

A certain degree of atelectasis is physiologic after birth. It has been stated that this may be demonstrated by an actual measured daily increase in the circumference of the chest, as well as by roentgenograms made on successive days after birth, showing that complete expansion of the lungs is a gradual process taking place over a period of days or even 1 to 2 weeks. The physician's attention is drawn to atelectasis of an abnormal degree when the color becomes cyanotic or the breathing becomes abnormal or when physical signs are present in the chest, such as râles, impaired percussion note, or diminished or increased breath sounds. When atelectasis persists and seems of sufficient degree to cause symptoms it is usually secondary to some condition interfering with the normal functioning of the respiratory center or to some abnormal condition within the thorax such as a congenital defect in the circulatory system or persistence of undeveloped lung.

PHYSICAL EXAMINATION

A detailed and careful physical examination of the newborn infant can usually be made with safety shortly after birth. There is no contra-indication to making as complete an examination of a newborn infant as of an older infant if the conditions are satisfactory. Indeed, it is of the utmost importance that such an examination should be made of every newborn infant, since on the basis of the findings treatment may be instituted which, in many cases, may save the life of the infant. There is, moreover, a distinct advantage in making an examination of the infant as soon after birth as possible to be sure that the upper respiratory tract is clear, the color of the skin good, the cry vigorous, and respiration well established.

If the infant is immature and weak the immediate examination should be brief and made with as little exposure as possible. Further examination may be made after the infant's rectal temperature has become stable.

It is of particular importance that the examination of the infant should be made in a warm room, since the infant must be completely undressed. The room should be well lighted, as observation plays a very important role in the examination of any infant.

All methods used in the examination of an older infant may be used in the examination of a newborn infant. The smaller the infant the more care should be taken to apply all methods known for a detailed and careful physical examination. Procedures cannot, however, always be carried out in the usual order. It may be best to use the stethoscope first, while the infant is sleeping, and to use palpation or percussion later. If information is to be gained by these methods the physician's hand as well as the bowl of the stethoscope should be warm, and percussion and palpation should be gentle.

MEASUREMENTS

Weight.

The infant is usually weighed immediately after birth. The average weight of the full-term infant at birth is stated to be about 3,175 grams (7 lb.).

An infant weighing 2,500 grams (5 lb. 8 oz.) or less should be regarded as needing the care given to a premature infant, regardless of the history of the duration of pregnancy. Some infants weighing more than 2,500 grams may also require such care.

In appraising the infant, comparison of his weight with the weight of the average infant is of little value, as weight is affected by a variety of factors, chief among which are sex and race. Male infants tend to weigh more than female, and white infants tend to weigh more than colored. The gain in weight is the important consideration. The weight of a newborn infant usually decreases in the first 3 to 4 days. This loss in a full-term infant is about 6 to 9 percent of the weight at birth. The birth weight is ordinarily regained between the tenth and fourteenth days. During the neonatal period after the first few days the average gain is at the rate of 30 grams (1 oz.) or more per day.

Skeletal growth.

Certain measurements of the infant should be made within 24 hours after birth because they are important from the point of view of determining maturity and also because they serve as a base line in respect to growth. These measurements should be accurately made and recorded. The important ones are as follows:

Crown-heel length.—The crown-heel measurement should be made with the infant flat on his back and extended. A measuring board or a metal anthropometer should be used. Measurements of the total length made by tape, with the infant hanging by the feet or even in a prone position, will obviously be inaccurate.

The average length of the full-term infant is usually stated to be 50.8 to 53.3 centimeters (20–21 in.). Length, like weight, is affected by various factors, such as race and sex. Growth in length during the neonatal period has not been satisfactorily studied.

Head circumference.—The occipitofrontal circumference of the head should be measured with a *steel* tape 24 to 48 hours after birth; this measurement should be made on the third or fourth day of life, since considerable edema of the scalp and molding of the skull are frequently present at birth. It is important to have this measurement recorded, as abnormal size of the head or abnormally rapid

growth of the head or disproportion between the head and shoulders or the head and chest has important clinical significance. The average circumference of the full-term newborn infant's head is 34.8 centimeters (13.7 in.). The head circumference should be considered in relation to the length. The head grows relatively rapidly, and the circumference at each age period is equal to approximately one-half the body length plus 10 centimeters (3.9 in.).

The occipitofrontal diameter of the head is a measurement that has been found to be closely related to weight. It may be used as a measure of maturity; a diameter of 10.5 centimeters (4.1 in.) or less is said to indicate prematurity. Calipers are necessary to make this measurement.

Measurements of the circumference of the thorax, shoulders, and abdomen are not easy to obtain accurately and are therefore of relatively little value in determining the degree of prematurity.

It is probable that some measurement of width should be made (the bi-iliac or bitrochanteric diameter, for example) to use in relation to crown-heel length in estimating the nutritional status. No indices have been worked out, however, for infants in the neonatal period.

TEMPERATURE

Immediately after birth the temperature of the infant is said to be slightly higher than that of the mother. In the next few hours it drops 1½ to 2 degrees and it has a tendency to remain low during the first day. The body temperature of the newborn infant is easily altered by changes in the environment and therefore even the normal full-term infant should be spared exposure and variations in the temperature of the environment.

GENERAL OBSERVATIONS

It cannot be too much stressed that ample time should be given to careful observation of the infant. Special attention should be paid to his color, the movements of his arms and legs, the ease with which he can be awakened or made to cry, the type of the cry, and his ability to suck. Observations should be made when the infant is asleep, or at least quiet, and again when he is awake or crying. The order in which the rest of the examination is carried out depends upon the state of activity or inactivity of the infant. When the infant is asleep is an opportune time to listen to the heart and lungs and to test the reflexes, as resumption of activity or crying makes these examinations difficult. On the other hand, the deep respiration during crying is of inestimable value in auscultation for the detection of râles.

Activity.

Normally a newborn infant remains asleep throughout the greater part of the day, but it is with difficulty that any part of a procedure requiring actual handling can be carried out without waking him. An infant is normally more active when hungry than after a recent feeding. He resists any attempt to change his posture, as well as any restraint of free motion of the head or extremities. Crying

is usually accompanied by vigorous movements of the arms and legs. Sudden noises or sudden change in body posture will often elicit in the normal infant a clonic flexion of the arms and legs (Moro reflex). A normal infant will remain awake throughout the examination while being handled, and if recently fed and comfortable will soon return to sleep when the examination is concluded.

The activity of the infant has great significance. The mature infant should cry when stimulated, maintain this cry for at least a few minutes, vigorously move the arms and legs, and then gradually settle back to sleep again. Difficulty in waking the infant and in making him cry and a feeble or poorly maintained cry are indications of the presence of some abnormality such as immaturity, atelectasis, narcosis, or intracranial lesions.

Posture.

The newborn infant lies with the head held to the right or the left and resists strongly any attempt to change this position of the head. (See Magnus reflex, p. 18). Usually, however, the head will be turned to one side when the infant is sleeping, and it will acquire a midline position when he is crying.

The newborn infant lies on the back with the arms and legs slightly flexed. There is normally slight outward rotation of the legs at the hips, and the legs tend to assume the same position both when the infant is awake and when he is asleep. The arms may assume varied positions when the infant is asleep. It is important to turn the infant over so that the back may be examined. The symmetry of bony points, such as scapulae, hips, and vertebrae should be noted. At birth two vertebral curves are present, a dorsal and a sacral, each convex posteriorly. The cervical and lumbar curves are not established until the infant is old enough to stand.

If the newborn infant is held upright and supported under the arms and the feet are brought in contact with a smooth, hard surface, he will tend to straighten the legs, flatten the feet, and bear a little weight on them; sometimes one leg and then the other will be raised and flexed as if making walking movements. When he is placed on his abdomen he usually makes an effort to raise his head. Frequently the newborn infant is able to raise his head well off the examining table and sometimes to maintain this posture for several minutes.

Special senses.

The special senses of the infant and the response to various stimuli have been studied to some extent. As is known, the infant can see light.

The sense of smell is probably present from birth. Observations of this sense in newborn infants are few and are not altogether conclusive.

The newborn infant is said to be deaf at birth and for several days thereafter. In the neonatal period infants vary greatly in their response to auditory stimuli, some starting at sudden or loud sounds, others not reacting to them. The testing of hearing is difficult in infancy.

Tactile and thermal sensibility and the sense of pain and of taste are all present at birth.

Crying.

It is important to determine the tone and strength of the cry. Most normal newborn infants cry during part of the examination. If the infant is hungry there will be a tendency to crying throughout the greater part of the procedure. If he has just been fed and is well satisfied it may be necessary to stimulate crying by gently snapping the soles of the infant's feet. If during the examination the infant cannot be made to cry or if the cry is feeble, shrill, difficult to elicit, or not maintained, it should be considered abnormal. A crowing cry, not accompanied by any signs of laryngeal obstruction such as cyanosis or retraction of episternal or suprasternal notch, is probably evidence of so-called congenital laryngeal stridor. It is attributed to looseness or redundancy of the vocal cords and has no pathologic significance. It usually disappears in a few weeks but may persist for several months. Tetany, and possibly enlargement of the thymus gland (very rarely) as causes of the crow should, however, be considered.

Yawning and coughing.

It is seldom that the newborn infant yawns or coughs. If he is examined before respiration is well established there may be gagging and vomiting of mucus or gastric contents, accompanied by irregular and difficult breathing. Hiccoughing and sneezing occur rather frequently in the normal infant.

Sucking.

Sucking is a well-developed reflex present in the infant at birth. Even after a sufficient feeding, sucking movements are stimulated when the nipple is placed in the infant's mouth. Absence or poor development of the sucking reflex indicates immaturity or the presence of some other abnormal condition such as intracranial lesions or narcosis.

SKIN

The skin of the newborn infant at birth is covered with vernix caseosa; the amount varies considerably. After the initial cleaning with oil the skin is normally moist, soft, and elastic. Pigmentation varies with the race of the infant and in the darker-skinned races may be deeper on certain localized areas, especially over the genitals, at the base of the nails, and around the areola of the nipples. Bluish pigmented areas, the so-called Mongolian spots, are frequently found on the back, buttocks, or extremities of infants of certain races, notably Italian, Jewish, Negro, and Oriental. The newborn infant's subcutaneous fat is well distributed and gives to the skin of the normal infant a soft, elastic feeling. The general color is normally a bright pink and in the dark-skinned infant is best seen by observing the palms, soles, nails, and mucous membranes. Physiologic jaundice is seldom observed during the first 24 hours of life. Coarse desquamation is sometimes present during the first 2 to 3 days of life. The hair of the scalp is present and varies in amount and length. It is fine or moderately coarse and usually is straight. The eyebrows are present, but in infants with light hair they may be difficult to see. The fingernails are normally well formed and often extend to or beyond the fingertips. The toenails are subject to great variations in size and shape, are often small, and appear embedded at the distal end.

LYMPH NODES

The various groups of lymph nodes are very frequently palpable in the newborn infant, especially if the subcutaneous fat is small in amount. Only when the nodes are definitely enlarged should they be considered abnormal. The groups of nodes most frequently palpable in normal newborn infants are as follows, in order: Inguinal, axillary, epitrochlear, posterior cervical. The anterior cervical, occipital, posterior auricular, and anterior auricular nodes are not palpable as a rule.

HEAD

The variation in the shape of the head due to molding may be very great in the first 24 hours. In some infants such changes are completely absent and in others they are very marked. The point of greatest molding may be asymmetrically located and may give the head a true asymmetry. Changes due to molding disappear rapidly and are usually gone in 24 to 48 hours, but may last much longer. The parietal bones normally are smoothly convex and slightly prominent. The forehead is usually on a horizontal line with the face but may be slightly prominent or slightly receding. The scalp should overlie the bones of the head closely and the bones should be firm. Careful palpation of the head is important, as edema, caput succedaneum, cephalhematoma, or defects in the skull bones, which are not obvious on inspection, may be present.

The principal sutures are: The sagittal or longitudinal; the coronals, which separate the frontal bone from the parietal bones; and the lambdoids, which separate the parietal bones from the occipital bone.

Great variation is found in the sutures in the newborn infant's skull; they may be overlapping, approximated, or gaping. Usually the bones at the edges of the sutures feel hard, but they may occasionally feel soft or thin or be movable. Within 24 hours after birth a suture that was overlapping at birth may became gaping. In hydrocephalus all the sutures are found to be gaping.

There are many fontanels, but the most important clinically are the anterior and posterior. The examination of the anterior fontanel is very important. There is a great variation in the size of this fontanel. It may be large enough to admit four or even five fingers in its anteroposterior and lateral diameters, or it may be so small that it is barely palpable, or even not palpable, on account of overlapping of the sutures. A wide-open fontanel may be impossible to measure because anteroposterior and lateral angles run into open sutures. The size of the anterior fontanel is usually of no significance if the tension of the fontanel is normal. A fontanel that is level with the surface of the skull or somewhat depressed is normal.

The posterior fontanel may be just palpable or may be widely open, but no clinical significance should be attached to the size of this fontanel when considered alone.

The parietal fontanel is a small fontanel situated about half way between the posterior angle of the anterior fontanel and the posterior fontanel. In many newborn infants it may be barely palpable or it may admit the fingertip. It has no clinical significance but is merely a developmental point in the growth of the skull.

There are a number of other fontanels which are not normally palpable, such as the mastoid and the sphenoidal.

Eyes.

When the physician examines the newborn infant on the day of birth, a solution of some silver salt has usually been instilled into the eyes, making the examination of them difficult. There may be a mild conjunctivitis, or a severe one with edema of the upper and lower lids and photophobia or even some purulent discharge. The possibility of gonorrheal infection must be kept in mind. These very acute symptoms, which are nonspecific, should disappear within the first 24 hours, leaving merely an injection of the palpebral conjunctivae. A mild inflammatory condition may persist for several days in spite of treatment. The tear duct or ducts may not be patent at birth, but this condition is usually remedied spontaneously.

The infant may stare fixedly or turn the eyes suddenly from one side to the other. A transient strabismus of one or both eyes is frequently seen. A few coarse lateral jerkings suggesting nystagmus are occasionally seen in the normal infant.

The pupils vary considerably in size from time to time and react very readily to light. It is important to note the reaction of the pupils and whether they are equal in size. Observations should be made with the light thrown with equal intensity into both eyes. Inequality of pupils or differences between them in reaction to light have important significance in relation to the central nervous system. After the photophobia of the first day or two the eyes do not seem to be especially sensitive to light, but the normal infant will wink if the light is brought close to the eyes.

Sight is difficult to determine in the neonatal period but perception of light can be determined readily, as described above.

Jaundice of the sclerae is seen in the majority of infants between the second and tenth days of life, a manifestation of the physiologic jaundice characteristic of the newborn period.

Frame-like subconjunctival hemorrhages are seen in so many infants in the first 3 days of life that although not normal they are more or less physiologic and are probably not significant except as evidence of changes in vascular tension during the process of birth. They disappear rapidly and completely.

No great difficulty should be encountered in examining the eye grounds of a newborn infant with an ophthalmoscope. If the infant is wrapped tightly and given a bottle of water or milk he will often open his eyes and hold them quiet for a considerable time, even when a strong light is reflected into them. Sometimes, and too often, of course, only transient glimpses of the disk can be obtained. The normal disk of the newborn infant is pale and sharply outlined. Small hemorrhages are frequently seen, which are evidence of increased intracranial pressure during delivery and are apparently of no pathologic significance unless other symptoms pointing to birth injury are present. Failure of the pupils to react to light is probably an indication for an ophthalmoscopic examination, for blindness may be due to retinal defects that will entirely escape notice unless ophthalmoscopic examination is made.

Nose.

The nose of the newborn infant is relatively small and flat. At the time of the onset of respiration the nares should be cleared of any secretion. Small whitish-yellow spots are often seen in the skin over

the tip of the nose. They are follicles of the skin filled with sebaceous material and they disappear spontaneously.

Ears.

The external and internal parts of the ear are well formed at birth. The drums may be retracted until the Eustachian tubes open. The surface of the drum forms an obtuse angle with the external auditory canal. If this angulation is appreciated and the otoscope tilted accordingly, examination is possible and the landmarks of the drums can be clearly made out. Otitis media is not unknown even in the first few days of life.

Mouth.

The lips should be red and smooth, but may show puckering and even desquamation of a coarse type apparently due to trauma from sucking.

The gums are smooth and pink and frequently show slight puckering or even grooving at the distal margins. Frequently small gray cystlike bodies are found, especially in the upper gums. When the infant cries the lips are drawn back symmetrically so that the nasolabial folds are equal. Rarely one or two teeth are present at birth.

The soft and hard palates and the uvula are well formed. There is often considerable variation in the width and in the height of the palate. In the midline of the hard palate whitish or yellow glistening raised spots may be seen, the so-called Bohn's nodules. They mark the fusion of the halves of the palate.

The tongue should be moist, smooth, and symmetrical. Fine fibrillary waves may be noted passing down over the sides of the tongue when it is extended during crying. The tongue should not normally be seen extending between the lips or protruding beyond them.

The buccal surfaces should be smooth and pink and usually the openings of Stensen's ducts are easily seen.

Throat.

Examination of the throat of the newborn infant is difficult because as soon as the tongue is touched with a tongue depressor the infant will make such strong sucking movements that the tongue cannot be depressed. In order that the examiner can see the throat satisfactorily the infant should be made to cry or should be gagged by the introduction of the tongue depressor. A good light should be thrown directly into the throat. The examination will be more satisfactory if an assistant holds the infant's head tipped back and straight in the midline. On the first day the throat will often appear red. This is due to trauma caused by the wiping out of mucus after delivery and perhaps to lack of fluids. The tonsils are not visible in the neonatal period, although occasionally there is a slight follicular appearance as if little bits of lymphoid tissue were present in the fossae. The voice should be clear and strong.

NECK

The newborn infant usually lies with the head turned on one side. The infant resents changes of this posture but there should be no actual stiffness of the neck when the head is turned from side to side or when the head is flexed on the chest.

The sternomastoid muscles are well developed and should be smooth and equal, with the head in the midline. When the head is turned from one side to the other the muscle on the side opposite that to which the head is turned becomes more prominent. The muscles should be palpated, as hematomata in these muscles are common as the result of trauma at birth. They are frequently not diagnosed until calcification takes place. Their only significance is that in an occasional case permanent torticollis results. This can usually be prevented by postural treatment.

The thyroid gland is not normally visible or palpable.

CHEST

The chest is normally well rounded (barrel shaped), although the contour may vary considerably. The costal angle is usually 90° or more.

Mammary glands.

Enlargement of the mammary glands is not present normally during the first day of life but sometimes appears in the early neonatal period even in male infants. The enlargement may be unilateral or bilateral. The breasts may contain a milky fluid. Manipulation should be avoided because of danger of infection; no treatment is necessary for this type of enlargement of the breasts.

Thymus gland.

The relation of the thymus gland to the well-being of the newborn infant is a matter which has been the subject of a vast amount of speculation and investigation.

Pathologic studies have shown a close relationship between the weight of the infant and the size of the thymus gland. The well-nourished infant has a relatively large thymus gland while the poorly nourished infant has a relatively small one. Any symptoms or clinical findings pointing to an enlarged thymus should lead to roentgenographic examination (see p. 19); but in the light of our present knowledge, treatment of an "enlarged" thymus gland by roentgen ray is justified only if symptoms are present that are regarded as characteristic of an enlarged thymus gland and that cannot be otherwise explained.

Lungs.

Respirations are chiefly abdominal in type. The rate and depth of the respirations are extremely variable, even in sleep. Light percussion produces normal resonance over the entire lung areas. Auscultation reveals bronchovesicular breathing of equal intensity over the corresponding areas of each side, without râles. The expiratory phase is longer and louder in the newborn than in the older child or the adult.

Heart.

Three points should be borne in mind when examining the heart of a newborn infant: The variability in the heart rate, the difficulty in determining the size of the heart, and the frequency of murmurs.

The heart rate of the new born infant is rapid and varies greatly with the phases of respiration and with crying and also with sleeping and waking (80 to 160 per minute). At times a very marked

bradycardia and again a very marked tachycardia may be found. These variations are merely manifestations of the instability or immaturity of cardiac regulatory mechanism and apparently have no significance unless they persist or recur.

The apex beat can be felt, well localized in the third and fourth interspaces, about 3 centimeters (1.2 in.) to the left of the sternal margin. Percussion of the borders of the heart is probably not worth while, since information obtained by this method is even less reliable in the infant than in the adult.

The heart sounds should be clear and distinct, the second being nearly equal in intensity to the first, giving the so-called "tick-tock" rhythm.

Murmurs in the heart occur frequently in the neonatal period. They may be present at birth, disappear, and reappear. The intensity of the murmurs may vary greatly from time to time. Differentiation between murmurs that have a pathologic significance and other murmurs is sometimes difficult. A final opinion probably should be reserved until repeated examinations can be made. The change from fetal to independent circulation is abrupt, but the functional as well as the organic closure of the fetal openings is not abrupt but gradual. No doubt many murmurs heard in the early days and weeks of life are explained by the persistence of these fetal openings or by pleuropericardial friction.

ABDOMEN

The ease with which the abdominal viscera can be palpated in the newborn infant may lead to wrong interpretations if the relative size and position of the organs are not known.

Liver.

The edge of the liver is usually palpable, and the distance below the costal margin should be carefully noted because increase in the size of the liver may be a significant point in later diagnosis.

Spleen.

The spleen can often be felt in infants that are apparently normal. As with the liver, an increase in the size of the spleen has more significance than mere palpability.

Kidneys.

The kidneys are easily palpable in most newborn infants, the lower poles lying at about the level of the iliac crests. The left kidney is usually lower than the right.

Umbilicus.

The condition of the umbilicus should always be noted, as at this point infections as well as abnormal persistence of fetal conditions may first be noted. The cord stump ordinarily drops off at about the fifth day, leaving a dry scab or scar. A hernia often is suspected when the stump is prominent but should be diagnosed only when bulging takes place during crying and when there is also a palpable defect in the abdominal wall in that region. Mild infection of the umbilicus is manifested by a slight discharge resulting in a granuloma; more severe infection, by redness and purulent discharge and occasionally by enlargement of the blood vessels.

Certain structures may occasionally be felt in the newborn infant's abdomen which represent persistence of fetal structures and may or may not have pathologic significance. The urachus, which represents the portion of the allantoic duct between the bladder and the umbilicus, may persist as a whole or in part. If it persists as a complete tube, urine may escape through it at the umbilicus. Fistulae at the umbilicus may, of course, be caused by persistence of the omphalomesenteric duct.

GENITALIA

The penis of the newborn male infant varies considerably in size and length. The foreskin is usually adherent to the glans and may be somewhat difficult to retract. The physician will have to decide whether forcible retraction, stretching, or circumcision is indicated, according to the findings. If phimosis is marked and is untreated the infant may have difficulty in voiding. The scrotum varies considerably in size from time to time. The scrotal tissue may, during the first day or two, contain a moderate amount of fluid, probably edema due to trauma and congestion during delivery, especially breech delivery. This condition is not a true hydrocele. The testicles should be palpable in the scrotum, but if the infant is slightly chilled or if he is active they may ascend toward or into the external inguinal ring. The testicles are usually quite small, firm, and of equal size, although asymmetry is sometimes observed.

The labia of the newborn female infant are usually prominent. The labia majora are not so close together as in the older child, and the labia minora are relatively large. When the labia minora are separated a white mucoid discharge is sometimes seen, which may be profuse in the first day or two. Slight bleeding may occur in the first few days of life, which, if unassociated with bleeding elsewhere, may be considered physiologic. The margin of the vagina may show a skin tag which requires no treatment. Sometimes a small cyst is seen closing the opening (hymenal cyst).

ANUS

The anal opening normally is closed tightly by the external sphincter. The mucous membrane is smooth and is free from venous engorgement, except in infants delivered by breech. In these cases submucous hemorrhages may be found at the mucocutaneous junction of the anus.

JOINTS, BONES, AND MUSCLES

Joints.

It is important to examine the infant's joints by inspecting them and trying out their function. By abducting the arm, the head of the humerus can be easily palpated in the upper axilla. Full extension of the elbows, knees, and hips is often difficult in the newborn infant, probably because the normal intrauterine position is one of flexion at these points. Flexion at the hips will be most marked in infants born by breech, and in these infants complete extension at the hips will be nearly impossible in the first 3 or 4 days. The great trochanter of the femur should be felt for on each side, and the leg should be rotated and abducted to determine whether the head of the trochanter is in the acetabulum. The contour of the buttocks and the level of

the gluteal folds should be carefully noted, as any asymmetry may indicate dislocation of the hip joint. Each extremity should be handled to see that function and muscle tone are normal.

Bones.

The clavicles are the first bones to be ossified and are the bones most often fractured during delivery. Fractures, however, will often be missed unless the clavicles are felt throughout their length. In an infant with a broken clavicle the stimulation of a sharp blow on the examining table, which ordinarily results in the so-called Moro reflex, fails for the arm on the side of the broken clavicle.

In examining the extremities the length and smoothness of the underlying bony structures should be observed. The skull also should be carefully palpated.

The vertebrae are occasionally broken during delivery. Palpation of the spine, especially in the cervical region, should be done, particularly after long and difficult labor and if the infant's respiration is not normal and the pupils are unequal.

Muscles.

The muscles of the extremities and of the abdomen should be palpated. Those of the extremities can be tested by pulling on the legs when flexed and palpating them when extended. Inequality of pull or tone should be tested for. Abdominal tone can be tested by palpation when the infant cries.

TESTS FOR REFLEXES

The clinical interpretation of the reflexes of the newborn infant requires very special consideration. There are many conflicting statements in the literature, due partly to differences in technique used for testing the reflexes but largely to lack of appreciation of fundamental conceptions of the development of the nervous system. Recent work has led to a conception that explains the variability of responses: namely, that the response to a specific stimulus is generalized and that specificity of response increases as a result of developmental and environmental factors, or both. Variations in response will be found, moreover, to depend upon the degree of activity or inactivity of the infant at the time when the tests of reflexes are made. In most reports no statement is made as to whether the infant was awake or asleep, or whether he was quiet, active, or crying. Standards for interpretation of reflexes have usually been based on tests made on an insufficient number of cases.

The following reactions to light are present at birth: Contraction and dilatation of the pupils, consensual pupillary reflex, corneal and conjunctival reflexes. The sucking and swallowing reflex is usually well established. Certain other reflexes should be tested for as a routine. Whether they are found present or absent in a normal newborn infant depends a good deal on the activity of the infant and the skill and patience of the examiner.

Chvostek sign.

Tapping the facial nerve in the cheek, especially if the infant is asleep, will frequently elicit the Chvostek sign, which usually has no clinical significance in the neonatal period. This response must be

differentiated from the mouth jerk that is obtained in an even larger number of sleeping infants in the form of a sudden pursing of the lips, which also has no clinical significance. By tapping the face a head-and-jaw jerk may be also found.

Abdominal reflexes.

The abdominal reflexes are easily obtained in the normal newborn infant when he is quiet, but cannot be obtained as a rule when the infant is active. These reflexes are very lively, even in the immature infant.

Knee jerks.

Knee jerks can be obtained in all normal newborn infants. There is great variability in the normal response, ranging from sluggish to hyperactive. Occasionally when the tendon of one knee is tapped there is a reflex response of the other leg. This is found usually in a sleeping infant and occasionally in an infant who is awake but not very active. The arm jerks (of triceps, biceps, and periosteoradials) are usually more difficult to obtain.

Ankle clonus.

The presence of an ankle clonus does not mean that the infant is abnormal unless it is accompanied by other signs or symptoms of disturbance of the central nervous system. Clonus that is not sustained or only moderately sustained (3 to 5 jerks) is frequently found in the newborn infant, especially if the test is made when the infant is quiet. When the clonus is sustained (10 to 12 jerks or continuous jerks) it usually has a pathologic significance, especially if accompanied by other symptoms.

Moro reflex.

Rapid rhythmic shaking of the arms and legs may occur spontaneously or may be brought on by suddenly rousing the infant or by jarring him by striking the fist on the hard surface of the table on which the infant is lying during the examination—the so-called Moro reflex. This reflex movement is a normal response and may occur during the first 2 or 3 days of life or even later. It has been shown that if after such stimulation symmetrical clonic movements of the arms do not occur this points to abnormality on the side on which the response does not occur. For example, if the clavicle is broken on the left side the left arm is kept close to the side while the right arm responds normally with a rhythmic or clonic shaking. The same type of jerking may occur spontaneously in the lower jaw or may be precipitated by depressing the jaw forcibly to examine the inside of the mouth and the throat.

Magnus reflex.

To test for the Magnus or tonic neck reflex rotate the head of the infant forcibly to one side. A normal newborn infant occasionally responds to this test by rotatory movements at the shoulders. The positive response to this test, which occurs only in the presence of a lesion of the central nervous system, is flexion of the arm on the same side and extension of the leg on the opposite side.

Cremasteric reflex.

The cremasteric reflex is present in the newborn infant. The movement of the testicle frequently cannot be seen in the first few days because of edema of the scrotum.

Response to plantar stimulation.

Because of the extreme sensitivity of the sole of the newborn infant's foot response to plantar stimulation is difficult to interpret. The reaction is usually a violent withdrawal. If the ankle is grasped firmly and a blunt object drawn from the base of the great toe to the other side of the heel the usual response is dorsal flexion alternating with plantar flexion; there may be no definite response. The Babinski sign has therefore little significance at this period of life.

Adductor spasm.

Adductor spasm should be tested for by grasping the knees, holding the legs extended, and abducting them. In the first few days of life a certain amount of adductor spasm is found, which gradually disappears.

OTHER TESTS

Laboratory tests.

Almost all the laboratory methods that are used for diagnosis in older children can be applied to the newborn infant. It is necessary, however, in some instances to make further refinements in technique for the application of the methods to very small infants.

Roentgen-ray examination.—The roentgen ray may be used as freely in the examination of the newborn as of the older infant, as an aid in diagnosis of pathologic conditions of the chest, including thymus, lungs, and heart, and of the gastrointestinal, genitourinary, and osseous systems. Frequently roentgen-ray examination is postponed or is not thought possible because of the relative lack of vigor of the newborn infant, but sometimes delay in its use results in loss of life. Since the use of the roentgen ray should become a common aid in the appraisal of the newborn infant, it seems worth while to give a somewhat detailed outline of its possible use in this period.

With the introduction of roentgenograms interest in the thymus gland was greatly stimulated, but because of the great variability in technique and in the interpretation of results much of the data gathered in the past are now known to be of relatively little value. Examination of the chest by means of the fluoroscope often gives valuable information in regard to the differential diagnosis of shadows in the mediastinum. When enlargement of the thymus gland is suspected roentgenograms should be taken in the lateral as well as the anteroposterior position, as in this way evidence of pressure of the thymus gland on the trachea may become apparent.

Considerable doubt has arisen as to whether abnormal clinical signs, or death, are ever attributable to enlargement of the thymus. However, there are instances in which the evidence that this gland plays a role is so strong that the best point of view to take at the present time seems to be that treatment with the roentgen ray should be given only if there is no other explanation of symptoms.

Roentgen-ray examination of the lungs of the infant in the neonatal period will sometimes reveal changes entirely unsuspected on physical examination. The interpretation of findings in this field is difficult, because of variations in technique used by different observers and because of the many changes in shape of the chest and density of the lung tissue due to expansion and growth of the chest during the first few days and weeks of life.

A certain degree of atelectasis is physiologic shortly after birth, as may be demonstrated by roentgen ray.

Roentgenograms of the heart of the newborn infant are difficult to interpret because the mediastinal shadows may partially obliterate the true outline of the heart and because of the technical difficulties met with in obtaining satisfactory films. However, gross deviations from the usual size can be made out from films taken with the infant in the prone position. The variation in the shape of the heart shadow that occurs in certain types of congenital heart disease may be a real aid in diagnosis.

The employment of the roentgen ray is important in the early diagnosis of congenital anomalies of the gastrointestinal tract. Certain of these anomalies are amenable to correction. Delay in making the diagnosis is a great factor in the high mortality from surgical procedure. Opaque substances may be used to define the tract, but will obviously be a handicap if operation must be performed.

Roentgenographic examinations of the bones in the neonatal period give important information from the physiologic as well as the pathologic point of view. Fetal maturity can probably be gaged fairly accurately in this way. The earliest signs of syphilis can often be seen in roentgenograms of the bones, and occasionally evidences of rickets can be found in this way. Cases of congenital rickets demonstrated by roentgen ray have been reported in infants whose mothers were suffering from osteomalacia. Fractures of bones, due to trauma of delivery or to pathology in the bone, may be seen by roentgen ray when unsuspected clinically. Congenital absence of certain bones and occasionally other anomalies may also be so diagnosed. Incompleteness of ossification makes the roentgen-ray diagnosis of congenital bone defects difficult, especially when joints are involved, as in dislocation of the hips.

Some idea of brain pathology in the newborn infant can be obtained from roentgen-ray examination of the skull by noting the width of the sutures, the appearance of the convolutional markings and the thickness and uniformity of ossification of the cranial bones. Encephalography and ventriculography may be done in selected cases.

The development of the vertebrae has been described by anatomists, but little information is available with regard to the roentgenographic examination of the spine of the newborn infant. Obviously, when any abnormality of the spine is found on clinical examination roentgenographic examination should be made.

Examinations of blood.—Fundamental to an interpretation of the findings in the blood of the newborn infant is the conception that the change from intrauterine to extrauterine life, with establishment of independent circulation, brings about readjustments in the physiology of the infant which are especially marked in the blood. Estimations of the number of cells, amount of hemoglobin, and so forth, have been found to vary widely with different observers. This variability in reports is probably due to several factors, among the most important of which are differences in technique of examination and variability in the time at which the examination was made. Cognizance must be taken of changes in the blood from day to day and from hour to hour.

The number of red blood cells of the infant at birth varies widely (from 4 to 7 million per cubic millimeter), with a definite tendency to range above the 5 million accepted as normal for adults. Shortly after birth, however, because of increasing oxygenation of the blood with the establishment of respiration, a rather rapid reduction in the number of red blood cells takes place and continues during the first week or 10 days. As a result of this destruction of red blood cells, blood pigment is freed and deposited in the organs. For this reason jaundice is found in varying degrees in most newborn infants, appearing on the second or third day and disappearing usually before the tenth day. This is a physiologic jaundice, the so-called icterus neonatorum. During the remainder of the neonatal period and for a few weeks afterward the number of red blood cells continues to decrease, though at a less rapid rate. The lowest count (3.3 to 5.0 million) is reached at 6 to 12 weeks, after which there is usually a tendency to rise slowly.

The hemoglobin content of the blood also is high at birth and parallels the red blood count closely but shows a tendency to be relatively higher in the first 2 months of life. At the end of the second month the hemoglobin should read approximately 13 grams per cc of blood and the red blood cells should number about 4 million per cm of blood.

In the blood of the mature infant in the first few days of life 1.25 percent of the red blood cells may be nucleated. In the premature infant these nucleated cells may be found in larger numbers and persist longer.

The reticulocytes, which number approximately 3 percent at birth, fall rapidly to 0.17 percent through the first 7 days, after which there is little variation during the neonatal period. The platelet count has been reported by one set of observers as relatively low at birth (mean value 227,000) and to rise gradually throughout the neonatal period until at 2 months the mean value is approximately 325,000. Another report gives the platelet count as approximately 500,000 at birth, with relatively little change throughout the neonatal period. In the former studies blood was obtained by skin puncture; in the latter, by venipuncture. The bleeding time at birth is from 30 seconds to 3 minutes (Duke method), the coagulation time (fine capillary tube method) from 2 to 4 minutes.

The total white blood-cell count varies greatly in the neonatal period and is particularly unstable at the time of birth. As late as the end of the first week the count in normal infants has been found to vary between 5,000 and 20,000 cells per cubic millimeter. Knowledge of the differential count in the neonatal period is of particular importance. At birth the polymorphonuclear-leucocyte count predominates over the lymphocyte count. Between the sixth and ninth days the number of the two types of cells tends to become equal, but by the tenth day the lymphocytes predominate, and this ratio persists throughout the neonatal period. Immature cells are frequently found.

The blood culture as a means of diagnosis has been greatly neglected. When, without obvious cause, an infant fails to thrive or has fever or some other symptom, the blood culture is one of the most important tests that should be made.

Serologic tests for syphilis must be interpreted with care, since the complement-fixing antibodies may pass the placenta and appear in the infant's blood without actual infection of the infant. A positive Wassermann reaction of the mother's blood therefore does not necessarily mean infection of the infant. A positive serologic reaction of the infant's blood has the same significance in newborn infants as in older ones if this reaction is still present after the second or third month of life, particularly if the results of quantitative tests become stronger. If clinical or roentgen-ray evidences of syphilis are present, however, a positive serologic test at any age should be interpreted as confirming the diagnosis.

Isoagglutinins and isohemolysins are present in the blood of the newborn infant in a large enough number of cases to make it advisable to carry out compatibility (typing and matching) tests before blood transfusions are undertaken.

The chemistry of the blood of the newborn infant has been studied to a considerable extent. Not all the standards that have been established for adults have been established for newborn infants, since the number of cases studied has, as a rule, been somewhat meager. It is important to know, however, that the standards for the calcium and phosphorus content of the blood have been satisfactorily established for the neonatal period.

Examination of urine.—Examination of the urine is too often neglected. Routine urinalysis should always be done when fever, even if slight, is present. The finding of pus in the urine of an infant in the neonatal period should always suggest infection and, especially in a male, may point to the presence of a congenital anomaly of the genitourinary tract. If the diagnosis of congenital defect is made early, correction of the defect may in certain cases prevent the development of more severe and sometimes fatal infection.

The urine of newborn infants should be observed for blood and bile, since the presence of either of these usually is of serious significance. In the first 3 or 4 days of life light pink stains may be found on the diaper, due to undissolved uric-acid crystals; these are of no significance.

Examination of stools.—The stools of newborn infants should be observed carefully. The time of the first passage of meconium, the color of it, and the transition from meconium to soft yellow stool should be noted. The presence of gross blood or the absence of bile (white stools) is of special significance in the neonatal period because either one may be the first indication of some abnormal condition peculiar to this period of life. If there is any question as to the presence of bile or blood, laboratory tests should be made.

Examination of spinal fluid.—The importance of examination of the spinal fluid in the newborn infant and the safety and ease with which it can be withdrawn by skilled operators even in the smallest infants if the proper technique is used has been pointed out by several investigators. On the other hand, there is some disagreement as to whether or not lumbar puncture should be done in the presence of increased intracranial pressure, as in hydrocephalus and hemorrhage. Moreover, since there is also some question as to interpretation of findings with regard to the fluid, spinal puncture should

be done only after careful consideration of the indications. If fresh blood is present it may be the result of trauma from the lumbar-puncture needle and is not necessarily evidence of intracranial hemorrhage. Yellow spinal fluid (xanthochromia) may be evidence of the presence of old hemorrhage or staining with bile. The tension under which the spinal fluid flows gives evidence of the intracranial pressure and should be considered in connection with the different types of hydrocephalus and hemorrhage.

In the rare cases in which meningitis is suspected lumbar puncture should be done for diagnostic as well as therapeutic purposes.

Special tests.

Electrocardiography.—The use of electrocardiography in the study of the normal heart of newborn infants, as well as in the diagnosis of congenital defects, is possible and requires no adaptation of the apparatus except that the metal cuff must be of small size. Care must be taken of course not to expose the infant to cold.

Records of electrocardiograms in the neonatal period are few, but they indicate that there is a characteristic electrocardiogram for this period, which changes to the adult type at about the third month.

Blood pressure.—In taking the blood pressure of infants a small arm band should be used (4–5 cm). Since there is no agreement in the literature as to blood-pressure standards in normal newborn infants, readings of blood pressure are not especially helpful for diagnostic purposes. The systolic pressure at birth is reported as below 100 and not less than 43; the diastolic as not below 40. There is said to be a rise in blood pressure during the first 10 days of life.

Metabolism.—The basal metabolic rate or average daily requirement for maintenance is about 55 calories per kilogram (25 per pound) of body weight per 24 hours. This of course does not make allowance either for growth or for activity. During the first days of life the total caloric requirements are low, about 60 calories per kilogram; during the second and third weeks they rise rapidly to about 100, the maximum, 120, being reached at about the seventh week. There is then a gradual fall in the caloric requirements, so that at the end of the first year the requirement is about 100 calories per kilogram, or 45 per pound.

Mental tests.—Tests of intelligence have not yet been developed for the infant at birth and in the neonatal period. The tests that have been developed are applicable at 3 months at the earliest.

REEXAMINATIONS DURING AND AT THE END OF NEONATAL PERIOD

The methods of appraisal of the newborn infant that have been discussed apply to the entire neonatal period, which is ordinarily considered as including the first month of life. Too frequently an appraisal is made at or shortly after birth and no further observations or examinations are made, particularly if the weight chart shows that the infant is making satisfactory gains. This neglect of the infant by the physician in the neonatal period has often led to serious results. It is wise to keep the infant under close observation even if he appears to be well. The neonatal period is a dangerous period, not alone because of the many physiologic adjustments that are taking place but because certain serious conditions, such as icterus gravis and erythroblastosis occur in this period. Early diagnosis is of the greatest importance if proper treatment is to be instituted.

As a rule it is unwise to call the parents' attention in the first few days of life to minor abnormalities or suspected major abnormalities until sufficient time has elapsed to make sure of their significance. Reexamination of the infant in the neonatal period is important because certain findings present at birth, such as heart murmurs, may disappear or change in such a way as to alter earlier impressions. As already stated, another complete examination should be made at the end of the neonatal period.

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