Neurological Examination of the Newborn and Older Infant

Raymond Lafontaine

Follow this and additional works at: https://scholarlycommons.henryford.com/hfhmedjournal

Part of the Life Sciences Commons, Medical Specialties Commons, and the Public Health Commons

Recommended Citation
Lafontaine, Raymond (1957) "Neurological Examination of the Newborn and Older Infant," Henry Ford Hospital Medical Bulletin : Vol. 5 : No. 3 , 198-211.
Available at: https://scholarlycommons.henryford.com/hfhmedjournal/vol5/iss3/10

This Article is brought to you for free and open access by Henry Ford Health System Scholarly Commons. It has been accepted for inclusion in Henry Ford Hospital Medical Journal by an authorized editor of Henry Ford Health System Scholarly Commons.
André-Thomas

Member of l'Académie de Médecine
NEUROLOGICAL EXAMINATION OF THE NEWBORN 
AND OLDER INFANT
RAYMOND LAFONTAINE, M.D.*

INTRODUCTION

In the field of the neurological examination of the newborn and older infant one of the most interesting and important contributions has been made by André-Thomas. He has written many articles related to the neurological aspects of the normal and abnormal newborn and older infant. His method and a form incorporating his ideas have been used for some time in the Division of Neurology. In view of the interest shown by our colleagues a summary of the neurological examination as described by André-Thomas and others is presented. This article is limited to part of his book published in 1952 and to a monograph on the same subject published in 1955.1,2

During the first days of life the newborn shows spontaneous activity. However, he is also capable of other reactions which can only be brought about by stimulating him — reactions which are in some ways comparable to those found at a later age when the cerebral cortex exerts its influence and has become the primary site of control. The study of this solicited activity and reaction of the newborn and older infant has been one of the great contributions of André-Thomas.

In order to clarify the description of the examination itself, a few explanatory remarks about terms follow:

When referring to tonus three components are included, consistency, extensibility and passivity. Consistency is evaluated by palpation and the muscular undulations obtained by shaking the corresponding segment. Extensibility is the maximum lengthening of which a muscle is capable when it is stretched away from its points of insertion. Extensibility is related to the muscular elasticity and to the resistance offered by the ligaments of the joints. Passivity is inversely proportional to the reaction of the muscle to stretching and is evaluated by the degree of resistance offered to passive mobilization of the segment directly seized. Passivity can also be evaluated by the degree of amplitude communicated through rapid mobilization of the above or subjacent segment. There is no idiomuscular reflex to percussion in the newborn.

Spontaneous motility connotes the absence of any actually avoidable interference. However, it is probable that besides the imperceptible exteroceptive afferences, some proprioceptive and interoceptive afferences constantly exist. Therefore, the spontaneity includes (like reflectivity) some afferent paths, centers, internuncial relations and efferent paths.

Reactions are distinguished from reflexes by their greater complexity and their less constant appearance. This is exemplified by such influences as (a) satiety or hunger on the reaction of the cardinal labial points, (b) modalities of general tonus on the tonic flexor reflex of the digits or on the digital reactivity to a stimulus applied to the

*Division of Neurology and Psychiatry.
internal border of the little finger or of the palm of the hand, and (c) the inhibitory action of the cry.

EXAMINATION

NEO-NATAL PERIOD: NEWBORN

The newborn period as opposed to the infant or post-neonatal period corresponds approximately to the first ten days of life. During this conventionally defined period some important changes have already occurred due partly to the increasing remoteness of the obstetrical trauma and partly to the evolution of the central nervous system in its new environment.

General posture: In supine, in prone position, suspended with face down or up, and in vertical suspension, head down, the posture of the newborn reflects both the foetal posture and the state of tonus which are responsible for the posture. However, the head does not continue with the flexion but actually gives way to its own weight. It is dragged in the supine position and is always extended when the newborn is crying. The head tends to remain in contact with the level of the crib.

Passivity: The passive rotation of the vertically held body whether done rapidly or slowly does not bring about any reaction in the opposite direction. Changes in position of the body do not bring about reactions of the head or limbs, such as the labyrinthine or cervical reflexes described by Magnus. The head in passive rotation at this age does not appear to bring about any change in the posture of the limbs and swings freely in all directions when the body is shaken. However, when the head is seized and then moved in various directions the flexion encounters more resistance than the extension. By repetition of a postero-anterior push over the occiput, the tonus of the extensor muscles of the head and neck increases to such an extent that the body axis can be raised by the occiput, the head remaining in line with the trunk. This same reaction can be seen when the child is crying or sucking its thumb.

The contrast between the passivity of the head when the body is shaken (induced passivity) and the resistance offered to occipital and frontal taps is another manifestation in the spatial reflectivity of the importance of the chronological factor.

Spontaneous motility: During the cry, which usually occurs after the first respiration, we see the earliest manifestations of the tonicity of the head and neck. Spontaneous rotation of the head in supine and prone positions occur. The latter position allows the newborn to free his nose. A lateral inclination of the head is not usually seen at this age.

Reactions: The head is capable of reacting by some very discordant movements in response to even a slight stimulus applied to the face. By rubbing the ear lobe lightly or by tickling the nasal septum we obtain a rotation of the head towards the opposite side.

The reaction of the cardinal labial points is demonstrated by the sucking reflex which is the first post-natal act to manifest itself rhythmically. It may even precede the first respiration. On touching lightly the right labial commissure we obtain the lowering of the right half of the inferior lip, and the tongue will orient itself towards
Newborn Infant

The stimulus. If the finger is then taken further way while remaining in contact with the cheek, the head turns to seek it. If the medial part of the lower lip is stimulated that lip and the tongue drop. If the examining finger moves downward towards the chin the mandible is lowered and the head flexes. The reaction is elicited more easily before feeding than after. In some newborns any contact with the face elicits some of these reactions. A finger introduced between the lips is sucked at. If the finger is progressively withdrawn the head flexes pursuing the finger. This reaction is strong enough to overcome the effect of weight and certain contractures in opisthotonos (meningeal hemorrhage, kernicterus).

Conflict of reactions: The simultaneous excitation of the right labial commissure and of the right ear causes the inferior half of the right lip to lower and the tongue to move to the right, but the head to turn towards the left.

Ocular and visual reactions: The eyes of the newborn open simultaneously or separately. They are attracted by daylight, close under strong light (dazzling reflex of Peiper), and the pupillary reflex to light is present at birth. During the first days of life when the head is passively turned, the eyes follow only after the head has stopped moving. The eyes then orient themselves and stare straight ahead. This is known as the doll’s eye phenomenon. The reaction loses some of its regularity and constancy and gradually disappears about the end of the first ten days.

Auditory reactions: A sudden and loud noise may cause blinking of the eyes (cochleopalpebral reflex) and may or may not be accompanied by a generalized start. The reaction is exhausted by repetition of the stimulus.

Gustatory reactions: The introduction of a sugar-coated finger between the lips of the newborn results in a sucking reaction, licking of the lips and pursuit of the finger while it is withdrawn and grazing the cheek. With salt the sucking is less or nil, a wry face is seen, and the newborn will force the finger back with its tongue, making irregular movements with its head. These contrasting reactions are most marked soon after feeding. The newborn, although he cannot identify the nature of sugar, salt or quinine sulfate, answers with a different affective reaction which precedes knowledge of the quality and nature of the stimulus.

Reflexes: Percussion of the base of the nose causes blinking of both eyes known as the naso-palpebral reflex. Percussion of the superior orbital region causes blinking of the homolateral eyelid known as the MacCarthy reflex. The ciliary reflex is manifested by touching the eyelashes lightly causing the eyelids, especially the homolateral one, to blink. The corneal reflex is present. The mandibular reflex is more brisk during the inspiratory phase of the cry.

UPPER LIMBS

The general attitude and relations between the spontaneous attitude of the upper limbs and the cervico-cephalic segment is referred to later in the presentation. When the infant is vertically held with head down the usual flexor posture of the limbs is maintained.
In the upper limbs the extensibility is greater and resistance to stretching (passivity) weaker for the extensor muscles. The reverse is true for the flexor muscles in all segments.

When the body is shaken, movement of the upper limb is slight and a dangling of the hand results. Amplitude of motion of the upper limb also evaluates the passivity of this limb when it is thrown back and forth. If the upper limb is raised a few inches and then released (the infant being in supine position) the limb will not fall abruptly on the table. If the fore-arm is extended and then released it returns quickly into flexion. Correspondingly, if the hand is flexed and then released it will return quickly to extension.

The newborn is almost constantly in movement which is varied, non-adapted (save for thumb-sucking), non-symmetrical (except during the cry), not really athetoid and increased locally by any stimuli.

If the upper limb is passively extended along side the body while the infant is in prone position the head will turn, the fore-arm and the arm will flex and the frontal upper limb will tend to move forward. The same reaction is enhanced when the examiner applies pressure over the buttocks on the opposite side.

Reactions: Digital reactivity is manifested by tactile stimulation of the ulnar side of the palm or of the little finger. The little finger is extended, followed by extension successively of the fourth, third and the index fingers. The thumb is not easily moved. The fingers will then flex again but in the reverse way. This reaction requires a summation of stimuli and appears after a certain lapse of time. The proximal segments react only slightly in contrast to the reaction elicited in the lower limbs to an analogous stimulus. For this reaction it is best to examine the newborn in complete calm, soon after feeding. In the same manner localized movements of the hand and forearm can be induced, such as that of pronation by touching lightly the dorsal aspect of the hand.

Grasping* as a tonic reflex of the flexors of the digits will result if tactile stimulation with slight pressure is applied to the metacarpo-phalangeal furrow. All phalanges flex and the thumb flexes simultaneously. If an object held by the child is pulled, his grip is sufficiently strong to cause extension of the fore-arm and arm and finally his body can be partly lifted from the table.

Submitting the hand to a marked dorsal or palmar flexion increases the tonic flexor reflex of the digits in the first instance and decreases the reflex to disappearance in the second.

As later in active prehension the extensors of the hand and the flexors of the fingers contract synergically. When the first are deficient the tonic flexor reflex of the digits must be explored by passively raising the hand. The passive flexion of

*The word "grasping" should be used only when referring to the pathological phenomenon described under this name in adults. Its relations with the tonic flexor reflex of the digits as observed in the normal infant are far from being clearly established.
Newborn Infant

the hand enhances the extension of the fingers as a result of a light and repeated dorsal touch to the last phalanges. This stimulus is more efficient in a period of spontaneous agitation than in a period of calm.

Reflexes: Tricipital reflex is not elicited because of the predominance of the flexor tonus in the fore-arms. If the other muscles are involved in paralysis while the triceps is intact, this reflex will be present. Palmo-mental reflex appears to be absent in the newborn.

In conformance with the opinion of Magnus the position of the upper limbs in the normal newborn does not seem to be related to the spontaneous or passive rotation of the head. The newborn sucking his thumb flexes the frontal fore-arm, that is, the arm toward which the head is turned, to an equal extent or even more so than the occipital fore-arm, the arm away from which the head is turned. The return into flexion of the previously extended fore-arms which are then released is done at an equal speed and amplitude on both sides, regardless of the side on which the newborn rests.

The “arms of the cross” reflex is induced by any brisk or rapid maneuver which will mobilize the head in relation to the body axis. It may be induced by the participation of the cervico-cephalic muscles to a generalized start, as in the test described by Moro.

Spontaneous appearance of the “arms of the cross” reflex occurs when the newborn is held in the sitting position, the head first flexed and the upper limbs in their usual position. After a few seconds the head erects, moves beyond the prolongation of the vertical axis and falls back under the influence of its own weight into the hand of the examiner. The arms are abducted, the fore-arms, the hands and fingers extended. However, when the head is passively brought back into flexion the upper limbs recover their position in flexion. When this second part of the reflex is spontaneous, it is called the embracing reflex.

The Moro reflex may also be induced by raising slightly, but briskly, the child seized by the thighs in dorsal decubitus, the head remaining in contact with the table. The maneuver, which consists in mobilizing the head of the newborn by allowing him to fall back on the table after he has been raised by the hands a few inches, has the advantage of moving his body less but the disadvantage of interfering with the upper limb which is an effector segment and must participate at the beginning of the reaction. The Moro reflex is inhibited homolaterally or bilaterally by the tonic flexor reflex of the fingers. An object held tightly in one or both hands is not dropped.

TRUNK

Flexion of the trunk progresses at a greater rate than does extension. When the trunk is swung in the antero-posterior direction the dangling is more marked at the level of the lumbo-sacral articulation than in the lower limbs. Spontaneous movements of flexion, extension, rotation and lateral inclination are not found at this stage.

Repeated pricking of the skin of the back from the twelfth rib to the iliac crest
causes curving-in of the trunk on the stimulated side with folding of the skin. The curving-in reflex is one of the most constant in the normal newborn as is the Moro reflex. The cutaneo-abdominal reflex, the cremasteric reflex and the anal reflex are generally not observed at this age.

LOWER LIMBS

The extensibility is greater and the resistance to stretching (passivity) less for the extensor muscles than for the flexor muscles in every segment. Dangling of the lower limb is slight when the body is shaken. The passivity is reduced for all segments, even for the feet. Dangling of the feet is less easily obtained than of the hands.

Spontaneous motility is demonstrated by alternate movements of flexion and extension, by volleys, in decubitus dorsalis and ventralis. There is also a contrast between the relative inactivity of the upper limbs and the lower limbs in this last position. This rhythmical activity is probably related to the automatic walk (see further).

By pricking one of the inguinal folds contralateral adduction of the thighs results. To produce the tonic flexor reflex of the toes tactile stimulus is applied to the metatarsophalangeal furrow using the shaft of a pin. Flexion of the toes occurs, and they are capable of holding an object. The reaction can also be induced by pressure applied to the anterior heel at the distal extremity of the first interosseous space. Its intensity is increased or decreased when the foot is passively brought into dorsal flexion or plantar flexion respectively.

Crossed extension is produced by stroking along the planter aspect of one foot while the limb is retained in extension. Flexion follows, then extension and adduction of the opposite lower limb with extension and fanning of the toes.

By pricking the plantar aspect of the foot extension of the toes, dorsal flexion of the foot and flexion of the leg and thigh result. No repetition of this stimulus is necessary. The reaction is rapid, almost immediate (see reaction of the upper limb to an analogous stimulus).

The tactile excitation of the plantar aspect of the great toe may give rise to the isolated extension of this toe. However, tactile excitation of the lateral aspect of the foot rarely produces the isolated extension — slow and steady — of the big toe as described by Babinski in the involvement of the pyramidal tracts in the adult. Flexion and extension are obtained with fanning of all toes, and at times, flexion on one side and extension on the other when the stimulus is applied simultaneously over both soles. The spontaneous movements may interfere with the interpretation, and these reactions must be looked for during a period of calm.

The patellar reflex is brisk and of slight amplitude with extreme, frequent, almost constant contralateral reflex of the adductors. The Achilles tendon reflex does not exist normally because of the relaxation of the gastrocnemius and soleus muscles and because of the relative hypertonia of the dorsal flexors of the foot. When dorsal flexors of the foot are paralyzed while the gastrocnemius remains intact the Achilles reflex is elicited.
On percussion of the heel there is brief extension and movement of the lower limb followed by an abrupt flexor movement of more amplitude.

**STRAIGHTENING REACTIONS — LOCOMOTION**

When the newborn is held vertically and the plantar soles are placed on the floor there is straightening of the feet and different segments of the lower limbs which may be obtained on one leg only. Standing is solid but should be tested for each leg separately. Standing is not constant at first and is, at times, facilitated by passive extension of the head.

For vertical straightening, the newborn is held in the examiner's arms facing forward. The trunk and the head are flexed under the influence of their weight.

With one hand pressure is applied to the soles of the feet and the ankles are manipulated. This maneuver elicits straightening of the different segments of the body. If the face or the nape is tickled the head and trunk straighten.

The primary or automatic walk is elicited when the newborn is held in a vertical position with feet on the ground and lightly propelled. At first he lacks equilibrium. Coordination is good and rhythm regular. The heel is laid first with a strong dorsal flexion of the foot. Associated movements of the upper limbs are not present. The newborn cannot walk backward. Within a few days the walking movements become more pronounced and the dorsal flexion of the foot less evident.

**POST-NEONATAL PERIOD — MIDDLE AND LATE INFANT**

The neonatal period is considered to be the first ten days of life. The remainder of the first year of life and that period immediately following when the principal functions of the adult type make their appearance is known as the post-neonatal stage. During this period the cephalic perimeter increases considerably paralleling the increase in weight of the brain. Some marked changes in behavior are also noted, indicating the passage from predominantly subcortical activities to controlled activities by superior centers, but at varying degrees. The primary reactions are modified or disappear and are progressively replaced by different reactional modalities. In a few instances, the control of a primary activity by the superior centers is first manifested by an inhibition. Such phenomenon is apparently the case when considering the static and locomotor aptitude of the lower limbs.

The clinical investigation at this stage no longer proceeds by regions as in the newborn but is oriented towards investigating the evolution of functions, their modifications and progression towards a final pattern.

**EVOLUTION OF THE TONUS**

The extensibility and passivity of the flexor muscles increase progressively in the four limbs. At the beginning of the second trimester the flexor tonus at rest evidently decreases in the different segments of the upper limbs including the fingers. The extensor attitude of the lower limbs, however, occurs at a later date. During the second month, the evolution of the tonus is more rapid and at the cervico-cephalic level, but in this instance it is toward an increase of the flexor tonus. These modifica-
tions in tonus result in parallel changes in posture. The tonic neck reflex may be positive in one infant or newborn and negative in another.

OUTCOME OF THE PRIMARY REACTIONS

The cardinal labial points reaction may persist for many months, but it is submitted to some modification by the cortex. The strength and amplitude of the Moro reflex decrease rapidly, probably in relation to the modifications of the tonus in the upper limbs and to the progressive fixation of the head. About the age of one or two months an incomplete Moro reflex can be demonstrated by raising the body axis briskly. The arms then are abducted to a certain degree and the fingers are not completely extended. The curving-in reflex of the trunk becomes weaker and disappears during the second month to reappear much later. Crossed extension reflex disappears in the lower limbs usually before the end of the first month. At this stage the opposite inferior limb flexes and remains in this position. Later, about the third month, the crossed extension reflex reappears but with some cortical characteristics (see discussion of tonic flexor reflex of the fingers and the primary stance and walk).

At the age of approximately three to seven months the Landau reflex can be elicited spontaneously. With passive flexion of the head the lower limbs are flexed and with passive extension of the head the lower limbs are extended.

NEW REACTIONS

Visual: The doll’s eye phenomenon disappears a few days after birth, but the dazzling reflex persists. During the first ten days orientation of the head and eyes to a subdued light may be seen; however, it is not restricted to this period. There is intermittent fixation of the infant’s gaze at about one month of age.

Visual pursuit of an object appears at the age of two weeks. An infant will follow intermittently and for a short distance an object held close and horizontally. About three or four weeks of age the head participates in the visual pursuit and must be held in order to appreciate the amplitude of the movements of the eye. At three months a posture facilitating the flexion-extension of the head makes possible the visual pursuit of an object held vertically. Convergence, accommodation, and visual-somatic associations (see prehension) appear at this time. The blink-reflex to threat is of a later date.

Audition: In general the orientation of acoustic origin appears later than that of visual origin. During the first month a small bell rung close to the infant may provoke the cochleo-palpebral reaction, a start or modification of the respiratory rhythm, or of general activity. A few weeks later the infant may lie still at the sound of a familiar voice such as that of his mother, or respond to it by looking toward the speaker. Only later will he turn his head towards the sound of a falling object.

Tactile Afferences and Painful Afferences: In the newborn, pinching the big toe provokes a generalized reaction, scream or cry face. In addition to this reaction we must study (a) the withdrawal of the stimulated segment and (b) the placing of the child’s hand on a stimulated area. At four or five months the child is able to remove a handkerchief covering his face. As early as the tenth month and certainly
by the end of the first year he will bring his hand to the homolateral region which has been pricked lightly, or even to the contralateral temple if the corresponding hand is restrained.

STANCE AND EQUILIBRIUM A: As Related To The Straightening Pattern From Prone:

About the end of the first month the newborn raises his head slightly, but it falls back immediately. Progressively, the head tends to fix itself in the raised position. Fixation of the head is more definite about the third month, and the infant is also able to raise the upper part of the trunk with the help of his upper limbs. This extension progresses from the nape to the lumbo-sacral region and is facilitated by the development of the upward gaze.

Displacement of the upper limb forward may be seen earlier when facilitated by a tactile stimulus which is applied to the hand after the upper limb has been previously extended along the body (see newborn). Later the displacement may be modified by affection; for instance, the infant’s extending the arm towards a familiar object or towards his mother. About the third month there is support upon the fore-arm facilitating the elevation of the thorax and head. A few weeks later the fore-arms may be extended on the arms, the support being first taken on the dorsal surface of the flexed fingers then on the palm of the hands.

About the sixth or eighth month, if the child is grasped and thrust from above downwards and laterally the corresponding upper limbs move towards the floor in order to seek support (static aptitude of the upper limbs). The different segments extend before establishing contact with the table. At first, support is taken with the hand closed and later with the palmar face of the hands. Support is strong enough to sustain the weight of the body and must be evaluated for each limb separately. This reaction may be obtained even when the infant is blindfolded as previous visual associations are not necessary. Even at a more advanced stage the hand will not open if it is holding an object.

Placing Reaction of the Hand: When the examiner places the dorsal aspect of one of the infant’s hands along the edge of the table there results flexion of the different segments of the upper limbs, bringing the hand over the table, and at the age of 3 or 4 months complete straightening of the upper limb. Support is first taken on the fore-arm, then wrist and later with the hand opened, and still later the fingers spread. Again the visual afferences are not necessary.

STANCE AND EQUILIBRIUM B: Sitting Position: During the first weeks of life, when the infant is pulled by the hands into a sitting position from the supine, the head falls back. About the age of three months the head is maintained in the prolongation of the body axis. The child, as yet, does not contribute to the movement. The lower limbs are often in flexion-abduction. Later he moves his head forward, the trunk flexes actively and the lower limbs are raised from the table.

Towards the end of the first six months the maneuver described above elicits a spontaneous movement strong enough to necessitate only a light pull. Later the child will sit alone. Gradually he will raise himself to a sitting position with the help of
his upper limbs from the prone position, the hands and knees position and later from
the supine.

At the age of four or five months lateral falls are frequent. However, the infant
will not fall laterally when placed in a sitting position, his back resting against a
pillow. If the trunk is not held it will fall forward. Early in this stage the infant
will not reach with his hands for support as he does at five months. The gradual
straightening of the trunk which has been passively flexed results in backward falls
at the beginning.

At about six or seven months the infant will remain in a sitting position without
support but will not resist even a slight thrust. Resistance of the trunk towards a
lateral thrust is developed earlier than towards a backward thrust. In the lateral thrust
the child will fall over, making no attempt to prevent the fall with his hands. (reflex
d'arc-boutement of the upper limbs or parachutism). However, at eight months the
contralateral arm is abducted, the fore-arm extends on the arm, the fingers open
before contact, and the support is obtained laterally on the palm of the hand and
fingers.

At ten to twelve months if the child is pushed backward the upper limbs are
thrown back. The hands are generally oriented from behind forward as a result of
a slight degree of internal rotation of the arm and pronation of the fore-arm. In
these two reactions of “arc-boutement” the support is first taken with the hand
closed. Even at a later stage the hand is not opened when it is already flexed over
an object.

STANCE AND EQUILIBRIUM C: Upright Position: The ability of the new-
born to straighten when the feet are placed on the table and to maintain an upright
posture disappears progressively. About the age of two months the feet are not well
oriented, the support is taken on the toes and later on the dorsal aspect of the flexed
toes (digitigrade attitude).

About the fifteenth day when the infant is placed with the dorsal aspect of his
foot along the edge of the table the first stage of the placing reaction is seen. Flexion
of the different segments of the lower limbs brings the foot over the table. The
second stage consists in straightening after active or passive application of the sole
of the foot on the table and the reaction is only elicited later.

The straightening reaction is lost when the feet are placed on the floor (physio-
logical astasia). Instead we obtain a passive flexion of the trunk on the thighs and
 persistence of the digitigrade attitude of the feet while the child is held. The stage
lasts approximately until the end of the first six months but may vary. Towards the end
of the astasic stage there is flexion alternating with extension in the lower limbs and
trunk (leaper's or jumper's stage).

As maintenance of the upright position becomes progressively more durable
and solid the support is taken on the plantar sole of the foot with the toes extended
(definitive upright position). Each limb must be evaluated separately. About the
ninth or tenth month the infant is able to stand with support.
Newborn Infant

STRAIGHTENING AND EQUILIBRIUM: When Vertically Suspended: Straightening persists in the infant for some time and is brought about by the same maneuver as in the newborn. However, before the end of the first six months the straightening becomes spontaneous.

Equilibrium is demonstrated at the cephalic level by supporting the infant’s head which is inclined laterally. Resistance offered by the head rapidly strengthens. After a few weeks, and even during the first days, there exists a real nystagmus of the head in this position. The head becomes totally fixed at about three months of age. Only at the beginning of the second six months does resistance of the trunk to slow anterior and lateral inclinations appear and increases progressively during the following months. Resistance of the head and trunk to brisk inclinations appears only later, the trunk then moving to the opposite side.

LOCOMOTION: The first walk of the newborn persists for a few weeks but may vary. Progressively, contact with the floor is made with the tip of the foot. Rapidity, regularity of rhythm and coordination diminish. Each foot is lifted less quickly from the floor. Between two and six months the feet drag when the infant is propelled (physiological abasia). Towards the end of this period the infant has a tendency to leap, jump or beat the floor first with one foot and then the other. A few weeks later steps may again be produced by lifting and propelling the child (final walk). At the beginning of this stage there is neither rhythm nor coordination. The movements are jerky, at times isolated, and the flexion is marked at the level of the knees and hips. Contact of the foot at first is digitigrade, becoming plantigrade and then with the heel.

At this stage the child in order to maintain equilibrium when walking supports himself by holding on to furniture or someone’s hand. At the beginning of the spontaneous walk the upper limbs are held in strong abduction. All segments including the fingers are extended and the feet thrown apart. Slowly the base of sustentation and the abduction of the arms diminish, and the associated movements of the upper limbs begin to manifest themselves.

As was seen before, the upper limbs appear to act quite independently of each other in the newborn. While crossed reflexes were noted as being numerous in the lower limbs of the newborn none are known to exist at that stage in the upper limbs. An painful stimulus applied to one of the upper limbs may bring out a generalized reaction, but no special correlation between both upper limbs were noted.

During the physiological abasic period of the lower limbs each upper limb begins to show a tendency to rhythmical progression. This tendency can be seen before the stage of spontaneous walk when from a position on hands and knees the child is lifted by the trunk and lower limbs and propelled on the floor (wheelbarrow maneuver). At first the infant advances on his fore-arms with hands closed and later on the extended upper limbs supporting himself with the palm of his hands. In contrast to the lower limbs, the alternate movements in the upper limbs gradually improve as soon as they appear and are never lost.
The same observations can be made for the static aptitude of the upper limbs. The sight or call of the mother helps to bring out these alternate movements of the upper limbs, and the infant progresses correctly on his hands while he is not yet able to walk.

**PREHENSION AND GRASPING**

Prehension is a cortical phenomenon both purposeful and voluntary. The phenomenon consists of the opening of the hand followed immediately by its closure when the infant sees, comes in contact with or hears the sound of an object. In the newborn the object once grasped is held, released or manipulated without apparent purpose. At this time the grasping reflex seems to consist more of tonic reflex of the flexors of the fingers. The prehension *per se* becomes possible because of the decrease in the permanent flexor tonus of the upper limbs and of the tonic flexor reflex of the fingers.

Sight, which limits the improvement or perfecting of tactile sense is of primary importance in the approach and in reaching for an object. With renewal of visuo-motor association and progress in visual memory the infant becomes capable, upon seeing an object, of reaching for it without continuing to look at it.

About the age of three months the sight is concentrated on the hand. In this way the associations between the visual and somatic afférences are established. Auto-exploration is, however, not only visual. The fingers of both hands come in contact with each other. Later they will discover the knees and feet.

Affectivity and environment also enter into the development of prehension, spontaneous reactivity. During the examination, for instance, behavior of the infant is seen to vary according to his familiarity with the person presenting the object. The characteristics of prehension and tonic flexor reflex of the fingers can best be differentiated by noting the isolated or separate mobilization of the fingers on the object and manipulation of the object after the opening of the hand.

Later when the infant brings an object grasped by chance to his mouth, he demonstrates a combination of the tonic flexor reflex of the hand and the thumb sucking reflex. At the sight of an object the child first shows generalized restlessness and beating of the arms soon combined with movements of opening and closure of the fingers which are kept at a distance. Later these movements are combined with those of approach and finally pursuit of the object. The approach is first bilateral then unilateral (mirror-like) before the laterality becomes established.

Mobilization first predominates at the level of the shoulder (abduction-adduction, then flexion and extension). Movements of the elbow are well developed by the end of the first six months of life and are slowly coordinated with movements of the other segments. Motility of the wrist (flexion, extension and ulnar inclination) increases rapidly during the second six months while at the same time the bidigital “claw” of the thumb and index finger appears. Lateral inclination of the wrist facilitates reaching for the object with the thumb and index finger and the moved hand is away from the visual field. This movement is facilitated by the predominance of the ulnar extensibility.
of the hand, a disposition frequently encountered and thought to be congenital. The preliminary opening of the fingers is, at first, hypermetrical. At the end of the first year it becomes related to the dimension of the object.

The participation of the trunk in prehension increases rapidly once the sitting position is mastered (flexion-extension, then torsion, the shoulders brought forward). At this stage the fields of prehension and sight develop parallelly. Prehension facilitates the rotatory movements of the trunk. Early in this stage the object is held in the tip of the palm of the hand and all phalanges are flexed.

The development of prehension is characterized by the substitution of the middle and distal phalanges to the proximal phalanges, by a more active part from the radial fingers and finally by isolated movements of the proximal phalanges and the opposition of the thumb to the index and other fingers. Slowly the infant adapts his strength to the weight and physical qualities of the object.

Around the beginning of the second six months manipulation associated with movements of the arm, fore-arm and hand in an attempt to bring the object into the visual field becomes evident. It is first bilateral like the approach.

CONCLUSION

Throughout the examination of the newborn from the time of birth to the stage when the principal functions of the adult type are established we see reaction patterns change continuously. Parallel progression or regression of reflexes, tonus and motility become evident as the child grows and is affected by environment.

It appears that continuous experience prepares the cerebral cortex for an accumulation of afferences and appearance of new reflexes. The cortex seems to act as a register while undergoing constant transformation, multiplying these accumulations in a chronological and spatial order, associating and classifying them through phases of trials and renewals. At the same time the motility is increased and extended and conductibility improved. The cerebral cortex accumulates new afferences which are integrated in the sensations and later in the perceptions. However, many, from the anatomical and functional point of view, although picked up by the cortex, remain below the level of consciousness.

Many tests described above are not easily performed. All newborns are not equally tolerant to stimuli and by nature are labile. The rapidity of response to stimulus, its briskness and persistance are equally variable. When a stimulus is repeated it is not uncommon to see the reaction less marked the second time, still less the third and finally disappear. Extinction of many vegetative or affective type of reactions upon repetition of the stimulus is not rare.

Particular attention, however, should be given to the main vegetative functions, general state of tonus, Moro reflex, curving-in reflex of the trunk, contra-lateral adductor reaction of the thighs which are most constant in the normal newborn. Any asymmetry of tonus, motility, rapidity of degree, regularity, osteo-dendinous and cutaneous reflectivity must be considered as abnormal either on a constitutional or
pathological basis. The prolongation of the least activity of a limb over a certain period must be given a similar interpretation. Asymmetry appears to indicate a morbid state more clearly than does a more or less marked motor, tonic or reflex activity which is strongly bilateral and symmetrical unless definitely abnormal.

On the other hand, although all signs are not equally important, every phenomenon of provoked motility may help to inform us on the state of anatomical and functional arcs which are unexplorable at this age through examination of the senses or of movements executed on command, as seen at a more advanced age. Besides the physiological interest of studying behavior of the newborn and older infant, the proposed neurological tests have a greater value when we consider that they allow us to detect an anomaly, an asymmetrical activity, some reactions and to uncover within the first few months of life a pathological process whether constitutional or acquired.

The newborn and older infant are exposed to factors of various degrees of morbidity and to more or less destructive lesions of the cortex. Whether these morbid factors date back to the time of birth or soon after, such as the third or sixth month of life, they will not manifest themselves under the same semiological aspect. Different impairments of function will appear according to the stage of anatomical development and physiological maturity that have been attained at the time of aggression.

In contrast with normal semiology, the pathological will vary with the stage of development. Besides the systematic affections and asymmetries an abnormal state may be due to the persistence of a behavior which should have disappeared and/or to a delay in acquiring the new pattern.

The utmost caution is necessary when referring to the interpretation to be attributed to the time of appearance or disappearance of any behavior modality. Here, as in psychology, the accepted period of appearance of a phenomenon is quite extensive. The neurological curriculum is a series of linked reactions, a sort of sketch or pattern already prepared by the anatomy or the histology. We do not necessarily find the same order of innovation and progression from one infant to the next. Even if both appear normal, a few links in the chain of events and reactions can be displaced or interchanged. Therefore, we must only refer to the dates or ages given previously as points of reference, as an approximate index of function.

The experience teaches us to be extraordinarily cautious when speaking of prognosis, particularly when the critical stage — evidence of maturation of the cerebral cortex — has not yet been passed. At this period some previously existing abnormalities of the cortex, until then latent, may begin to manifest themselves in an infant previously considered normal. Conversely, some substitution may be established which may mitigate the previous pathological manifestations or cause them to disappear entirely.

BIBLIOGRAPHY